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AUTHORS

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

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E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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Engineering News-Record is a consolidation of *Engineering News* and *Engineering Record*, effected in 1917.

Engineering News was founded in 1874 by George H. Frost, as the *Engineer and Surveyor*, which title subsequently became the *Engineer, Architect and Surveyor*, then *Engineering News and American Railway Journal* and finally, *Engineering News*, under the successive editorships of D. McN. Stauffer, Arthur M. Wellington and Charles Whiting Baker.

Engineering Record was established in 1877 by Henry C. Meyer as the *Plumber and Sanitary Engineer*. The name was subsequently changed to the *Sanitary Engineer, Engineering and Building Record* and, finally, to *Engineering Record*. During his ownership of the paper, Mr. Meyer was directly responsible for the editorial policy. John M. Goodell became editor in 1902, and was succeeded by E. J. Mehren.

The Contractor was consolidated with *Engineering News-Record* in 1918.

The staff of *Engineering News-Record* consists of

New York: E. J. Mehren, *Editor;* F. C. Wight, *Managing Editor;* M. N. Baker, F. E. Schmitt, R. K. Tomlin, Jr., C. S. Hill, J. W. Shaver and V. T. Boughton.

Chicago: W. W. DeBerard, E. E. R. Tratman.

San Francisco: N. A. Bowers.

An Extraordinary Structure

THE Los Angeles theater described in this issue is a remarkable example of reinforced-concrete design. There have been other theaters built of this material but so far as we can now find reference there has never been one with such long and large girders and trusses. Indeed the 126-ft. girders here are, we believe, the longest span concrete beams ever built. To Eastern engineers, fairly convenient to the structural steel mills, there will certainly arise doubts as to the economy of these huge beams and trusses in competition with a steel frame, but conditions on the West Coast are different and it is to be noted that the designing engineer says that his structure figured at less cost than one of steel. Then, too, there will be those who look askance on the tremendous concentration of steel in the large members and who will doubt the possibility of completely surrounding the rods with steel or of guaranteeing the interaction of steel and concrete once both are placed and under load. These, however, are merely questions; the Los Angeles engineers are answering them pragmatically. The Grauman theater design is made; the building is up; it works.

Engineering Societies as Public Advisers

EMPHASIS of the rôle of the engineering society as a watchdog of the public treasury, having wide duties and opportunities in relation to the economic aspect of public improvements, was the keynote of the presidential speech of C. A. Morse at the recent annual dinner of the Western Society of Engineers. As an unbiased expert the engineer is specially qualified to inform and advise the public on matters in which its vote is involved, so that reports or statements of society committees may have—and should have—a large influence in public welfare. This opportunity of the engineering society was illustrated by Mr. Morse in regard to bond issues. In the first place there is the question of the issue itself, the vote on which is determined usually by personal opinion or prejudice as to the amount involved and the desirability of the improvement. Further, the public has little comprehension of the subsequent expense involved in maintenance and operation of public works. In fact, Mr. Morse considers that many a bond issue would be defeated if the voters understood that it covered first cost only and would entail heavy and continual future expense. One of the most important functions of an engineering society in taking an active part in public affairs, should be not only to check unwise expenditures for new improvements but also to promote proper maintenance and operation of existing works.

How To Do It

IN THE victory of the New York City engineers in saving High Bridge last week it was this attention to the economic side that apparently turned the tide, although the representatives of the societies are to be congratulated on their persistence in continued fighting for what appeared at times to be a lost cause. The Board of Estimate of the city was not much impressed with the sentimental regard that engineers and architects had for this early monument to American engineering skill but when they were shown that the new siphon required by the destruction of the bridge aqueduct plus the demolition itself would cost more than an artistic revision of the bridge, continuing thereon the aqueduct, they reversed their decision to tear High Bridge down. Engineering societies can get action if their cause is just and they know how to present it.

City Freight Belt Railways

REROUTING through freight traffic around large cities by means of loop or cut-off lines, in order to avoid congestion of busy local centers, has been extensively practiced in recent years, but the Flint belt line described in this issue serves two other purposes. In the first place, it will so relieve conditions on a line crossing the city at grade that costly track elevation projects are likely to be postponed indefinitely. In the second place it provides direct railway connection and switching service for a large industrial district established in the outlying part of the city by local interests in order to encourage the location of large manufacturing plants. Belt lines are an increasingly important feature in city and industrial development. L. F. Loree in his new book on "Railroad Freight Transportation," summarizes the situation well in the following sentences: "It seems quite certain that recent practice and experience is tending toward a recognition of the value of the belt line as one of the mechanical

elements of a comprehensive district clearing system. As a means for controlling and directing urban development along the rational lines of a wholesome city plan, the belt line appears to have been rather neglected. Of course, Chicago with its four concentric belt lines and New Orleans, Indianapolis and San Francisco are examples to the contrary. But this is especially true in the smaller but rapidly growing industrial centers. And here, if not in the older and larger cities, this feature of terminal organization might well receive further study and development."

New Opportunities

RATHER tardily, perhaps, but with the active approval of its membership the American Society for Testing Materials has decided to undertake the conscious stimulation and cultivation of research in materials. Heretofore its field has been limited quite narrowly to making specifications, and the committees have taken only incidental notice of the various deficiencies in knowledge of materials which their work revealed. It is true that many results of research were presented at the society's meetings, comprising the voluntary contributions of research investigators and the reports of studies carried out to clear up doubtful points about specifications. But all such papers had to edge their way into the program, so to say, and were not recognized as vital parts of the society's work. Moreover, when a committee encountered a new problem it had no encouragement to go into a study of this problem beyond what the purposes of the specification in hand required. But now that the development of new knowledge—study of materials and their behavior under various conditions, and of instruments and methods for observing this behavior—is established in recognized position as a main objective of the society's existence, new opportunities are opened up. Research will no longer be in the position of tagging along as a mere auxiliary of specification-making; it can thrive as an independent activity. To what extent this activity can or should be organized and systematized may yet need to be considered, though the achievements in the field of organized research are not particularly encouraging. Regardless of this detail, however, the society is entitled to congratulations on its forward-looking step. It has assumed a larger responsibility and assured itself a future of increased value to the world.

Efficiency Versus Tradition

WITH this hopeful reflection the observer of last week's meeting of the society is bound to couple a less optimistic thought. For a long time the society has enjoyed the distinction of having the longest and most unwieldly meetings among all our many technical societies, and it confirmed its claim to this title by the past week's meeting, which extended from Monday evening to the small hours of Saturday morning. With the help of a touch of very hot weather the meeting came near to wearing out the patience of many members in attendance—an effect not favorable to active thought and animated discussion. There has been in recent years a very marked slackening of activity on the meeting floor of the society. This has been coincident with increase in the length of the meetings; and while it would be unreasonable to argue herefrom a direct cause-and-effect connection, it would be just as unreasonable to deny that length of meeting had a contributory influence. The society's practice in the makeup of its programs has always been out of square with the principle and experience of other technical organizations, but it has been successful enough in the past to give color to the claim that the American Society for Testing Materials is quite exceptional in that its meeting is in effect a series of meetings, attended by successive relays of members. Even this fact, in so far as it is a fact, is of limited bearing on the matter, and cannot forever justify adherence to a precedent that may have been outlived. Continuing growth of its work, and increasing breadth and complexity of the interests concerned, demand that concentration and efficiency should be made prime ingredients of its meetings. These elements, however, are incompatible with programs so long as to tax the endurance and deaden discussion. Where efficiency demands, even tradition must yield.

For Improved Structural Knowledge

NOTABLE extension of the possibilities of strain measurement in engineering structures is in prospect if two new instruments brought to notice at the American Society for Testing Materials meeting last week carry out their full promise. One is a distant-reading extensometer, the other a highly sensitive and yet convenient and rugged instrument of the optical-lever type. Both were developed at the Bureau of Standards. A third instrument of equal importance, the photo-recording strain-gage of the Bureau of Public Roads, was described only a short time ago. Thus within the short space of a few months the art of structural investigation is enriched by a group of three new tools which add greatly to its resources. What they will accomplish is yet a matter of the future, but some indication of possibilities is given by their use for measuring stresses in airplane stay cables during flight, deformations in riveted joints, and impact in bridges, respectively. It is now possible, in other words, to follow the stress changes in inaccessible parts, to measure very minute, localized distortions, and to direct and record rapid changes of strain, even the high-speed vibrations occurring in bridges, all of which has not hitherto been practicable. This extension of our powers virtually assures important advance in structural engineering knowledge when the instruments are fully utilized.

Railroad Activities Ahead

NUMEROUS summarized programs of individual railroads which have been published in our news pages during the past few months indicate that the construction season of 1923 is to be exceptionally active in railroad work. As examples, there are the contemplated expenditures of \$50,000,000 by the Louisville & Nashville, \$41,000,000 by the Illinois Central, \$12,000,000 by the Philadelphia & Reading, \$6,000,000 by the Rock Island and \$3,000,000 each by the Nickel Plate and the Frisco lines. In most of these projects new construction and extension are relatively insignificant. Probably 85 or 90 per cent of the expenditure is for the improvement of existing lines by grade and line revision, additional main tracks and passing tracks, freight yards and yard extensions, engine terminals and various facilities. Furthermore, a large proportion of the small item of new line construction represents relief or cut-off lines built to increase traffic

capacity or operating efficiency rather than lines to open up new districts or develop new traffic resources. Part of this present and prospective activity is due to the necessity of making good the improvements deferred under war conditions, but the greater part is due to the growth of traffic which necessitates increase of facilities on existing lines rather than the extension of lines to produce additional traffic from new sections of settlement and cultivation. But although present attention is concentrated on improvement work the railway system is far from complete, and there is still future work for the pioneer and the locating engineer in new country, as well as for the engineer with the problem of the economic possibilities of improving operated railways.

To what extent the above improvement programs can be carried out during the present season will depend largely upon conditions of labor, wages and material supply and prices. But even if all the prospective work should be completed there is plenty more needing to be done as long as financial and political conditions will permit the railroads to proceed with adequate improvements and developments to bring the railroad system abreast of the country's needs.

Business Man or Administrator

WITH commendable promptness both the American Society of Civil Engineers and the Federated American Engineering Societies have put in motion investigations into the removal of Director Davis of the United States Reclamation Service. The issue is more than the injustice done to one engineer, however great that may be. The removal, or more particularly the appointment of Governor Davis, implies a charge against the whole engineering profession, to which the professional organizations must reply. And to formulate that reply those organizations must have all the facts. The Secretary of the Interior can hardly continue to maintain his reticence before the representatives of the engineers of the country, when they come before him for an explanation of the accusation that engineers are incapable of conducting an engineering organization.

Herein lies the seriousness of the Davis incident; that it may well be the beginning of a movement at Washington to make the government engineers merely the day-laborers of engineering work, the bosses of the concrete gangs, the instrument men of the surveys, the draftsmen and the estimators, leaving the direction of all of these to the so-called business man, who changes with each new administration or even with the political exigencies of the administration itself. It may mean a complete about-face from the ideal of engineering direction of government engineering work, which the profession knows itself competent to assume to the benefit of the country, and which would result from a properly organized department of public works.

Dr. Work, in one of his few announcements, defends himself with the statement that the work of the Reclamation Service has largely passed beyond the engineering stage and has become a business, that the chief engineer will continue to have charge of all engineering details but that this business operation must be in charge of a business man—the new commissioner at Washington being of that type. Passing over the obvious triteness of this glorification of the "business man," which name covers such a multitude of sins, it may be worth while to examine into this business of irrigation and to find out wherein the engineer is disqualified for it and the groceryman and banker qualified.

What does the Reclamation Service do? It designs and builds irrigation systems with government funds, it operates or supervises those systems after they are built for the benefit of settlers who pay the government for the land and the service at certain rates fixed by law. The design and construction are obviously engineering, the service is certainly engineering; there remains then only the matter of payment and the relations between the government and the settler. Is this more a matter for the business man than for the engineer? Is there anything inherent in the man who buys and sells which makes him better suited to deal with a group of farmers than a man who not only has designed and built the thing those farmers are using but also is in constant touch with their problems through the daily operation of that which they use?

It is not a "business man" that this business of irrigation calls for; it is an altogether different kind of person—an administrator. The Secretary's defense confuses these two terms. The engineer does not claim to be a "business man." He does not buy things which he later sells at a profit, he does not take chances in the hope that a successful guess will outweigh in profits the losses from half-a-dozen unsuccessful ones. He is trained to learn facts and to proceed from those facts in orderly steps to a desired and desirable end. When in the individual he combines this method of practice with a knowledge of how to deal with men he becomes the ideal administrator, especially so when the field of his administration lies within the range of his specialized technical knowledge. The railroads are fast finding this out; is the government business so different that the rule does not hold? Is not the Secretary of the Interior acquainted with the Secretary of Commerce?

The question might be put to the Secretary in a somewhat more personal way. He is a doctor of medicine, a leading practitioner in that profession, we are assured; he has, in fact, been president of the American Medical Association. He also conducts a hospital, a matter which would seem to require a deal of so-called business ability. Does he think that it is necessary in the conduct of that hospital to bring in a business man to supervise his work and correct his judgment; would he insist on the appointment of another such business man to supervise the doctors in charge of the government hospitals? Or does he think that the profession of medicine is less technical than that of engineering and that the practitioners of the former have opportunities for administrative development not permitted the latter?

Doubtless the committees of the engineering societies will present some of these considerations to the Secretary. The day is past when the assumption that the engineer is a narrow specialist can be allowed to go unchallenged. As we said last week the whole morale of the government engineering service is imperilled, but more than that there is here an opportunity to take advantage of what bears all the earmarks of a political maneuver to give the people of the United States some understanding of the breadth of training and experience of the engineering profession.

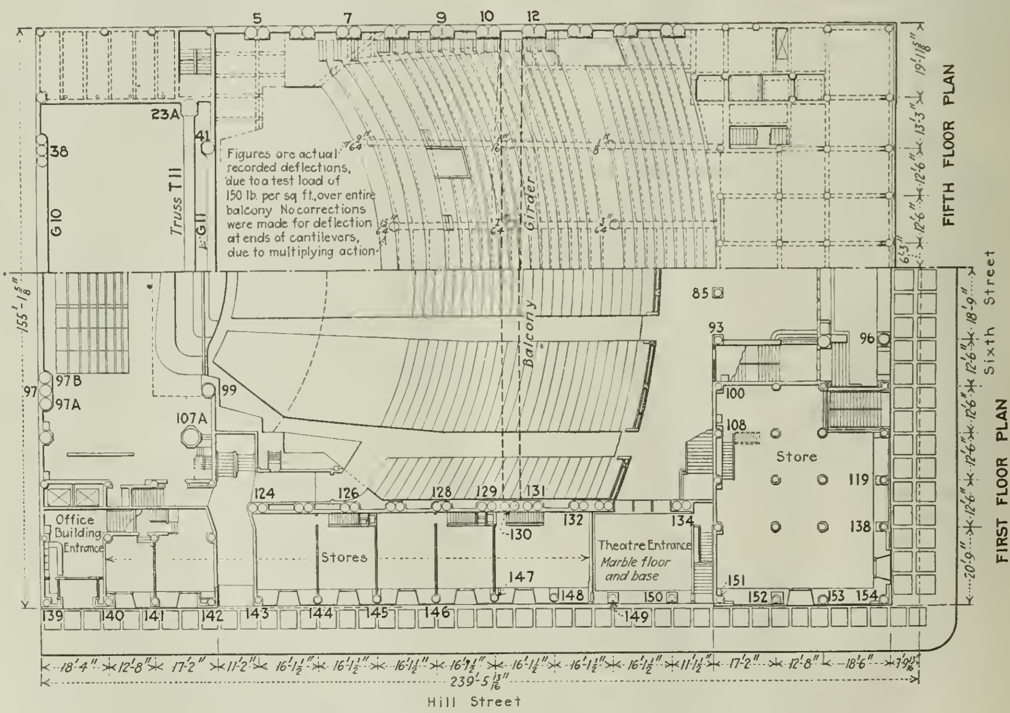
Huge Concrete Girders and Trusses in New Theater

Grauman's Theater and Office Building in Los Angeles Contains Reinforced-Concrete Roof Trusses 126-Ft. Span, Large Cantilever Truss Under Balcony and Girders Up to 126-Ft. Span

By Roy C. Mitchell
Engineer, Edwin Bergstrom, Architect, Los Angeles, Calif.

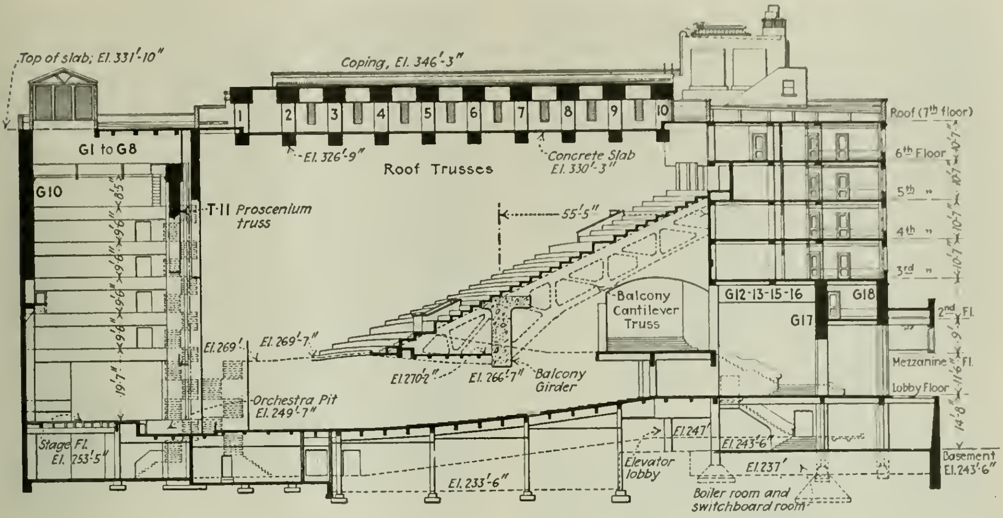
GRAUMAN'S Metropolitan theater and office building at Sixth and Hill Sts., Los Angeles, is a monumental piece of reinforced-concrete construction; other structures may have a larger volume of cubic content or number of cubic yards of concrete used, but from a standpoint of extraordinary structural design as varied as the component parts of a theater building and on the stupendous scale with which it was carried out, it has no equal in building construction. The main structural features are the ten 126-ft. span roof trusses; the cantilever balcony construction and the great 126-ft. girder which carries it; the framing over the main lobby with the marquise extending out 12 ft. from the building, with terra-cotta facing; the heavy girders over the stage supported by a large truss and girders over the proscenium arch and the large combined footing under the stage. There was used in this entire structure 2,700 tons of reinforcing steel, 84,000 cu. yd. of concrete, 127,000 bbl. of cement and 1,500,000 ft. of lumber.

This theater and office building, in general, is thirteen stories in height, with a frontage of 240 ft. on Hill St., 155 ft. on Sixth St., with an alley extending along the east side and the property line along the north side. Grauman's Theater will occupy the greater part of the building, with a seating capacity of 3,900. The offices, one tier deep along the Hill and Sixth St. sides, extend up to the seventh floor. From the seventh floor up the office portion of the building will be a U-shape plan, 48 ft. deep on each side. Above the seventh floor this office portion will be over the entire stage, along the alley side, extending out 48-ft. over the theater auditorium, which is supported on the reinforced-concrete roof trusses, and also along the entire Sixth St. frontage.



PLAN OF GRAUMAN'S THEATER SHOWING LOCATION OF TRUSSES AND HEAVY GIRDERS

When the original plans were made, the building was to be a combination of structural steel and reinforced concrete. The main girders, trusses and framing over the stage were to be of structural steel on steel columns, but owing to the exorbitant price which was asked for the 1,500 tons of structural steel at that time, it made it almost prohibitive in going ahead with this building unless some other means could be devised for

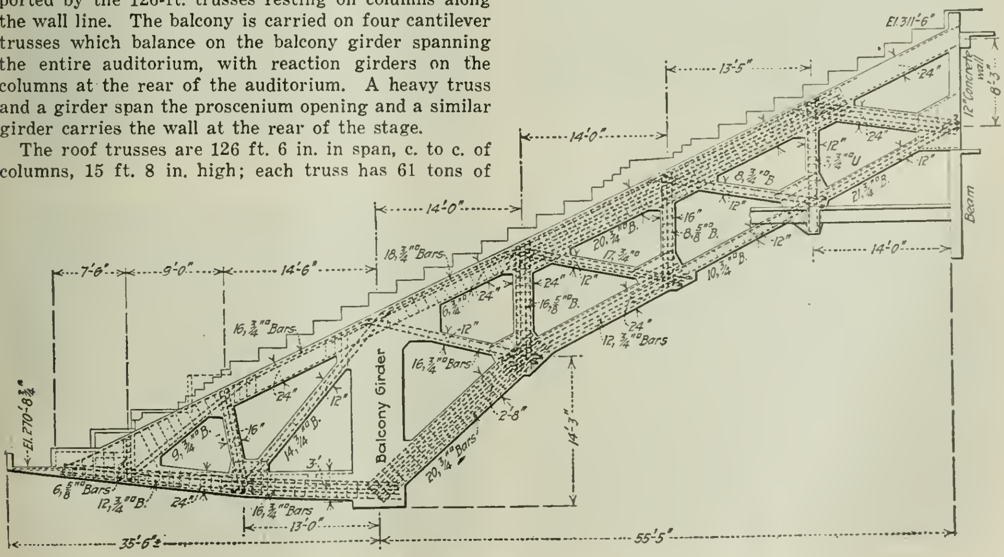


SECTION THROUGH AUDITORIUM OF GRAUMAN'S THEATER, LOS ANGELES
Note heavy trusses over stage and over auditorium. Large balcony cantilever and girder are of reinforced concrete.

lessening the cost. Upon investigation it was found that by making the structure of reinforced concrete a big saving, both in money and in time could be made. If the steel construction were used all of the trusses over the auditorium would have had to be shipped knocked down and later riveted up on a falsework; also this steel framing would have had to be fireproofed which would make the members approximately the same size as members used in a reinforced-concrete truss.

The disposition of the structural members may be noted from the plans and sectional elevations given herewith. The auditorium is clear, the roof being supported by the 126-ft. trusses resting on columns along the wall line. The balcony is carried on four cantilever trusses which balance on the balcony girder spanning the entire auditorium, with reaction girders on the columns at the rear of the auditorium. A heavy truss and a girder span the proscenium opening and a similar girder carries the wall at the rear of the stage.

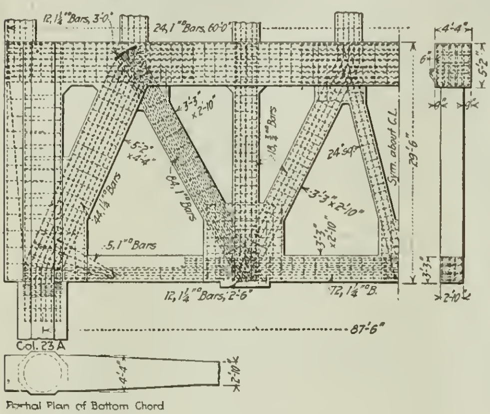
The roof trusses are 126 ft. 6 in. in span, c. to c. of columns, 15 ft. 8 in. high; each truss has 61 tons of reinforcing steel, 231 cu.yd. of concrete and carries a load of 750 tons. In the building up of these trusses the soffit of the truss, with its reversed decorative forms, was put in place first; the bottom chord steel was next laid out and fastened securely in place. Spacers made of 1¼ x 1¼-in. bars bolted together, placed approximately 10 ft. centers, were used to hold this bottom chord steel in place. Cement blocks were used to carry the load. Care was taken in placing these blocks to see that they were staggered so as to allow for the placing of the concrete. The bottom chord consists of 1¼-in. square deformed bars, 65 ft. long; a 6-ft. lap was used at the



TYPICAL REINFORCED-CONCRETE CANTILEVER GIRDER CARRYING BALCONY

splices with three ¾-in. U-clamps. Particular care was taken to see that these U-clamps were securely in place and tight. The locations of these splices were all laid out so as to stagger with the splice in the bars adjacent to them. At the ends of the truss the bottom chord bars were all hooked around the vertical column bars. Bars in the diagonal tension members were laid out so as to work in between each layer of the bottom chord. These bars were hooked on both ends with a cross-bar running through the hooks, the top chord being rectangular in shape and reinforced as for a rectangular column.

The columns along the alley which support these trusses have a double core, 36 in. in diameter, with steel



REINFORCED-CONCRETE TRUSS OVER PROSCENIUM

on the inside, figured to carry a direct load. Bars to take the bending were placed outside of the hooping and tied in, extending from the foundation to the top of the roof truss.

The huge balcony girder, which carries the four cantilever trusses, has a length of 126 ft. 6 in. c. to c. of columns; it has 570 cu.yd. of concrete and 110 tons of steel. The reinforcing steel in the bottom at the center consists of 204 1¼-in square bars. This girder was poured in one continuous run of 47 hours. The supports consist in double core columns at each end which set in between the columns carrying the roof. The ends of the girder are 6 ft. thick and 26 in. high, and at the center it is 5 ft. thick and 18 ft. 11 in. high, carrying a load of 2,000 tons. Two large holes are left through the girder for the ramp leading from the foyer to the front edge of the balcony.

The four cantilever trusses which are carried by the above girder have a maximum overhang of 43 ft., the anchor arm being 55 ft. 5 in. These trusses were cast with the large girder; the floor system was built after the forms were removed.

Some of the other structural features consist of the heavy framing over the entrance lobby with a 12-ft. reinforced-concrete marquise, extending out 12 ft. beyond the building line. This marquise is 89 ft. long, the central portion is built on a circle and faced with terra cotta, and it has a marble ceiling. The main supporting girders extend back into the building and are hung to the bottom of the girder spanning the lobby. An exit 15 ft. wide on each side at the rear of the orchestra floor was required; as the main supporting columns are only 12 ft. 6 in. centers, this required that these columns be spread and carried up about half way and then drawn in together to the 12 ft. 6 in. centers. So as to get the maximum depth of stage, the columns at the rear of the stage are bunched together at each side and support a reinforced-concrete girder which is 3 ft. 10 in. thick and 40 ft. deep, 64-ft. span with three 40-in. diameter core columns at each end. A girder of similar size is directly over the proscenium opening. In order to get a maximum height of proscenium opening a truss is placed directly back of this proscenium so as to allow for the asbestos curtain to have a maximum possible height. This truss has a span of 87 ft. 6 in. and is 29 ft. 6 in. high, and carries the ends of the girders over the stage which, in turn, carry the office portion above. It is carried at each end by a column with 54-in. core, with 52 1¼-in. vertical bars on the inside of the core, and 28 1¼-in. bars outside of the core to take care of the eccentric loading.

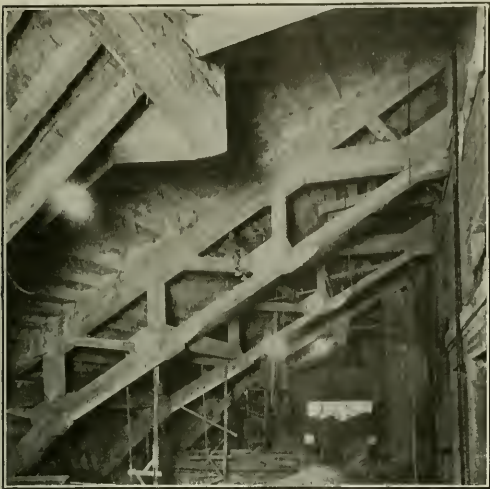
Two immense combined footings were required to support the columns which are bunched at the rear of the stage. At each side of the proscenium opening each one of these footings is approximately 56 ft. long, 9 ft. 9 in. deep, with a varying width from 24 ft. up to 35 ft. and has 156 1¼-in. bars at the top, and 460 ⅜-in. square stirrups, 450 cu.yd. of concrete, and carries a load of 5,200 tons.

The footing along the alley is continuous for a length of 164 ft., the footing being an inverted tee with a maximum width of 19 ft. and 5 ft. 6 in. thick, with a distributing wall 4 ft. thick which furnishes the support for the eleven sets of double-core columns supporting the roof trusses and balcony girder.

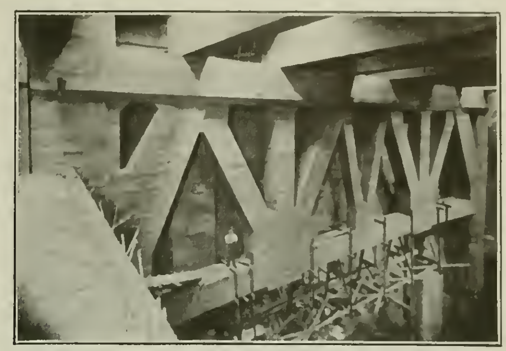
A flat-slab floor system was used in the office wings of the building. Spacing of the columns here gives panels to which a simple flat-slab with two-way reinforcing is readily adapted. The columns are all 20 in. square and the beams of the same width and 16 in. deep, which carry a rough slab 4½ in. thick or 5½ in. from finished ceiling to finished floor.

The finished walls and ceilings of the interior portion of the theater auditorium are directly on the rough concrete, using reversed forms quite freely on all the walls and soffits of the beams and cornices, leaving the concrete in its natural gray color—no attempt being made to make the concrete smooth. The ceiling decoration consists of a large round doily. Outsids of this the trusses are exposed.

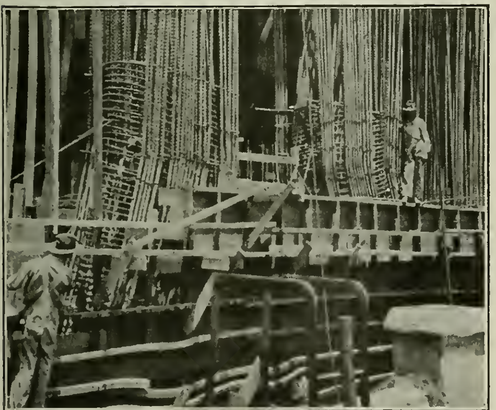
Construction Details—To carry out this work there was first erected an immense falsework to support the forms for the trusses and girders over the stage and theater auditorium. (See *Engineering-News Record*, March 3, 1921.) This falsework was erected and completed before the contract for the general work on the building was let. The main procedure of construction was to erect the walls around the auditorium, stage and office portion of the building up to the bottom of the roof trusses. While this work was being done all erecting of forms and placing of reinforcing for the roof framing were being carried on and were ready for the concrete by the time the other portion of the building was built up to this point. After the roof construction was poured, the balcony girder and cantilevers were built in between the falsework supporting the roof. This was done without removing any of the falsework.



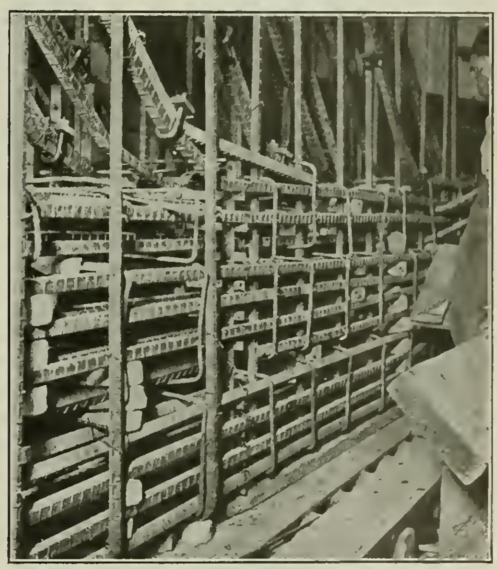
UNDERSIDE OF BALCONY SHOWING CANTILEVER TRUSS SUPPORTS
Anchor arm of cantilever shown. Length of anchor arm 55 ft. Cantilever portion of truss 43 ft. 3 in.



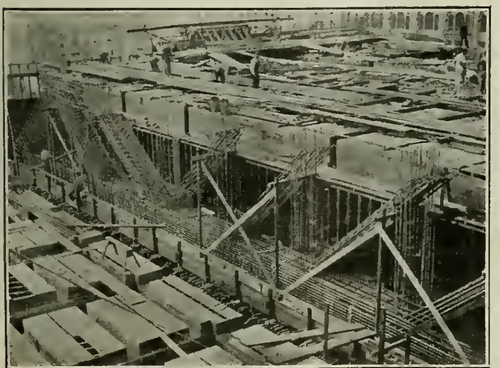
REINFORCED-CONCRETE TRUSS OVER PROSCENIUM
Span 87 ft. 6 in., height 29 ft. 6 in. Bottom chord, 34x39 in., with 72 1¼-in. bars.



CLOSE-UP OF COLUMNS UNDER ROOF TRUSSES
Note columns drawn together above the opening by foyer.

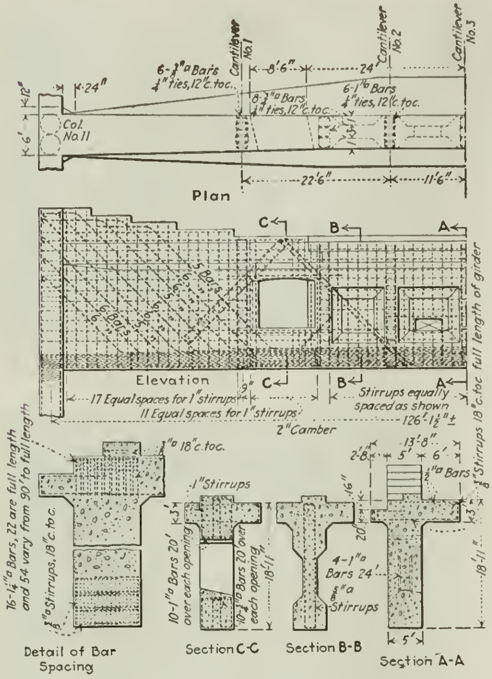


STEEL IN BOTTOM OF BALCONY GIRDER
In this lower section are 204 ¾-in. bars across a width of 5 ft. and extending up about 3 ft. Outside layer of steel is outside of part of the stirrups.



REINFORCING IN PLACE IN ROOF TRUSS

UNDERSIDE OF ROOF TRUSSES
Note the widening of chord near support.



DETAILS OF 126-FT. CONCRETE GIRDER CARRYING BALCONY CANTILEVERS

The floor system on the balcony was next placed; then the first floor in the auditorium and stage was built.

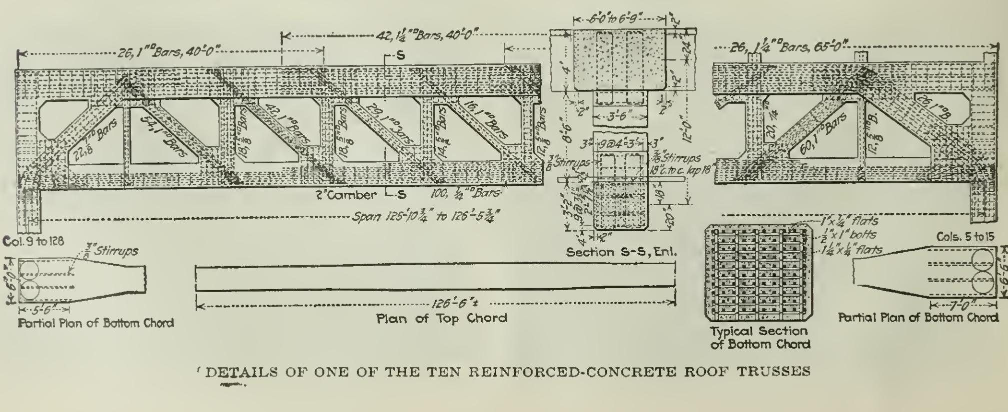
After the removal of the forms from the balcony a test was made by the city building department. This consisted in loading the entire balcony with a load equal to twice the designed live-load, which was 75 lb. per square foot. This test was made by piling a uniform load of 150 lb. per square foot consisting of earth, sand, cement and lumber over the entire balcony, equal to a load of 1,500,000 lb. This load is equal to seven times the weight of the people that can be seated in the balcony. Before this test load was placed, triggers to measure the deflection were set up at the end of each cantilever and under four points on the girder, also under the anchor arm of each cantilever. This test showed a minimum deflection of $\frac{1}{32}$ in. and a maximum deflection of $\frac{5}{64}$ in. on the four anchor arms; a minimum deflection of $\frac{1}{32}$ in. and a maximum deflection of $\frac{7}{64}$ in. in the balcony girder, and a minimum deflection of $\frac{9}{32}$ in. at the front end of the cantilevers. Close examination was made for cracks while this test load was in place but no cracks could be found at any point, and on removing the load the entire balcony came back to its original position.

The settlement and shrinkage of the falsework which supported the roof trusses up to the time of starting to pour the concrete was $\frac{5}{8}$ in. During the pouring of the bottom chord of the truss an additional settlement of $\frac{3}{8}$ in. took place. Upon removing the supports from under these trusses, after sixty days, a deflection of $\frac{3}{16}$ to $\frac{5}{16}$ in. took place; also a horizontal deflection of $\frac{1}{8}$ in. in the long columns next to the alley side.

The unit stresses used on all this work are those required by the Joint Committee on Concrete and Reinforced Concrete, 1921. No attempt was made to use any high stresses or extra mixing of the concrete, the concrete being one part of cement, two and one-half parts of washed sand and three and one-half parts of $\frac{3}{4}$-in. rock. All cement and steel were tested. All the concrete was mixed in 1-yd. batch mixers, hoisted and placed from buggies and wheelbarrows. No spouting of concrete was allowed. Particular attention was paid to the mixing of this concrete to see that it was of a consistency that would properly flow.

Two concrete mixing plants in the basement of the building consisted of storing bins, conveyors and elevators for the sand, rock and cement with a capacity to permit of pouring any two of the largest units on the building at one continuous pour without depending on material to be delivered. Extra precaution was taken so as to guard against a breakdown of this mixing plant by having duplicate parts on hand for both mixers, as well as two separate sources of electrical power.

The forms used consisted of ordinary construction of 2x4's and $\frac{7}{8}$-in. form lumber. The falsework was built up to a point approximately 4 ft. below the bottom of the trusses or girders and was then covered with a 2-in. plank floor. On top of this, 4x4's set on wedges were used to support the forms for trusses and girders. The ten trusses over the auditorium were built up in pairs. This permitted building the sides of two ad-



DETAILS OF ONE OF THE TEN REINFORCED-CONCRETE ROOF TRUSSES

jacent trusses and formwork before placing the steel. A full-sized template of the trusses was first laid out on top of the falsework; boxes were made for the inside and were later put in place after the steel had been erected. The forms were allowed to remain in place for sixty days after the concrete was poured. However, a small portion at each end was taken down at the end of thirty days.

In each one of these large trusses or girders the concrete was all placed in one continuous pour. On the roof trusses each truss was poured in a continuous run of about seven hours on ten consecutive days. No attempt was made to hurry. Concreting was started by pouring the bottom chord full at one end and gradually working the concrete the full length of the bottom chord; then the diagonal members were poured and finally the top chord and roof.

The construction of the balcony girders, cantilever trusses and the framing over the stage was carried out in practically the same way as for the roof truss.

The Winter Construction Co. was the general contractor. The structural design was made by the writer in the office of Edwin Bergstrom, the architect.

Waterpower Resources of Russia Concentrated in Asia

Vast Resources in Asiatic Russia—Limited Ones in Europe—Possible Effect on Centers of Population

By I. Gutmann

THE COLOSSAL plans of the Soviet Government for the electrification of Russian industry and transportation through the development of the hydraulic resources of Russia cannot be studied intelligently until one has an idea of the magnitude, availability, and geographical distribution of these resources. Such detailed quantitative data are now available through their publication by Prof. A. Deysha in the *Vyestnik Inzhenyerov* of Moscow, the official organ of the "All-Russian Association (Union) of Engineers." A brief discussion of these data is believed to be timely.

The accompanying table, giving an abstract of these data, does not include streams or portions of streams which may be covered with ice more than 200 days in the year, or whose slope is less than 1 in 3,000. Catchment areas lying higher than 2,000 meters above sea level have also been excluded. The column headed "concentration" gives the minimum horsepower per square mile of contributing catchment area and serves roughly as an index of the availability and cost of development of the hydraulic energy of the basin.

For comparison, the Mississippi has a minimum of 5,500,000 hp. at a concentration of 4.5 hp. per sq.mi., the St. Lawrence, to the Canadian line, has nearly the same number of hp. at a concentration of about 18 hp. per sq.mi.; and the average "concentration" of potential power in the state of Washington is about 70 hp. per sq.mi. It should also be noted that the United States, with area only one-third that of Russia, exceeds the total potential hydraulic power of Russia by a half.

It will be observed that European Russia, which has a population of over 100,000,000, or about 80 per cent of the total population of Russia, is quite poor in hydraulic power resources. Indeed on an area which is about three-fifths of the size of the United States there is only 586,000 hp. or just about one-fiftieth of the potential water powers of the United States. The state of North Carolina has as much hydraulic energy as the whole of European Russia, California has six times as much and even Nevada and South Dakota are comparatively richer in hydraulic power resources than European Russia. The Russian territories which are rich in hydraulic power—Caucasia, south-eastern Siberia, Kamchatka, etc.—are very remote from the centers of population and industry which are in European Russia, and the power which may be developed in these territories cannot be used for the electrification of present day Russian production and transportation any more than the water powers of California and Oregon can be used for the electrification of industry and transportation in Illinois or New York.

DISTRIBUTION OF THE WATERPOWER RESOURCES OF EUROPEAN AND ASIATIC RUSSIA

Region or Basin	Concentration Hp. per Sq.Mi.	Hp.	Total Hp.
European Russia	0 26		586,000
Caucasia:			7,715,000
Black Sea slope	450 00	2,285,000	
Northern Caucasia	106 00	3,330,000	
Caspian slope	54 00	400,000	
Southern Caucasia	23.00	1,700,000	
Ural	4.70		923,000
Russian Turkestan:			1,550,000
Syr Darya	17.00	1,550,000	
Southern Siberia:			5,055,000
Irtish		725,000	
Yenissey	8 00	3,565,000	
Lena		765,000	
South-eastern Siberia or Amur Region			3,130,000
Zeya	23.00	2,000,000	
Bureya	34 00	970,000	
Ussury	2.10	160,000	
Kamchatka	21.00		410,000
Total for Russia		about	20,000,000 hp

In other words, industry and transportation in Russia proper may be electrified, by the utilization of the hydraulic resources, only to a very limited extent.

For the present at least the enormous quantities of hydro-electric energy which can be developed in Caucasia and Siberia will have to be consumed within or near the regions where they may be generated. Fortunately these regions are rich in minerals, lumber, livestock and agricultural resources, and the power developed in them may be applied to mining, manufacturing, irrigation and agriculture. Caucasia which besides its immense hydraulic resources has also rich oil fields and a wonderful climate, may rival California in its development; the Amur region in southeastern Siberia may surpass British Columbia; while southern Siberia may develop like Montana and Alberta.

These rich sections of the Russian Republic promise to become great centers of production which may bring about a shift in the centroid of population towards the periphery, southwards and eastwards—chiefly eastwards—towards the Pacific.

Irrigation and Drainage Have Helped Italy

In the course of a recent address on Economic Progress in Italy before the Engineer's Club of Minneapolis, Dr. Jeremiah W. Jenks, who spent six months abroad late in 1922, said: "Italy of all countries in Europe has made most progress since the war. This is especially notable in agriculture, which is now in better condition than before the war, principally because the Italian government invested in drainage and irrigation projects.

Coal Storage for Year's Supply for Detroit Water-Works

Duplicate Coal-Handling Equipment Gives Continuity of Service—Dragline Scrapers Reclaim Coal to Feed Hoppers

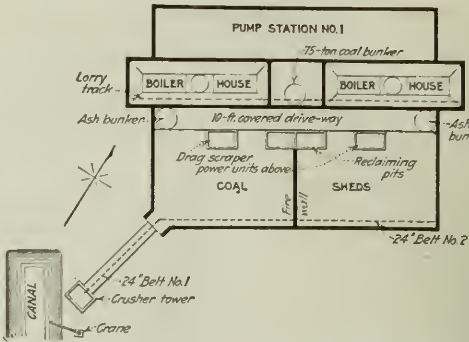
CONTINUITY of operation of the Detroit water-works pumping stations is assured by duplication of equipment and by summer storage of sufficient coal to last throughout the remainder of the year. Coal is purchased and shipped by water during the summer to secure an adequate supply at reasonable cost. The present installation, completed in 1922, was designed to crush and store coal in the 25,000-ton shed at the rate of 100 tons per hour and to supply intermittently any one of twelve 400-hp. horizontal water-tube boilers equipped with underfeed stokers. A crane unloads into a crusher the coal from vessels traversing 2,000 ft. of canal from the Detroit River. The crushed coal is delivered by an inclined belt to the end of a second belt conveying it the length of the storage house.

LONG LOW 25,000-TON COAL STORAGE BUILDING WITH DUPLICATE BOILER HOUSES AND STACKS IN REAR

City-owned canal for coal delivery by vessel connects with Detroit River 2,000 ft. away. Pent house over 175-ton coal bunker is just below one of the cupolas on pumping station 1. In the right rear is pumping station 2. In extreme left rear is obsolete water tower. Crane unloads coal from vessels to crusher. Inclined belt 1 (just back of smoke of crane engine) delivers to end of belt 2 running entire length of storage house.

As shown in the sketch the boiler house is in effect two distinct installations, each with its own chimney, boilers, breechings, feed-water heaters and pumps. The boilers are grouped in batteries of three on either side of each of the two 150-ft. chimneys. The units are separated by two fire walls with a shop space of 20 ft. intervening. It was also considered best to keep the coal and ash-handling systems separate so that failure of one might not interfere with the functioning of the other.

The source of supply is the Toledo pool of Ohio and Pennsylvania run-of-mine bituminous coal. Barges are docked in the department's canal and unloaded by clamshell bucket and crane. Coal is dumped into a hopper with a reciprocating feeder and crushed by a 30-in. double-roll crusher fitted with replaceable steel teeth. The hopper, crusher and lower end of a 24-in. belt conveyor together with motors and interlocking control are housed in a brick crusher tower which supports the lower end of a reinforced-concrete bridge inclosing the belt conveyor. On its journey to the storage building the coal is weighed as the belt passes over an integrating weightometer. A 24-in. horizontal belt receives the coal where it enters the building and distributes it along the south wall by means of an automatic self-propelled and reversing tripper.



RELATION OF COAL AND ASH-HANDLING EQUIPMENT TO DUPLICATE BOILER HOUSES AND PUMPING STATION 1

The coal storage building, 320 ft. long and 180 ft. wide, divided by a central cross-wall, is constructed with reinforced-concrete retaining walls for a height of 20 ft. From the top of the concrete up to the parapet is ordinary brick curtain wall construction. The entire roof area of 10-ft. span reinforced-concrete slabs is supported on a system of Pratt trusses and girder trusses. Only two concrete-incased steel columns in each half of the building obstruct the clear area. Coal is stored to a depth of 20 ft. and reclaimed by means of 1,000-lb. capacity drag scrapers. A complete scraper system with power unit is provided in each half of the building. Either scraper will store coal about as fast as delivered from the 24-in. belt, leaving the other for use in reclaiming the daily supply to hoppers installed centrally in the north side of the building. These hoppers with feeders and the boot of a bucket elevator are inclosed in a concrete pit. The coal is elevated and stored in a 19-ft. diameter cylindrical steel bunker of 175-ton capacity, located centrally between the east and west boiler house units, directly over the line of travel of the motor-driven 1-ton capacity weigh larries feeding the stoker hoppers. It is of interest to note that 20,000 tons of coal were weighed in over the weightometer during a certain period last year and that the coal weighed out on the larry scales checked this figure by less than 50 tons; the discrepancy no doubt was largely due to evaporation of the moisture.

At Detroit, under-water storage is not practicable because of the cold winters, and no other special provisions were made to prevent fires. After various schemes were considered for combatting possible fires from spontaneous combustion, it was decided that barricading the two handcar track doors and flooding the entire building with water to a depth of 4 or 5 ft. would quench any fire that a trench cut through the affected area with drag scrapers would not control.

The ash-handling equipment is designed as a separate unit for each boiler house. One unit is located at the east and one at the west end of the plant, easily accessible to motor trucks. Ashes are drawn by hand from the boiler ash pits into small 18-cu.ft. ash cars moved by one man along a 24-in. gage track and dumped into the 20-cu.ft. bucket of the skip hoist. The mechanism is operated by push-button control to elevate the bucket and discharge ashes into a 14-ft. diameter ash bunker having a capacity of 2,500 cu.ft. A balanced duplex gate in the bottom cone of the bunker, about

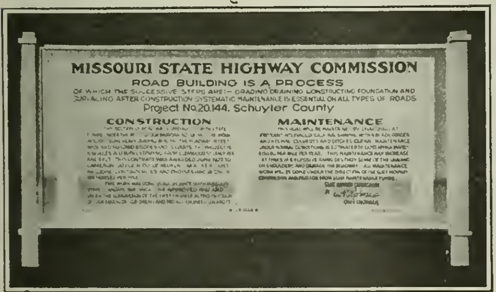
9 ft. from the ground level, provides for loading the ashes into a motor truck.

The installation has proved satisfactory in every way, according to the engineers. W. H. Mueller, of Detroit, executed the contract for the coal-storage building. The coal-handling equipment was installed by the Guarantee Construction Co., of New York, and the ash-handling equipment by the Palmer Bee Co., of Detroit. The design and construction of this work was carried out under the general direction of George H. Fenkell, superintendent and general manager, and Theodore A. Leisen, consulting engineer.

Planned Publicity Aids Missouri Road Program

Signs Describing Operation Placed on New Projects—Located State Routes Marked Before Road Is Improved

A NECESSARY adjunct of state road building at the present time is well organized publicity. In Missouri the State Highway Commission, realizing the necessity of gaining the confidence of the citizens in the commission, established a policy which was expressed in formal resolution "to take the people of the state into the confidence of the Commission." The result has been that the comprehensive plan of building 7,643 miles of highways in the state has withstood the onslaughts of politicians and has weathered a session



PROJECT-INFORMATION SIGN-BOARD

of the legislature which was so influenced by public sentiment that all efforts to change the state law were effectively throttled.

One of the publicity methods which has given much satisfaction throughout the state has been the erection on all large projects in the various counties of a sign-board shown by the accompanying illustration. This sign carries at the top the announcement that the project is being constructed under the direction of the Missouri State Highway Commission, followed by the statement that "Road building is a process of which the successive steps are grading, draining, constructing foundation and surfacing. After construction, systematic maintenance is essential on all types of roads." This is followed by the project number, the name of the county, the length of road to be built, the cost, the material to be used and the name of the engineer in charge and of the division engineer. This sign is erected on the right-of-way at some point along the project and may be seen by all travelers.

So far, there have been erected 100 of these large

MARKERS PLACED ON LOCATED STATE ROUTES

signs and this will be followed by the erection of another 100. It is hoped to have at least one in each of the 114 counties in the state. The experiment is not a costly one considering the value the commission believes it receives therefrom, and, since building roads is an operation of which the general public knows little in detail, the information serves a splendid purpose by keeping the entire state advised of the progress towards attaining a condition of perfection in highways.

Another essential feature of the publicity campaign is the erection of road markers upon the *designated* highways of the state. There are some 90 of these numbered routes traversing the state in both directions, with a large number of shorter stretches connecting the important primary routes. Each one of these highways carries its distinctive number. Pending the construction of all highways these markers are placed on the decided routes between the points named in the law and should the surveys and actual construction follow a different route, they will be reset after the roadway has been completed.

Another method used to enlighten citizens on the work of building roads, is the transmission at frequent intervals of short news stories to the leading weekly papers of the state. It has been found that so much interest is manifested in highway construction that the county newspaper is always anxious to secure reliable data that it can give to its subscribers. There are some 200 or more newspapers in the state that regularly print this matter which is prepared in the office of the commission by a trained newspaper man. This publicity goes into the rural communities and carries information to those places where it is, no doubt, most needed.

Tests Show High Impact on Culverts

Tests of the transmission of impact from road surfaces downward through the fill to culverts have been carried out at Iowa State College. Prof. Anson Marston states that impacts as high as 100 per cent of the static effect of the moving load may occur where the thickness of cover over the culvert does not exceed 2 ft. This experimental showing, moreover, is verified by field experience with pipe culverts under thin cover. In one case, many culverts broke under shallow fills.

Belt Line and Industry District at Flint, Mich.

Pere Marquette R.R. Builds Loop to Detour Freight Traffic and Serve Large Outlying Industries

An 8½-mile line now nearing completion by the Pere Marquette R.R. at Flint, Mich., will not only divert through freight traffic from the main line which traverses the city but will serve also to develop a large industrial and manufacturing district established by the city. In addition, this improvement is likely to postpone indefinitely a move for the more expensive work of elevating the main line in order to eliminate street crossings at grade, since it is the freight trains which are the main cause of complaint in obstructing traffic.

From Fig. 1 it will be seen that the main line runs practically north and south in a wide loop through the city, and near the center of the business section it has a grade crossing with the Grand Trunk Ry. The Detroit United Electric Ry. operates an interurban passenger and freight service through the city. All these lines are at street grade. About twenty years ago the Grand Trunk Ry. built a freight loop or belt line which runs south of the central portion of the city and thus keeps its through traffic away from the business district. In recent years, however, the city has been built up to this line. On the Pere Marquette R.R. there are about eight passenger trains daily, but the interruption to street traffic comes mainly from the long and heavy freight trains moving at slow speed. Fire equipment has been halted occasionally in this way, with consequent public complaint and demand for grade separation.

A project for an east side industrial district with railway communication, in order to provide systematically for the commercial expansion of the city, was included in a report made to the City Plan Commission in 1917, by Bion J. Arnold, consulting engineer, Chicago, and John Nolen, city planning expert, Boston. For railway service it was proposed to have a municipal line extended through this district, to be operated either by the city or by some connecting line under lease, with the provision that free use of the line should be accorded to all railways entering the city. Track elevation and a union passenger station for steam railways and electric interurban lines, were included in the suggested improvement, but it was shown that the diversion of freight traffic from city streets was of more immediate importance.

War conditions delayed the proposed development, but in 1921 the Chamber of Commerce agitated the matter, the city limits were extended north and east, an area of about 1,000 acres within the new eastern limits was secured by local interests for the industrial district, and a right-of-way for an 8½-mile belt line was also obtained. Negotiations for the construction and operation of this line were entered into with the Pere Marquette R.R. and that company offered to undertake the work if the right-of-way was provided. The necessary land was then donated to that company with the understanding that the trackage would be available for any railroad which might desire to use it. Later, however, the railway company bought the line for use as a freight cut-off. The company will operate all industrial switching movements and will provide for interchange with other roads. A structural steel plant and two or three automobile plants have been erected already in the industrial district.

For the first five miles of the belt line the earthwork is light, but for 3½ miles at the north end it is much heavier, the line crossing the Flint River valley and ascending to a higher plateau. Two long fills of about 130,000 cu.yd. on the south and 50,000 cu.yd. on the north form the approaches to the Flint River bridge. The total excavation on the line is about 280,000 cu.yd. A roadbed width of 20 ft. is given on fills and 24 ft. on cuts. In fills the quantity is increased by raising 10 per cent above subgrade to allow for settlement and subsidence. The maximum grade is 0.3 per cent and the sharpest curves are of two degrees.

Track is laid with 90-lb. rails on hardwood ties treated by the zinc-creosote process. Interlocking plants will be provided at the intersections of the Grand Trunk Ry. and the Detroit United Ry. At the north end of the line is the McGrew yard, where cars to and from local points and the industrial district are cut out and assembled.

In making the large fills, framed bents were used for the temporary trestles as it was cheaper to buy timber than to drive piles. Filling was handled by 8-car

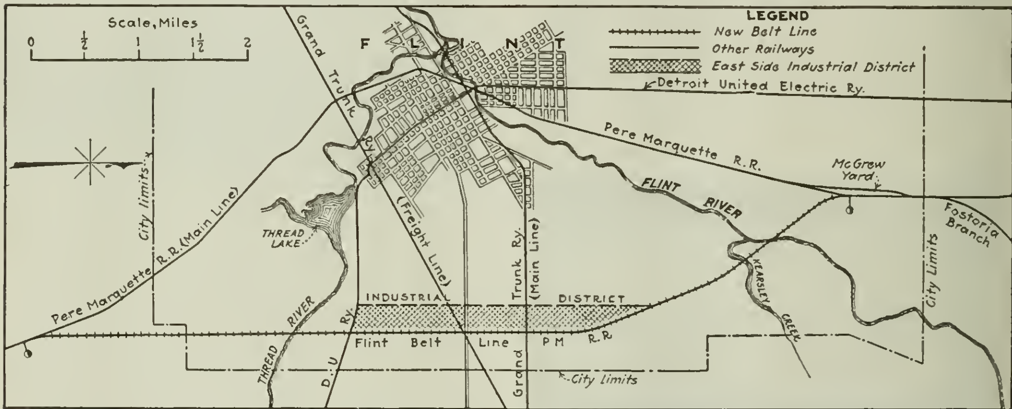


FIG. 1—BELT LINE OF PERE MARQUETTE AT FLINT

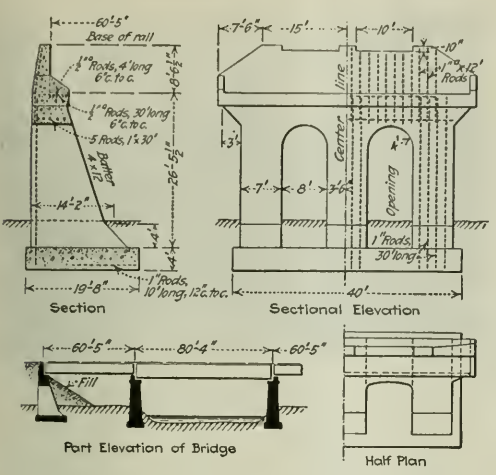


FIG. 2—ABUTMENT WITH ARCHED OPENINGS

trains of gondola cars having the sides formed by panels hinged at the top, these cars averaging loads of 25 cu.yd. When the train reached a fill, with the locomotive and unloader car at the rear end, a car with unloader plow in place was coupled to the head end. The hook of the plow cable on the drum in the rear car was then attached to a derrick beside the track and the train pulled ahead until the cable was strung along the train and hooked to the plow on the head car. The train was then backed down onto the trestle and the unloader engine hauled the plow through the cars, men keeping ahead of it to release the latches of the side doors. When the empty train had pulled off the trestle, the car with plow (next to the unloader car) was cut off and left to be attached to the head of the next train.

The two principal bridges are those over the Flint River and Kearsley Creek (Fig. 2), both of which are plate girder structures on concrete piers and abutments. The former has two 70-ft. spans and the latter has one 80-ft. and two 60-ft. spans. The abutments are of very heavy design and have arched openings so that the end slope of the fill extends through the abutment, which is thus largely embedded in the earth so that the pressure against it is equalized. Under the surface sand and clay is a deep bed of hard blue clay in which foundation piles could not be driven and it was even difficult to drive sharpened sheet piles for the cofferdams. The piers were built in this clay and built up as concrete monoliths. All foundations and substructures are built for double track, with single track spans at present. All bridges of the line are designed for Cooper's E-60 loading.

The Dominion Construction Co., Niles, Mich., has the contract for the entire line and has operated a force of about a hundred men, working 10-hour days and accommodated in two camps. The line was laid out and built under the direction of A. L. Grandy, chief engineer (now assistant to president and general manager), Pere Marquette R.R., and J. Tuthill, assistant chief engineer, with Frank Manning as resident engineer in charge. The total cost will be about $800,000 and it is expected to have the line completed by the summer of 1923.

Tests a New Locomotive Booster

An EXPERIMENT of particular interest to railway mechanical men, and of general interest to all engineers interested in railroad operation, is now being carried on by the Delaware & Hudson Ry. on its Susquehanna division. It consists in the trial of a new type of booster for use on the tenders of locomotives, known as the M. & L. booster. Heretofore the only boosters in actual operation were installed as trailers on the locomotives. There are at present about 1,000 of this type in use, some of them for nearly three years.

On June 5 the D. & H. company gave a demonstration of their new booster in actual operation over a section of track between Central Bridge and Delanson, a distance of 9.5 miles and up an 0.8 per cent compensated grade 5⅝ miles long. An inspection train was run on a track parallel to the one on which the locomotive with the new booster was operating, so that it was possible at all times to observe its performance.

The locomotive was a consolidation type with a rating of 1885 adjusted tons. For the purpose of this test the rating was increased by 591 tons, or 31.35 per cent, a total of 36 loaded cars. To demonstrate the capacity of the locomotive the train was stopped on the middle of the hill. Without the booster the locomotive could not start the train, but when it was cut in the train was started again without difficulty.

This booster was designed by Col. J. T. Loree, general manager, and Maj. J. A. McGrew, general superintendent of equipment, both of the Delaware & Hudson Co. It consists of a simple two-cylinder engine with 12 x 10-in. cylinders geared to the rear axle of a pedestal type four-wheel truck of the locomotive tender. Power is transmitted to the forward axle of the truck by side rods. The engine is so arranged that it can be thrown into mesh by a bell crank operated by a piston impelled by steam from the line supplying the booster engine.

The advantage of this type of booster over the type now in general use on locomotives is that it makes use of the weight of the tender in gaining tractive effort, and does not increase the weight of the locomotive. This feature is of particular advantage on lines where the concentrated weight of the locomotive has about reached the carrying capacity of some of the bridges. It is lighter in weight, and has developed a higher efficiency by about 15 per cent than most of the boosters now in operation.

The first booster of this type constructed under the patent of Messrs. Loree and McGrew was made at the D. & H. shops. The booster tested on June 5 was manufactured under the same patent by the Baker Manufacturing Co. of Saratoga Springs. The D. & H. company considers that this booster has gotten beyond the experimental stage, and it is reported to have placed an order with the Baker Manufacturing Co. for 100 more.

Typhoid Fever a Compensable Accident

Typhoid fever contracted by a hotel employee "as the result of drinking impure well water furnished by the hotel," states *Public Health Reports* for June 8, 1923, "has been held compensable as an accident within the meaning of the Workmen's Compensation Act by the Supreme Court of Michigan." (Frankamp *v.* Fordney Hotel et al., 193 N. W. 204.)

Revolving Screens for Low-Lift Pumping Station, Detroit Filters

Primary Mission to Intercept Floating and Slush Ice—Adhering Matter Flushed Into Trough Leading to Sewer

By Theodore A. Leisen
Consulting Engineer, Department of Water Supply, Detroit, Mich.

IN THE OPERATION of the new Detroit filtration plant (see *Engineering News-Record*, May 17, p. 860) the water will be raised from 25 to 30 ft. for delivery to the coagulation basins. The low-lift pumping station, constructed for this purpose, is equipped with five electrically-operated centrifugal pumps, and one of the factors of special interest in this station is the system of revolving screens which intercept the water before it reaches the pumps.

The water from the Detroit River is conveyed to the station through a 10-ft. tunnel and conduit, and at the southerly or influent end of the station it enters a chamber 31 ft. wide by 59 ft. long, the bottom of which is slightly lower than the invert of the tunnel, and about 35 ft. below the surface of the ground. The screens are in a perpendicular plane, centrally located across this chamber on its longer axis. Beyond the screen chamber a suction well 11 ft. deep and 26 ft. wide extends for the full length of the station, with the pumps located on the floor immediately above this suction well or conduit.

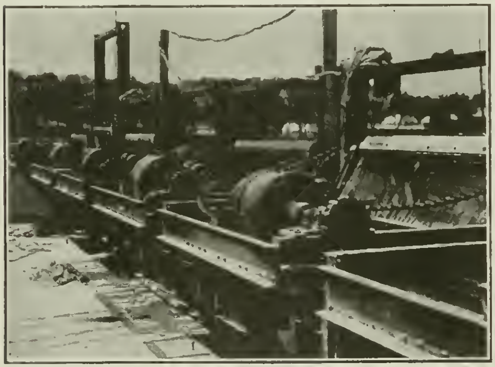


FIG. 1—INTAKE SIDE OF REVOLVING SCREENS
Each set is operated by separate 5-hp. motor.

There are seven sets of revolving screens, operated by a separate 5-hp. electric motor, providing a speed of 10 ft. per minute. Each screen consists of thirty-eight panels 24 in. wide by 72 in. long, interlocking along the upper and lower edges, and in close contact at the ends with the stationary guides. The panel frames are made of 2x2-in. steel angles with a 3-in. projecting lip or bucket at the bottom upstream face of each panel. The screening element, which is bolted to the panel frames, consists of 14-gage copper wire, three meshes to the inch, making the net openings approximately $\frac{1}{4}$ in. square. These panels are secured to endless link chains revolving around upper and lower sets of sprocket wheels, with the lower end passing through a special shoe and the upper end projecting 6 ft. above the operating floor, the total distance between upper and lower sprocket-wheel shafts being 31 ft.

FIG. 2—DISCHARGE SIDE OF SCREENS DURING ERECTION
The $\frac{1}{4}$-in. mesh screen panels are 2 ft. wide by 6 ft. long and the total opening interposed across the screen chamber is six times the area of the inlet tunnel.

Under normal conditions of operation the screens are submerged to a depth of 24 ft., and the net water area of openings in the seven sets of screens is approximately 500 sq.ft. or over six times the cross-sectional area of the intake tunnel, resulting in a very low velocity in the passage of the water through the screens.

The primary mission of the screens was to intercept all floating or slush ice coming through the tunnel, and to prevent the permanent formation of frazil or needle ice on the surface of the screens, but incidentally they serve also to prevent the passage of fish and all floating débris. All material adhering to the face of the screens or caught on the projecting lip or bucket is washed off by means of a water spray. A perforated pipe placed back of the screen below the upper sprocket wheel, where the downward passage begins, supplied by water under 60-lb. pressure, washes all adhering matter off into a trough connected to a sewer. Warm water and steam are provided for use in the event of persistent ice formation.

The screens, which were built by the Link-Belt Co., were in use throughout the past winter, proving entirely satisfactory and clearly demonstrating their value.

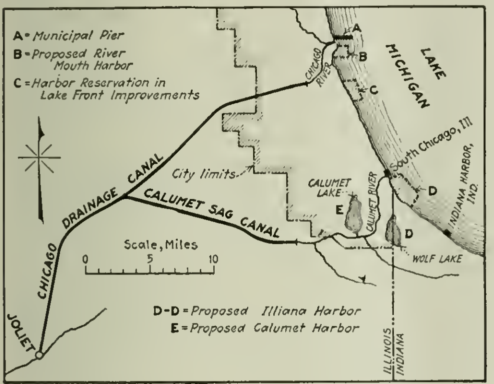
Canadian Good Roads Association Meets

The tenth annual convention of the Canadian Good Roads Association was held at the Royal Connaught Hotel, Hamilton, Ont., June 11-13 with a large attendance of delegates representing every province of Canada, and including many cabinet ministers. Among the more prominent of those who delivered addresses or read papers were Hon. J. L. Perron, Minister of Roads for Quebec Province; Hon. H. Cockshutt, Lieut. Governor of Ontario; Hon. E. H. Armstrong, Premier of Nova Scotia; Hon. F. C. Biggs, Minister of Public-Works for Ontario; Hon. J. D. MacLean, Provincial Secretary of British Columbia; D. M. Hill, Provincial Highway Engineer for New Brunswick; Hon. J. P. Veniot, Premier of New Brunswick, and A. W. Campbell, Dominion Commissioner of Highways. Strong appeals were made for a continuance of federal aid in highway construction. The following officers were elected: honorary president, Hon. J. L. Perron, Quebec; president, Russell T. Kelley, Hamilton; first vice-president, Hon. Frank C. Biggs, Ontario; second vice-president, A. McGillivray, Manitoba; secretary-treasurer, George McNamee, Montreal.

Calumet Harbor Advocated for Chicago

THE Interstate Harbor Commission organized by the states of Illinois and Indiana to report upon the so-called "Illiana" project for a harbor on Lake Michigan at the state line and also utilizing Wolf Lake, has reported adversely to this project. In view of the large areas of undeveloped harbor sites, the uncertainty of early development of the St. Lawrence waterway and the enormous cost of $400,000,000 estimated for the Illiana harbor, it is recommended that no further action be taken at this time, but that the waters of Wolf Lake be retained for possible further use. On the other hand, the development of a harbor in Lake Calumet is recommended, as approved by the War Department.

A general review of the Chicago harbor and waterway situation is given in the commission's report, and is explained by the accompanying map. It is pointed out that the Great Lakes and St. Lawrence waterway



HARBOR PROJECTS IN CHICAGO DISTRICT

project is only in its preliminary stages but that there is no adequate accommodation for such vessels as are expected to reach Lake Michigan if, and when, this waterway is completed. On the other hand, it is planned to have the Illinois link in the Lake and Gulf waterway completed in five years, but this will be for barge traffic and not for large steamers. Closing the Chicago River to all navigation is not approved, since the commission considers a local harbor desirable at the mouth of the river, with barge service to industries along the river. Further, barge navigation in connection with the Lake and Gulf waterway "can be provided through the Chicago River cheaper than through the Calumet River." Under this plan drawbridges would not be needed.

As a result of its study the commission has made the following recommendations and states that the proposed developments together with existing facilities will serve for many years:

1. Development of facilities along the mouth of the Chicago River to serve the city's commercial district.
2. Development of harbor facilities along both branches of the Chicago River for barge transportation in connection with the Lakes and Gulf waterway.
3. Development of the harbor facilities of the Calumet River for industrial purposes.
4. Improvement and development of Calumet Lake as an industrial and transfer harbor, having adequate connections with Lake Michigan and the Calumet-Sag canal.
5. Development and use of the unoccupied lands inland from Indiana Harbor, Ind.
6. Improvement of the Little Calumet River and the Calumet-Sag canal of the Sanitary District of Chicago as demands may require.
7. All terminal developments and operations to be under the supervision of the Illinois Division of Waterways and some appropriate state agency for Indiana.

Boston Metropolitan Planning Commission Created

A DIVISION of Metropolitan Planning within the Metropolitan District Commission of Massachusetts is created by Chap. 339 Acts of 1923 of that state. The commission has comprehensive duties in the way of investigations, reports and advice on transportation in all its phases and in its various relations to local and metropolitan planning.

The commission is to consist of seven members of whom three, to serve without pay, are to be appointed by the Governor, with the approval of the Council, for five-year terms, while one is to be an associate commissioner of the Metropolitan District Commission (which now has charge of water supply, sewerage and parks of the Metropolitan District); one a commissioner of the Transit Department of the City of Boston; one an associate commissioner of the State Department of Public Works (which has charge of highways, waterways and lands), and one a commissioner of the Department of Public Utilities. Each of the four ex-officio members is to be designated by the head of his department. The chairman of the division is to be named by the governor. The division is required to report annually to the Legislature and to submit annually to the budget commissioner an estimate of its expenses for the ensuing year. This estimate is limited to $25,000 annually and is subject to legislative approval.

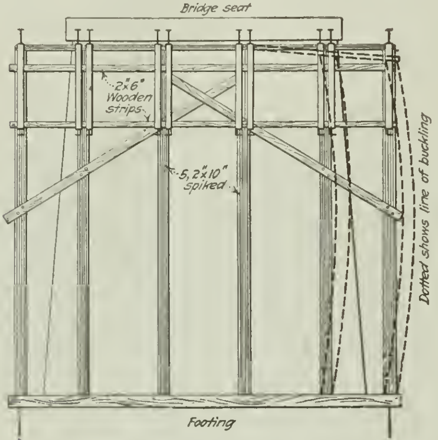
The section of the act stating various duties follows:

Said division shall investigate transportation service and facilities within the metropolitan district, which shall consist of all the cities and towns in either of the metropolitan sewer districts, the metropolitan water district or the metropolitan parks district, and the co-ordination thereof upon highways, roads, bridges, waterways, railroads, street railways and other arteries of traffic; what, if any, use of existing facilities of carriers by one or more of such methods can and should be made by others; the manner of effecting such co-relationship and what improvements and new facilities should be provided for a comprehensive and co-ordinated development of transportation for said district; and the relation of such service to the general service rendered by all highways, roads, bridges, waterways, railroads, street railways and other arteries of traffic in the commonwealth so far as the division deems it necessary or desirable. It shall confer with the local planning agencies in the district with regard to such projects as are not of an exclusively local character. It shall recommend the method of executing and paying for the same, and shall make such maps, plans and estimates of cost as may be needed for its investigations and reports, and may employ such assistants therefor as it deems necessary. The various other departments, boards, and divisions of the commonwealth, the public trustees, respectively, of the Boston Elevated Railway Co. and of the Eastern Massachusetts Street Railway Co., the street commissioners, planning boards and other officials of cities and towns comprising said district, and the various public utilities operating therein may, and upon request of the division shall, consult with it and furnish all facts and information requested within their knowledge and control.

Tall Unbraced Timber Posts Cause Falsework Failure

Built-Up Columns, Made of Five Thicknesses of 2 x 10-In. Planks, Buckle When Concrete Pouring Is Under Way

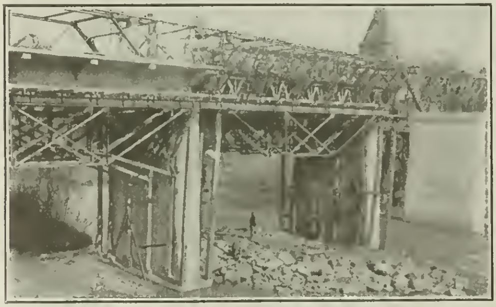
FAILURE of falsework due to the buckling of unbraced, built-up timber posts in a bent carrying one end of truss supports for the deck and girder forms of a concrete road bridge span was recently the cause of a serious accident in building an eight-span bridge across the Haw River in North Carolina. A 50-ft. span being concreted fell into the river carrying with it and injuring several workmen. Investigation disclosed that the contractor had used 30-ft. posts in the bents supporting the trusses, had built the posts of short



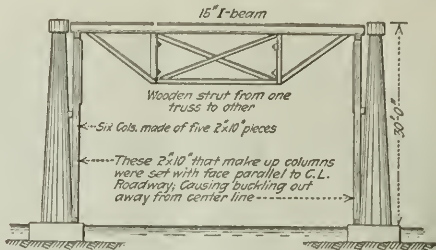
SIDE ELEVATION OF FALSEWORK

planks spiked together and had used no bracing between posts. The sketches indicate where it failed.

As stated, the bridge had eight spans. All were 50-ft. deck-girder spans with a 20-ft. roadway and two 5-ft. sidewalks. The spans were reinforced and so were the abutments, but the simple slab piers, indicated by the view, were plain concrete. I-beams trussed as shown carried the deck forms and were braced together across the span by 2x6-in. planks. The ends of the trusses rested on the caps of timber bents set close against the piers and on the pier footings. In the span



BUCKLED POSTS OF FALSEWORK BENT



ELEVATION OF BENT SHOWING BUCKLED COLUMNS

which failed the posts of the bents were approximately 30 ft. long and were made up of five thicknesses of 2x10-in. plank spiked together. The planks composing the posts were less than full length but they had been spiked with staggered joints. The posts were set with the 10-in. sides of the planks parallel with the length of the span. Originally there was, between cap and sill, no bracing between posts.

Buckling of the composite columns was first noticed after about 25 cu.yd. of concrete had been poured. The two outer columns of a bent buckled outward about 2 ft. causing a settlement of some 3 in. in the outside trusses. Work was stopped and the forms were brought back to line by adjusting the wedges. Also the posts were braced by spiking to them 2x10-in. plank diagonals. Pouring concrete was resumed but after about 75 cu.yd. were in place additional buckling was noticed and within a short time the entire falsework collapsed. It was evident that the buckling of the two outer posts caused a downward deflection of the cap which threw the outer trusses out of plumb thus bringing an eccentric load on them which caused failure. The remaining trusses were carried along in the collapse by the horizontal bracing connecting the trusses.

Standard Signs for Mississippi Valley State Roads

ADOPTION of standard caution and guide signs and other safety devices on highways in the Middle West States has been recommended by the Mississippi Valley Asociation of State Highway Officials. The Minnesota Highway Department states that it will follow the recommendations as closely as possible, particularly that portion with reference to shape. Old signs are not to be destroyed but when new ones are erected they shall conform.

Some of the recommendations are as follows: Route marks are to include road numbers and be of the distinguishing symbol characteristic of each state. All warning signs shall be uniform in all states and guide and information signs as uniform as possible. Warning and guide signs are to be black and white. Warning signs are not to be placed at too frequent intervals because the public then discredits their value. The location is to be 3 and 4 ft. above the center of the road, 1 ft. outside of the outer shoulder line and 300 to 500 ft. back from the danger point. Round signs 2 ft. in diameter indicate railroad crossings; octagonal, 2 ft. across, stop; diamond, 2 ft. square, slow, and square, 2 ft. caution. The stop sign should be located in the center of the road. Guide signs are to be rectangular and of suitable size to accommodate the information. Advertising signs on right-of-way or pavement are forbidden.

Predicting Next Year's Rainfall for Southern California

Scientists Attempt Basis for Long-Range Seasonal Forecasts by Study of Ocean Currents and Atmospheric Pressures

By Paul A. Ewing
Oakland, Calif.

Table copied and text rewritten from official publication of San Diego County Farm Bureau.

URGED by the constantly growing seriousness of the water scarcity, scientists in Southern California have finally evolved a system of long-range rainfall forecasting which promises eventually to establish a basis for anticipating, with a fair degree of certainty, seasonal precipitation for the California coastal region or for any other section whose climate is similarly affected by ocean currents and the distribution of atmospheric pressures. Particular attention has been directed to the possibility of seasonal forecasts by western meteorologists for many years past, the need for such anticipatory knowledge being of great importance there on account of the rapid expansion of irrigation and power developments having a close dependence on rainfall. The influence of sun-spots has been much discussed, and even the growth of rings of trees has been studied to obtain seasonal variations of weather. The close relation of weather to barometric pressures has been the basis of the studies conducted by Scripps Institution of Biological Research, at La Jolla, Calif., and it is upon the accumulating results of these observations that present hopes of California agriculturists and hydro-electricians are centering.

While the scientists of Scripps Institution who have had this work in hand are not yet willing to assert that dependence may be placed upon forecasts based on their records, on account of the comparatively short period covered, they have been much encouraged by successful forecasts of the monsoon rainfall of India, months in advance, which were based upon observations of atmospheric pressure distributions over vast areas of land and water. Prof. George F. McEwen, in charge of the forecasting studies at La Jolla, has now a six-years' record of ocean temperatures for a ten-weeks' period each year, and the seasonal rainfall observed at six inland recording stations following the date to which the summer temperature corresponds. The computed rainfall and that actually observed during the six years recorded are in no case far apart.

Recording Stations—Six stations were selected in two groups of three each, Bonita, San Diego and Escondido representing the coastal region of San Diego County, and Tustin, Corona and Los Angeles being assumed to be representative of the northern part of Southern California. The average rainfall of all six stations was considered as representing the general coastal region of Southern California. In tabulating the data secured so far and computing the values of the seasonal rainfall from temperature observations, it was assumed that the departure of the temperature at any season from the average during the period of observations is proportional to the departure of the subsequent seasonal rainfall from its average value. The temperature departure multiplied by the constant factor 2.4 gives the computed rainfall departure. This is shown in the accompanying table, prepared by Prof. McEwen.

As explained by Prof. McEwen, the general atmospheric circulation between equatorial and polar regions brings about the high barometric pressure in the belt centered near the parallel of 35° N, the lower air of the equatorial region forming the west-bound trade winds, and that north of the parallel forming the westerlies. The deflecting force of the earth's rotation, acting to the right, forces the two oppositely-flowing currents of wind together, compressing the air between, and so forming the high-pressure belt; and the smooth surface of the ocean permits a higher wind velocity than does the land, so that the barometric pressure is greatest at sea. To all this is added the thermal effect due to the difference in radiation and evaporation from the land and water surfaces, which makes the land in the high-pressure belt colder than the water in winter and warmer in summer. In the latter season thermal dynamic causes together develop and maintain the belt of high pressure, but with the approach of winter the air flows landward in response to changing temperature relations. By mid-winter the dynamic causes have the upper hand and a land "high" is developed by the transfer of a great mass of air from the ocean to the continent. The fact that the probable amount of this air movement could be estimated if detailed measurements of the pressure distribution over the North Pacific were available was what suggested the possibility of forecasting the consequent seasonal rainfall from pressure observations made during the summer.

Theory Stated—The practical impossibility of securing such observations in sufficient number would have prevented use of the idea; but the known relationship between pressures and surface ocean temperatures off the coast of California still permitted the study to proceed. Briefly, the theory is that the lower the surface ocean temperature, the greater the intensity of the ocean "high" and the heavier the consequent seasonal coastal rainfall. The results of daily surface temperature observations at Institution Pier, La Jolla, agree with this inferred correlation between temperature and rainfall, showing that a fall of one degree in temperature corresponds approximately with an increase of about 2 in. in the subsequent seasonal rainfall. Prof. McEwen refers to the results obtained so far as "the first crude approximation to the lengthy and detailed investigation that should be made." The studies are being continued and extended, with the idea that a long record may eventually permit accurate predictions of the rainfall many months in advance, to the very considerable benefit of agricultural and industrial interests of the southern part of California.

Year	Ocean Temp. at Institution Pier for Ten Weeks Aug. 1 to Oct. 15, Deg. F.*		Seasonal Rainfall† Following Date to which the Summer Temperature Corresponds.* Bonita San Diego Escondido		Tustin Corona Los Angeles		Mean of All Six Stations		Computed Departure From 6-Year Seasonal Mean
1916–17.....	66 4	—1.2	12.8	+0.2	13.0	—0.2	12.9	0.0	+2 9
1917–18.....	68 8	+1.2	10 0	—2 6	11.7	—1 5	10 9	—2 0	—2 9
1918–19.....	69 3	+1 7	9.6	—3.0	8.1	—5.1	8.9	—4 0	—4 1
1919–20.....	66.7	—0.9	11.7	—0.9	12.6	—0.6	12 2	—0.7	+2 2
1920–21.....	67.8	+0.2	9.2	—3 4	12.5	—0.7	10.8	—2.1	—0 5
1921–22.....	66.3	—1.2	22.3	+9 7	21.0	+7.8	21.7	+8.8	+2 9
Means...	67.6	....	12 6	...	13.2	..	12.9	..	..
1922–23.....	67.8	....	..	...	....	..	..	....	—0.5

* First of each pair of columns gives actual figure for the period indicated, while second column of the pair gives departure from 6-yr. mean.

† The seasonal rainfall is for the year beginning July 1 of the year at the extreme left.

Self-Contained Steam Railway Coaches

A new type of self-contained, steam-driven railway coach has been developed for use on British railways. The coach is known as the Sentinel steam railway coach and is capable of developing a speed up to 50 m.p.h. It is remarkable in that while the average weight of the present steam railway coaches is over 40 tons, or about 1,650 lb. per passenger carried, the new coach as designed for standard-gage railway weighs less than 500 lb. per passenger carried. Similarly, the fuel consumption of the heavy type of coaches is approximately 25 lb. of coal as against 4 lb. per mile for the new Sentinel car, and the water consumption is 15 gal. as against 2½ gal. per mile. The boiler of the Sentinel coach is designed to operate with either coal, coke, charcoal, wood, or waste vegetable products, and therefore is capable of being operated in almost any locality. The light weight of the car makes it possible to operate it over railways that on account of light track or bridges are incapable of carrying the heavy railway coaches.

Ice House Wrecked by Overturning Ice Due to Flood

By Charles W. Lusk
City Engineer, Arkansas City, Kan.

On June 10 flood waters of the Arkansas River descended upon Arkansas City, Kan., setting a new high-water mark 8 ft. above all previous levels. More than a third of the residential section of the town and part of the business section were covered with water 2 to 15 ft. deep. Thousands were driven from their homes, and the property loss has been estimated in the millions. In this flood a new ice storage house was wrecked in remarkable manner; it constitutes one of the largest single losses.

Last year the Arkansas City Ice and Cold Storage Co. completed construction of one of the most modern ice manufacturing plants in the middle west, which supplies

CONCRETE ICE HOUSE WRECKED
Flood waters melted lower layers of ice causing pile to overturn.

ice for refrigerator cars on the A. T. & S. F. Ry. from Kansas City to Fort Worth. This 10,000-ton season storage house was valued at $165,000. It was practically demolished by the melting and overturning of the pile of 40,000 300-lb. cakes of ice stored in it.

The building, which is 50 x 100 ft. in plan, rests on a foundation 4 x 4 ft. running entirely around the four walls. The floor is a 3-ft. cinder fill on the ground surface, with 10 x 14-in. timber stringers and 2 x 10-in. timber flooring. The walls are 9-in. reinforced-concrete slabs 50 ft. high, with 2-ft. square pilasters 16 ft. on centers, and 2-ft. square reinforced belt courses at the base, the middle height and the top. The walls inside the concrete slabs consisted of a 13-in. space filled with mill shavings, and twolayers of 1 x 8 -in. shiplap siding with tarred paper lining. The roof was constructed of steel girders 16 ft. on centers, 2 x 10-in. timber stringers, two courses of 1 x 12-in, sheathing with paper lining, and three layers of 2-in. cork insulation laid in asphalt, covered with three-ply asphalt roofing. From the roof were suspended four series of cooling coils containing 22,000 ft. of 2-in. wrought pipe.

At the time of the flood the storage house contained some 6,000 tons of season storage ice, piled regularly with about 4 ft. clearance around all walls. The flood waters, rising 7 to 8 ft. above the floor level of the building, filtered in through the door openings and partially melted the lower tiers of ice cakes. The entire mass of ice tipped against the east longitudinal wall and forced it outward, permitting the roof to sag to the ice pile. The foundations, parts of three walls and the floor are still intact, but the roof, the cooling system and one wall are completely wrecked. Except for 200 tons salvaged, the 6,000 tons of ice, valued at $36,000, were lost.

The company has other storage of 1,000 tons capacity that was not damaged by the flood, and by July will be turning out ice at the rate of 120 tons daily, so that all demands will easily be met. Rebuilding of the damaged storage house will be started late this year.

British Experiments With Rubber Paving

London Correspondence

Rubber in several forms is being tested for street pavement in London, England. In one instance the rubber was laid in a business thoroughfare, carrying a traffic of 240 tons per yard width per hour. The section paved varies from three to five yards in width between the curb and tramway margin on one side of the road only, and is fairly level. Two types were laid: (1) 9x3x½-in. rubber, vulcanized on expanded metal and anchored to concrete. The area laid was 161 super yards. This has had two years' wear. (2) 8x4x4-in. composite blocks laid on concrete foundation, similar to wood blocks; area laid, 20 sq.yd. This has had one or two months' wear.

This work was carried out in December, 1920, and January, 1923. The foundation consists of 6-in. to 9-in. reinforced concrete, and the price of the paving (including cost of foundation and estimated cost of rubber blocks) is about £5 per sq.yd. The rubber was supplied free to the council, who laid the paving with direct labor. The engineer states that in his opinion rubber has proved to be a most suitable material for road paving, showing a minimum of wear. Possibly the second type (the composite blocks) may prove to be the ideal form of using rubber for paving purposes.

In another instance experimental rubber paving blocks were laid at the exits of a dock. The paving blocks in this case were 9 in. long, 3 in. wide and 3¼ in. deep and consist of hard basic compound with approximately ⅜ in. of rubber capping directly vulcanized on the 3-in. width of face. A test piece of roadway of 50 sq.yd. (30x15 ft.) consisting of these blocks on a foundation of 6 in. of cement concrete was laid. The approximate tonnage of loaded vehicles such as motor trucks and wagons (excluding passenger and unloaded vehicles) passing over or brought to rest on the test piece has been on an average 18,000 to 20,000 tons per month. The average total tonnage, however, of loaded and unloaded vehicles traversing this test area would approximate to some 30,000 tons per month.

A close examination has disclosed no signs of wear in the rubber capping surface, and only in two places can any signs of movement be detected; in both these cases a course of the blocks crept forward to a trifling extent, which may probably be attributed to a slight movement in the granite curbs placed at each end of the test portion to enclose the area.

The surface shows no signs of slipping or skidding, which is surprising in view of the fact that the test portion is subjected to fast and slow moving traffic in addition to heavily-laden trucks and wagons pulling up on it and restarting, since, as mentioned before, it is laid outside one of the busiest box offices on the dock premises where the main cargo traffic has to stop while documents are being dealt with.

A New Transmission Line Tested by Frozen Fog

Warm Moist Air Rising Into Cold Mountain Regions Encases Transmission Line with Ice—Will Be Insulation Problem

By William D. Shannon
Superintendent of Construction, Stone & Webster, Inc., San Francisco, Calif.

The 110,000-volt transmission line to carry power from the White River hydro-electric station to the apple district of the Wenatchee Valley in the State of Washington has the unique distinction of passing through five counties, each county showing a special peculiarity of climate. The route that this line follows passes over two ranges of mountains and partially traverses three valleys, thus giving five physical conditions running the whole gamut of weather varieties and ranging from the mild climate of the Puget Sound region, with its high humidity, to the cold dry climate of the Wenatchee Valley.

In one instance there is a conflict between two climatic conditions, which during the first winter of operation produced an interesting phenomenon. This condition


ONE OF THE TOWERS AFTER THAWING HAD STARTED

was found at the boundary line of two counties, which happens to be at the summit of the Cascade Mountains. The elevation at this point is 3,900 ft. above sea level and the mountains are therefore covered with snow during the winter season. At certain times during the winter, the moisture-laden winds from the Puget Sound area blow eastward up the Green River Canyon, keeping at a comparatively low elevation until within two miles of the summit. The rise over the summit is therefore rapid to the point where the winds meet the dry cold air currents from the Kittitas Valley. In its rapid ascent up the slopes of the mountain range, the moisture laden air partially condenses until it becomes a heavy fog. On the last 500 ft. of ascent the fog rapidly congeals and at the summit is of such form that it adheres instantly to anything it touches. At this stage of its transformation, the fog undergoes a small physical change, so that it may be aptly described as "frozen fog" or as one of the engineers described it "fog frango." The accumulation or growth of this "frozen fog" is very rapid and in a few hours' time a steel tower may become coated with one or two feet of the "frango." The accompanying photographs were taken after thawing had started. From all indications, the masses of "frango" on the towers, insulators and conductors must have been enormous, and it is reasonable


ICE FORMATION AT THE TOP OF A TOWER

to suppose that the whole mass of structural steel was as heavily coated as was the top. One photograph shows the top of the tower after all the "frango" on the lower portion had melted away. The top was practically an entire mass of ice.

A windrow of ice and snow on the ground under each wire was mute evidence of the punishment the copper conductor received during the "fog storm." The size of wire in this district was 4/0 H.D. stranded copper. While none of the "frozen fog" was weighed a conservative estimate would be not over 10 lb. per cu.ft.

A recent number of the *National Geographic Magazine* contained a photograph of a similar phenomenon on the summit of Mount Washington in New England.

This transmission line was not in operation at the time this storm occurred. It is being constructed for the Puget Sound Power & Light Co. by the construction and engineering division of Stone & Webster, Inc.

Strain-Gage Used to Check Bridge Reinforcement

In strengthening an old four-span bridge on the Great Northern Ry. by the addition of a center truss, recently, strain-gage measurements were made on the completed structure to verify the assumption made in designing the reinforcement that the three trusses would divide the load in proportion to their respective strengths. H. S. Loeffler, assistant engineer, describing the operation in the *Railway Age* of May 12, states that strain-gages were attached to similar members of the three trusses of a span and the maximum reading of each instrument during the passage of a train was noted. In every test it was found that stresses occurring simultaneously in similar members of the three trusses in any span were practically identical. The bridge crosses the Mississippi River at St. Cloud, Minn., and consists of pin-connected steel truss deck spans, 170 ft. long, built in 1893 on old masonry, and designed for a capacity equivalent to Cooper's E 33. The center truss applied to each span is also pin connected, and is of the same depth as the old trusses, but is placed lower by 6 ft. 3½ in. to bring its top chord under the floorbeams. It was designed to carry E 30 loading, so that the bridge now is good for E 63. Stiff swaybracing has been inserted. Three other bridges are to be reinforced in similar manner this year: A 160-ft. deck span at Sandstone, Minn., two 215-ft. deck spans at Coram, Mont., and a viaduct at Minot, N. D. A. H. Hogeland is chief engineer and J. A. Bohland is bridge engineer of the Great Northern.

Building a Concrete Flume in Rough Country

Railroad Built Along Line From Source of Materials and Then Taken Up as Flume Is Built in Reverse Direction

By H. K. Fox

Construction Superintendent, San Joaquin Light & Power Corporation, Fresno, Calif.

A CONDUIT and flume line, 2½ miles long, was recently completed by the San Joaquin Light & Power Corp. on the north fork of the San Joaquin River in California, by means of which the water supply serving a chain of six power houses will be materially increased. The inaccessibility of the upper end of the conduit line and the fact that a grade for a flume was cut along approximately the same location in 1910 made it advisable first to build a construction railroad along this old line, beginning at the lower end which was reached by road, and then to build the new conduit from the upper end down. With this plan a constantly advancing source of water supply was made available by admitting water from the upper end to completed sections of the conduit. The entire job was finished in eight months with one daily 9-hour shift.

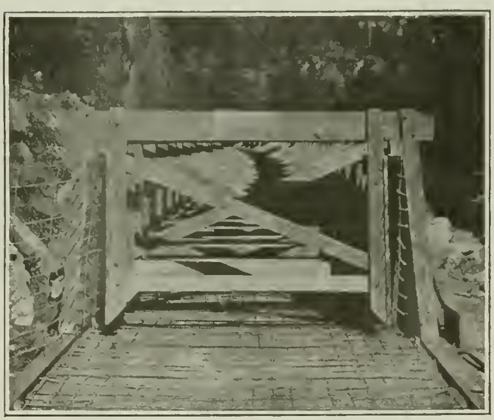


FIG. 1—FORMS AND REINFORCING IN PLACE

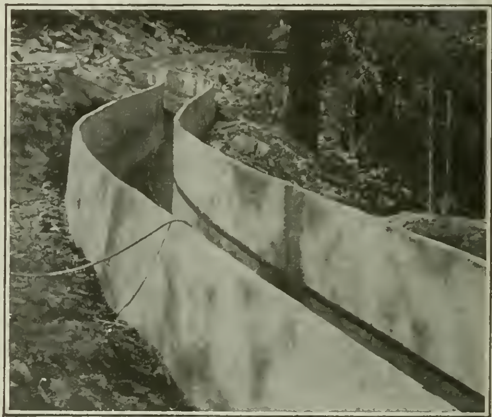


FIG. 2—COMPLETED CONCRETE FLUME

The original conduit built in 1910 to provide sluicing water for the Crane Valley Dam was a combination unlined ditch and wooden box flume with a capacity of 30 sec.-ft. The flume and trestles were largely destroyed by forest fire. The new conduit line consists of concrete lined ditch, concrete box flume, and riveted steel flume on redwood trestles, all with a uniform capacity of 100 sec.-ft. Very careful figuring was required to make the new construction fit the old grade and at the same time conform to uniform cross-sections as far as possible. It was not advisable to change the section more often than absolutely necessary, due to the additional cost and delays which such changes made in forms and reinforcing.

A construction headquarters was first established at the lower end of the line and a small warehouse and material yard were built there. An 18-in. gage railroad with 12-lb. rails was then constructed. Most of the ties were salvaged from what was left of the old flume and the track was laid alongside the old ditch, on the upper side where possible. Where the line crossed ravines, trestles, to be used later by the steel flume, were built first and the railroad was carried across on them. The trestles were built as the railroad advanced so that except for a small amount of cement used in the trestle footing no material had to be carried in on the backs of workmen.

As soon as the track reached the intake, construction of the small concrete arch dam was immediately started just above the old rock crib diversion. This new diversion dam is about 30 ft. long, 2 ft. thick throughout and 10 ft. in height, with reinforcing in both faces. A very simple form of inlet gate made of redwood was used. Thus a source of water supply and inlet control at the flume head was provided before construction of the conduit itself was started.

The material handling plant was small and simple. A quarry was opened on the right-of-way and a 9x18-in. jaw crusher set up over a 40-cu.yd. storage bin. The crusher jaws were set to produce rock with a maximum size of ¾ in. and because of this close setting produced a greater portion of the sand than would otherwise have been obtained. The product was not screened, crusher run being used by adding some sand. A spur from the track allowed dump cars to run under the chutes of the bin. Three 1-cu.yd. cars were handled in a train by homemade locomotives consisting of a Ford engine mounted on a steel frame with a special transmission to chain sprockets on all four wheels.

These locomotives proved very successful. There were several short stretches in the track which had grades as high as 14 per cent and on these the locomotives would haul 120 sacks of cement. The usual requirements of the locomotives under these operating conditions were 7 gal. of gasoline and 1 quart of oil for nine hours service.

The mixer was a gasoline-driven, one-sack batch machine specially mounted on flanged wheels. Six successive setups were used at advantageous points on the line. At each of these points the mixer was placed on a spur where it could discharge into cars on the main track. For the ditch lining the concrete was discharged directly from the cars into the ditch and for filling the forms for the box flume into concrete buggies which traveled on a plank runway laid on top of the forms.

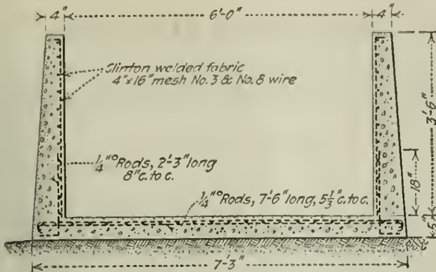


FIG. 3—TYPICAL FLUME SECTION WITH STANDARD REINFORCING

This section has the following hydraulic values: grade, 1 in 675½; velocity, 5.54 ft. per second; flow, 100 sec.-ft.; value of N in Kutter's formula, 0.014.

Thus the advantage of having the track above the conduit is apparent. The only available water supply was that retained in the flume itself by sack dams built across completed sections of the flume as near the work as possible. A gasoline-driven pump delivering into a 2-in. pipe line to the mixer and ditch-shaping crew was installed with its intake just behind the sack dam. One day was required to move the dam and pumping equipment forward as work progressed.

The old ditch section was enlarged to carry 100 sec.-ft. and before placing the concrete the earth was well soaked to avoid settling away from the lining. The maximum progress for the concreting crew of 10 men per 9-hour day was 360 lin.ft. A fairly dry concrete was used, the floor being poured first and the sides on the day following. No difficulty was experienced in placing the concrete on the slope, the method being simply to throw it on with shovels to the depth of the squeeds, and smooth it up with wood floats following with steel floats for the finish; no skilled labor was used. The best progress on the sides alone was 385 ft. per day.

The concrete box flume was designed without expansion joints, sufficient steel being provided so that nothing but hair cracks is expected as the result of temperature changes. To date practically no visible cracks have developed. The reinforcing was varied to give the flume box additional strength where the floor was not fully supported or where there was considerable external earth pressure.

Type 1 reinforcing, illustrated in the accompanying cross-section, was standard, and to this was added more steel as specified in types 2 and 3 (not illustrated) which were designed to meet the two special cases mentioned where additional strength was required.

FIG. 4—FORD LOCOMOTIVE WITH TRAINLOAD OF 120 SACKS OF CEMENT

The forms were the key to the rapid progress made in constructing the box section. They were designed with practical considerations paramount and no changes were found necessary as the work proceeded. The panels, made of 1-in. ship-lap, were all 3 ft. long and 3½ ft. high, no specials being used on curves. To make curves with forms of standard length, wall forms for the longer or outer side of the curves were supplemented by strips or "Dutchmen" of varying width placed between the ends of the panels.

The process of setting up forms and pouring concrete was programed as follows: (1) the 2x6-in. sills were carefully set to line and grade, (2) floor reinforcing placed, (3) outside panels with cross-ties on top set in place, (4) side reinforcing, (5) inside panels, and, finally, (6) cross bracing.

The wall forms were held in place at the top by the 2x8-in. cross-ties bolted to the panel studs. At the bottom the outside panels were prevented from spreading by No. 10 wires laid across the sills in pairs and twisted up, after the panels were placed, around the bottoms of the panel studs. These wires extended the full width of the flume box from outside to outside. The panels were fastened to one another, at the outset, by hook bolts. Nailing blocks were soon substituted as being much faster and better suited to the use of "Dutchmen" on the curves.

FIG. 5—PLACING CONCRETE IN LINED DITCH

The maximum progress for a crew of six men in setting up the forms complete was 200 ft. per day. The maximum progress in pouring was about 238 ft. per day. The floor was ordinarily kept poured about 20 ft. ahead of the sides.

Concrete was delivered from the mixer in side-dump cars, a maximum distance of 2,000 ft., but because of the danger of taking initial set en route it was not found advisable except in unusual cases to deliver distances greater than 1,000 ft. from the mixer.

The work was done by the San Joaquin Light & Power Corp. under the direction of R. C. Starr with the writer as superintendent of construction and A. M. Smith as resident engineer.

New Specifications and Facts Concerning Materials

Twenty-sixth Meeting of American Society for Testing Materials Shows Steady Extension of Committee Work—Society to Cultivate Research in Materials—Behavior of Concrete Under Discussion

CONTINUED broadening of the scope of its specification work was apparent at the meeting of the American Society for Testing Materials at Atlantic City last week. The organization entered its second twenty-five-year period of existence with the novel condition of having relatively little specification work to report in the field of the major materials—steel, cement and wood—but a great deal in miscellaneous materials and items, from broken slag and rubber matting to thermometers. There was rather more than the usual number of technical papers, in line with the deliberate effort of the past few years to develop this side of the society's work more fully. New results of the study of materials and various interesting new instruments were described. Several special subjects were discussed at considerable length, one of them being the group of phenomena and terms described by such words as consistency, plasticity, workability, and the like, and another being the condition of concrete structures, with special reference to the defects which they have developed in service. This latter discussion, despite the unfavorable condition of being placed in the closing session—the thirteenth—of an excessively long and fatiguing meeting occupying an entire week, was in certain respects its most important and most sensational feature.

With nearly 900 members in attendance, the meeting far surpassed previous ones in point of size, and represents an increase well beyond the increase in total membership.

To Develop Research—Carrying out a suggestion made in the presidential address of J. A. Capp several years ago, the society has now decided to enter upon a systematic effort to stimulate and cultivate research in its work and its meetings.

Special emphasis was laid on the importance of research in the address of the retiring president, Dr. George K. Burgess, director of the Bureau of Standards, which had the general subject "The Trend of Standardization." The main portion of the address was a strong exposition of the value of standard specifications and a denial of the charge that has sometimes been made that standardization will interfere with the freedom of development of the arts.

A matter also dealt with in the address, and one which is assuming renewed and serious importance in the society's work, is the difficulty of obtaining proper balance between producer and consumer in the formulation of specifications. The charge often heard in former years that the specifications of the society are essentially manufacturers' specifications is again coming to the front, and has received serious consideration in the councils of the society. President Burgess referred to "the importance of maintaining adequate attendance of representatives of consumers' interests at committee meetings to secure at all times a real balance of producer and consumer in the formulation of standards and specifications."

Talbot Made Honorary Member—Past president Arthur N. Talbot was elected to honorary membership in the society, in recognition of his long, brilliant career in the study of materials and the testing of structures, carried on mainly at the University of Illinois.

Guilliaem Aertsen, of the Midvale Steel & Ordnance Co., was elected president of the society to succeed Dr. Burgess. W. H. Fulweiler, of the United Gas Improvement Co., is the new vice-president, and the following four become members of the executive committee: J. H. Chubb, of the Universal Portland Cement Co., T. G. Delbridge, of the Atlantic Refining Co., H. L. Scott, of Henry L. Scott & Co., and P. H. Walker, of the U. S. Bureau of Standards.

In the general field of the society's committee work the meeting showed that important work is being done in two new fields entered within the last year or two, namely, the unification of nomenclature in the field covered by the society, and the harmonizing and standardizing of test methods. On the latter subject, the committee on methods of testing presented an outline specification for tension tests of metals. However, it also proposed to change the current definitions of stress and strain by defining stress as the intensity of internal force in a piece in pounds per square inch, and strain as the deformation per inch of length. There was much opposition to this radical proposal, but by rather routine vote it was approved by the meeting for tentative publication. The committee has laid out an extensive program of work, with the ultimate purpose of placing all test procedure on a standard basis, and its work so far is only a beginning.

Progress in Specifications—While most of the specification committees of the society work independently rather than in conjunction with other societies, the reports of the past year's work presented at the meeting indicate that there is steady improvement in the general tie-up the committees with other organizations. Contact secured in this way led to the revision of several specifications during the past year, including those for trolley wire, in which field there is a close tie-up with the work of the American Electric Railway Engineering Association. Direct co-operative work was not noticeably extended during the past year.

The broad range of the specification work and its highly detailed and specialized character in most instances make it impracticable to review this work here. The new specifications presented at the meeting, all of which were approved by the meeting for publication as tentative, are listed below.

Steel
- Boiler and fire-box steel for stationary service
- Steel plates of flange quality for forge welding

Copper Wire
- Hard drawn copper trolley wire
- Soft rectangular copper wire
- Hot-rolled copper rods for wire drawing

Corrosion of Iron and Steel
- Method of determining weight of coating on zinc-coated articles
- Method of determining weight of coating on tin, terne and lead coated sheets

Wire Cloth
- Non-ferrous screen wire cloth

Metallography
- Definitions of terms relating to metallography
- Recommended practice for photography as applied to metallography
- Methods of metallographic testing of non-ferrous metals and alloys

Timber
- Test for coke residue of creosote oil

Methods of Testing
- Methods of tension testing of metallic materials
- Definitions of terms relating to methods of testing
- Methods for verification of testing machines

Road and Paving Materials
- Method of test for the determination of proportion of bitumen insoluble in carbon tetrachloride
- Asphalt cement, 25 to 30 penetration, for use in sheet asphalt and asphaltic concrete
- Asphalt cement, 30 to 40 penetration, for use in sheet asphalt and asphaltic concrete
- Natural or artificial sand-clay mixtures for road surfacing
- Broken slag for bituminous macadam wearing course
- Broken slag for bituminous concrete (coarse-graded aggregate type)
- Broken slag for bituminous concrete (fine-graded aggregate type)
- Sand for sheet asphalt and bituminous concrete pavements

Lime
- Method for measurement of consistency of lime pastes

Gypsum
- Gypsum partition tile or block

Coal and Coke
- Method of test for volume of cell space of lump coke
- Gas and coking coal

Paint and Varnish
- Definitions for toughness and elasticity
- Tests for specific gravity or pigments
- Methods for testing shellac
- Methods of testing oleoresinous varnishes

Waterproofing Materials
- Asphalt mastic for use in waterproofing
- Bituminous grout for use in waterproofing above ground level
- Bituminous grout for use in waterproofing below ground level
- Felted fabric saturated with bituminous substances for use in waterproofing
- Woven cotton fabric saturated with bituminous substances for use in waterproofing
- Burlap saturated with bituminous substances for use in waterproofing

Petroleum Products
- Method of test for water in petroleum products and other bituminous materials
- Method of test for color of lubricating oil by means of Union colorimeter
- Method of test for color of refined petroleum oil by means of Saybolt chromometer
- Method of test for steam emulsion of lubricating oils
- Method of testing gas oils

Electrical Insulating Material
- Method of test of electrical insulating materials for voltage effects at radio frequencies
- Method of testing cable splicing and pothead compounds

Rubber Products
- Wrapped cold water hose
- Rubber matting for use around electrical apparatus or circuits not exceeding 3,000 volts to ground

Textile Materials
- Imperfections and tolerances for cord tire fabrics
- Tolerances and test methods for cotton yarns and cords
- Tolerances for hose ducks and belt ducks

Thermometers
- Thermometers (four classes)

Following long established custom in the society, the committees reported these specifications as well as numerous detailed revisions of existing specifications without indicating reasons or essential elements. In consequence the proceedings in the meeting, so far as they related to the committee work, were formal and devoid of any special interest. Quite recently, however, the executive committee decided to change this practice by calling for statement of reasons in connection with the revision and formulation of standards in future.

Phosphorus and Sulphur Investigation—A second report of the joint committee on investigation of phosphorous and sulphur in steel was presented, in preliminary form. While the definite data are not yet ready for publication it was stated that in plate steel, with sulphur ranging up to 0.15 per cent, the results are substantially the same as previously reported for rivet steel, showing no influence of sulphur variation upon the several strength properties of the material, except that the Charpy impact values are erratic.

Corrosion Test Results—Further report was made on the elaborate exposure tests of bare iron and steel sheets conducted by the committee on corrosion of iron and steel. Atmospheric exposure tests at Pittsburgh, at Fort Sheridan (Ill.), and Annapolis confirm the previously indicated conclusion that steel containing copper is much more resistant to corrosion than steel free from copper. Three other sets of tests, with the samples immersed in water, have not yet led to definite conclusions, but up to the present show that copper-containing steel has no advantage over copper-free steel in water immersion. As the tests have developed up to the present, the acid mine water at Calumet, Pa., has six or seven times as rapid a corrosive effect as city water in Washington, and the latter has several times as strong an effect as brackish water at Annapolis.

New Instruments—Two remarkable extensometers were described, both having been developed during the past year at the Bureau of Standards. O. S. Peters and R. S. Johnston, under the title "New Developments in Electric Telemeters" described the carbon resistance extensometer which has already found useful application in the test of wide web plates made for the Delaware River Bridge Commission. L. B. Tuckerman, in a paper on "Optical Strain Gages and Extensometers," described a mirror extensometer with ingenious triple-reflection optical lever and an autocollimetor reading telescope, which with the triple mirror eliminates disturbance and errors due to shift of the telescope, and has a very high sensitivity, reading easily to 0.00001 in. in displacement. Another ingenious instrument was described by E. B. Smith, of the U. S. Bureau of Public Roads, under the title "An Accelerometer for Measuring Impact." In this device a small hammer moving against a spring and automatically held in the position of its extreme throw measures the force of negative acceleration. It is available for truck-wheel impact and pile-driver work and the like.

A wear machine developed in the Goodrich laboratory to measure the abrasive resistance of rubber compounds was described by W. W. Evans. G. B. Haven presented "A Constant Load Rate Testing Machine for Textiles." In this instrument the load is applied by a weight resting on an inclined plane, and changing the inclination of the plane changes the load in uniform increments. A device by which the color of oils may be compared more effectively than heretofore was described by D. C. Cox, under the title "A Method for the Estimation of Color in Oils." The instrument com-

pares the amounts of blue light absorbed by two oils, these amounts taken to be a measure of the yellow or red color of the oil.

Chemical Limits for Cast Iron—In a topical discussion on the subject "Is It Desirable to Include Chemical Requirements in Specifications for Cast Iron?", Robert Job upheld the view that good results cannot be obtained, in many classes of cast-iron service, without careful specification of the limit of various elements, such as sulphur, combined carbon, and the like, while Richard Moldenke urged that the foundryman be left free to meet the required physical properties by any chemistry that he finds suitable. However, Mr. Moldenke admitted the need for fixing chemical limits in certain cases, and the general result of the discussion was to support strongly the modern tendency toward fixing chemical requirements for cast iron almost as definitely and fully as for steel. H. J. Force, in particular, made a strong presentation of the case for chemical specifications in car wheels and locomotive cylinders.

Magnetic Analysis—An elaborate study of magnetic analysis in application to twist drills was reported by the committee on magnetic analysis. Some fifty or sixty drills especially made for the purpose were tried as to their cutting properties and their magnetic properties, and in general no correlation was found. In connection with the same work, however, A. V. de Forest developed an instrument in which two independent magnetic measurements are taken on the sample, the claim being made that under proper manipulation the magnetic measurements indicate respectively the quenching temperature and the drawing temperature of the specimen, thereby in turn indicating the cutting power. Some success was attained in applying this instrument to the drills, suggesting the need for further study.

Paint Studies—H. A. Nelson and G. W. Rundle gave results of elongation measurements on paint films, and the effect of moisture on the elongation. No direct conclusions followed.

Two papers on the relation between white paint pigments and ultra-violet light demonstrated convincingly that certain pigments reflect more ultra-violet light than do other pigments, but opposite conclusions were drawn, one showing the advantage of zinc oxide, the other the advantage of white lead. Discussion of the two papers merely continued the general antagonism of the zinc and lead interests that has been displayed in previous paint sessions of the society.

Preservative Value of High-Test Creosote—A final report on a fungus-bed test of wood preservatives was presented by Cloyd M. Chapman, covering some 30 different preservatives and several kinds of wood. The results indicate that high-boiling creosotes are the best preservatives, but that no preservative and no method of treatment tried will furnish complete protection from active decay attack. An abstract is given on p. 27 of this issue.

New Facts on Fatigue of Metals—Elaborate further data on the fatigue of steel were presented by D. J. McAdam, Jr., of the Naval Engineering Experiment Station, while R. R. Moore of the Army Air Service reported on extensive fatigue tests of manganese bronze, duralumin and electron metal. These papers made important additions to the knowledge developed by the fatigue research carried out at the University of Illinois under the auspices of the National Research Council. An abstract of the results of one of the papers is given on p. 26 of this issue.

Of the other papers presented, the following may be noted: "Methods of Casting Test Specimens of Gun Metal," by E. H. Dix, Jr.; "The Influence of the Ratio of Length to Diameter in the Compression Testing of Babbitt Metal," by John R. Freeman, Jr., and Paul F. Brandt; "The Properties of Metallurgical Coke," by G. S. Perrott and A. C. Fieldner; "The Significance of Tool Temperatures as a Function of the Cutting Resistance of Metal," by H. A. Schwartz and W. W. Flagle; "Gases in Metals," by Louis Jordan; "The Testing of Glue," a discussion led by Jerome Alexander; "Some Relations Between the Characteristics of Straight Distilled Tar Residues," by J. W. Kennedy; "Use of an Air Bath in Determination of Solid Residue of Road Oils at 100 Penetration," by H. F. Clemmer and H. C. Helmle; an elaborate scientific dissertation under the title of "Color," by G. W. Thompson; "A New Combined Viscometer and Plastometer," by E. C. Bingham and H. A. Perry, Jr.; and several papers on insulating varnishes and on slate.

What is Consistency?—The best part of one session was devoted to the discussion of the principles underlying the measurement of consistency, plasticity and related properties, particularly as such discussion might lead to a definition of consistency. It was introduced by F. G. Breyer and Henry Green, of the New Jersey Zinc Co., who define consistency as "that property of a plastic material which it possesses by virtue of its yield value and mobility, and manifests itself as resistance to flow." W. E. Emley, of the lime committee said since lime which can maintain its consistency long enough to permit completion of the work is said to be plastic, it may be said that plasticity is a property inherent in the lime itself and has nothing to do with consistency. Duff A. Abrams, of the concrete committee, submitted the definition "The relative plasticity or workability of freshly mixed material" and explained the work that has been done of late to determine that quality in concrete. It is evident that this committee considers the term in its practical application as describing a readily observable, though not necessarily readily measurable condition, and not as a physical property. Prof. E. C. Bingham (Lafayette College) after defining in the terms of physics the qualities viscosity, plasticity, mobility, etc., said that the present looseness characterizing the word "consistency" would be avoided if its use were restricted to the definite meaning of the reciprocal of mobility, for which there now exists no term. Dean A. N. Johnson said that consistency should be used as indicating a condition and not a property, and that a definition should be made on the basis of determining the phenomenon which brings about the condition.

The discussion may have served to bring out more clearly a divergence in view between the physicist and the man interested in producing and using materials, but it did little to clarify the understanding of the word in either of the two groups.

Concrete Brick Postponed—Committee C-4, on Brick, put on record the six standard sizes for paving brick adopted by the conference organized by the Department of Commerce, and voted to submit to the letter ballot of the committee the suggested specifica-

tion for concrete brick which the committee rejected last year. This postpones for one year consideration by the society of the concrete brick specification which the advocates of that type of brick claim was justified by the recent tests by Columbia University (see *Engineering News-Record,* May 31, 1923, p. 959).

Cement and Concrete—Little developed in the field of cement and concrete. Committee C-1, on Cement, had no recommendations but reported that it was continuing the study of the compression test for cement and also studying the general nature of cements with a view to improving specifications. Committee C-9, on Concrete and Concrete Aggregates, submitted a revised tentative specification for aggregates, which includes a new section on grading of fine aggregate and coarse aggregate both, changed from circular to square openings in grading the coarse and admitted air-cooled blast furnace slag as a suitable aggregate. In this latter connection the report says:

In regard to the changes which have been made in the paragraphs dealing with coarse aggregates, the recognition of air-cooled blast-furnace slag is the most important. A large amount of test data has shown this material to be acceptable as concrete aggregate, and there is also a large amount of data from the field in testimony of the durability and permanency of slag concrete structures. The only special restriction which has been put upon this material is a limitation upon weight per cubic foot, the specified weights being high enough, it is believed, to exclude undesirable material. No restriction has been placed upon the sulphur content of slag, for the reason that inspections made by members of the committee of reinforced slag concrete structures in the course of demolition showed no corrosion of reinforcement that could be attributed to slag, nor is there any published evidence that such corrosion has been observed, so far as the committee is aware.

In a report for the Joint Committee on Concrete and Reinforced Concrete, Richard L. Humphrey, chairman, told of the status of that committee's final report. He said that the committee did not intend to cover all phases of the uses of cement but merely intended to bring the old report to date. He thought that there had been fair criticism of the committee's provisions on quality as not being entirely practicable and said that the committee was considering that part of the report with the greatest care. It is intended now to review all the criticisms of the report and to prepare a final report which should be ready next year. As a final word he said the committee considered itself in a judicial position, not to formulate opinion but to crystallize practice.

Several excellent papers on concrete were presented at one of the sessions. They include a study of calcium chloride as a curing agent and accelerator, by H. F. Clemmer and Fred Burggraf, of the Illinois Highway Division; the fatigue of mortar, by R. B. Crepps, of Purdue University; a new test for workability by J. C. Pearson and F. A. Hitchcock, of the Bureau of Standards; and a paper on blast furnace slag aggregate by Raymond Harsch, of the Bureau of Public Roads. Abstracts will appear in an early issue.

Behavior of Concrete—Great interest was aroused in a symposium on the service study of concrete. Although this was set for the last night of the meeting some 200 members were present. The subject of the symposium was "What Properties of and Methods of Making Concrete Require Further Investigation?—A Discussion of the Requirements of Concrete to Meet the Many Varieties of Service Conditions. What Can Be Learned From Behavior of Actual Structures?" The scheme of the discussion was first to consider the constituents of concrete and its methods of making, in the light of service requirements, with a view to developing future possibilities in cement, aggregates and proportioning. This was followed by a study of service conditions in roads, sea water, alkali water and under the normal attacks of weather.

The subdivisions, briefly considered, were as follows: P. H. Bates, (Bureau of Standards) discussed the behavior of concrete under three conditions of exposure —ordinary air moisture, non-sulphate water and sulphate water, and considered the cement requirements for each. His conclusions are that for each there are possibilities of improvement in the cement itself, though the needed improvements may differ in detail for different uses. He recommended a new slogan "Concrete for Study." Duff A. Abrams (Structural Materials Testing Laboratory) discussed aggregates. He said that the strength and resistance of concrete depended more on proportioning and methods than on aggregate, which if well graded, clean and structurally sound could be made to produce good concrete regardless of other qualities. He emphasized, therefore, further study of methods of manufacture. R. B. Young (Hydro-Electric Power Commission of Ontario), considering methods of proportioning and mixing, noted the complications of applying the newer methods in this field, emphasized the necessity for more careful measuring and for more study of the mechanism of mixing and of the influence of plant design. Arthur P. Davis (Washington, D. C.) reported the behavior of mass concrete under the varying service requirements of the Reclamation Service. P. J. Freeman (Pittsburgh) cited several cases of bad disintegration and concluded that density is the great desideratum, not strength. A. T. Goldbeck (Office of Public Roads) cited the numerous details of design and construction of concrete roads that have resulted in undesirable conditions, with a view to pointing out proper methods. S. C. Hollister (Philadelphia) summarized the knowledge on the behavior of concrete in sea water and G. M. Williams (University of Saskatchewan) of concrete when exposed to alkaline conditions.

This comprised the formal reports. Some twenty informal discussions followed. They, together with the main reports, will be abstracted in a later issue. As the chairman, Prof. A. N. Talbot, said at the close of the session, the symposium was worth while as a resumé of the present state of knowledge of concrete and as an indication of where to look for improvement. It is perhaps pertinent to remark that the high points of the discussion were the contention of Mr. Bates that present cement standards do not satisfactorily cover all kinds of service and that different cements for different purposes may prove advantageous; the opposition, based mostly on economic grounds, by the cement manufacturers to multiple standards; the statement of the manufacturers that they are now engaged in a thorough chemical and physical study of the nature of cement which conceivably may lead to an improvement in the product; and finally the repeated conclusions of discussors that improvement of concrete lies mostly in the bettering of workmanship, though there are many instances of poor concrete not altogether explained on this ground.

Abstracts of Test Methods and Results

Principal Points in a Series of Papers Read Before the Atlantic City Convention of the American Society for Testing Materials, June 25-29

Accelerometer for Measuring Impact

Abstract of a Paper by Earl B. Smith

THE force of impact in most cases cannot be measured directly as can be done by weighing a static force. It is a product of mass and acceleration, and the most convenient and direct method of determining this impact value is by means of an accelerometer which may be attached directly to the moving body or hammer and which will indicate the acceleration value.

FIG. 1—ACCELEROMETER WITH OPTICAL LEVER

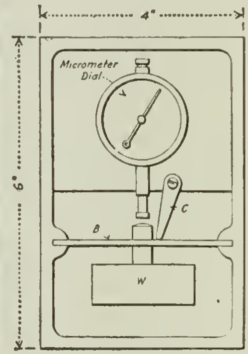


FIG. 2—ACCELEROMETER ARRANGEMENT

The essentials of a small accelerometer are shown diagrammatically in Fig. 2. Within a rigid frame is mounted a steel beam, *B*, supported only at the two ends. At the center of the beam is attached a mass, *W*. A toggle, *C*, is provided which will hold the beam at any maximum deflection position until the amount of deflection may be measured with the micrometer dial. In use, the accelerometer is rigidly attached to the moving body or hammer, with the plane of the beam *B* at right angles to the direction of motion or to the line of action of the force to be determined. When the velocity is constant there will be only the static deflection of the beam, but when the velocity is changed and the acceleration is negative the beam will be further deflected because of the inertia of the mass *W*; that is, under the influence of a deceleration (negative acceleration) the mass *W* will exert a force which will deflect the beam. By properly proportioning the beam and its attached mass, the range of the instrument may be made suitable for any desired condition. The deflection of the beam must be restricted to very small limits; it is kept within about 0.015 in. and the exact amount is read from a micrometer dial or by means of an optical lever system.

An improved design of instrument is shown in Fig. 1. In this case the beam *B* has fixed end supports and its maximum deflection is 0.003 in., which is measured by the movement of a beam of light giving a magnification of about 800. The stem *W*, which is also the weight attached to the beam, operates a small oscillating mirror at *M*. The light from a small electric lamp is focused by the lens *L* onto the small mirror and reflected to the scale *S*. At *R* is a stop or brake which holds the small mirror in its deflected position after the deflection of the beam until the reading may be made from the scale. A small push rod allows the brake to be released and the mirror returned to the zero position. The weight of the stem and parts *W* supported on the beam, including one-half the weight of the beam, is 0.0249 lb.; the static weight necessary to deflect the beam and move the light ray on the scale 1 in. is 0.650 lb.

A calibration curve for this instrument compared with the results from a space-time curve indicates a reliable degree of accuracy. The range of this accelerometer is from about 2 to 25 times the acceleration of gravity. Continuous records may be obtained by a photographic recording attachment.

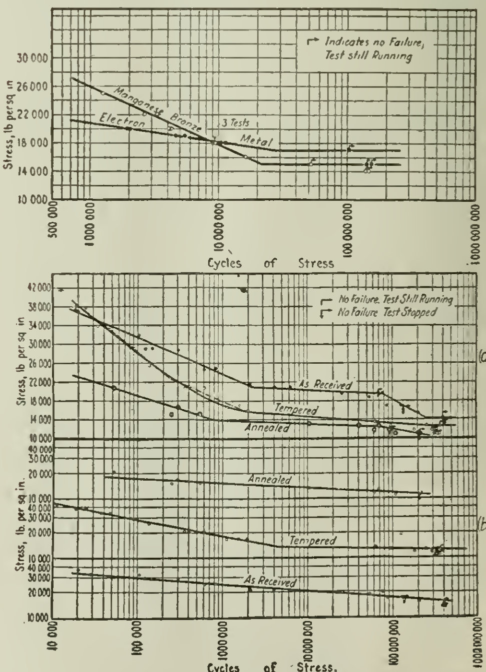
These accelerometers were originally designed for use at the Bureau of Public Roads on autotruck wheels and axles in connection with special investigations of the impact of trucks on roads.

* * *

Endurance of Duralumin, Electron and Manganese Bronze

Abstract of a Report by R. R. Moore on Investigations by the Engineering Division of the Air Service at McCook Field

ENDURANCE tests on three of the most important light alloys were carried out by means of a rotating-beam machine, which subjected the test bar to alternating stress. The general character of the results is shown by the curves reproduced herewith. In contradistinction to the results found for steel and other ferrous materials by H. F. Moore at the University of Illinois, in whose tests a definite



ALTERNATING-STRESS TEST RESULTS

Upper diagram, manganese bronze and electron, plotted on semi-logarithmic paper; middle diagram, duralumin plotted on semi-logarithmic paper; lower diagram, duralumin on logarithmic paper, which fails to reveal important features of the curves.

endurance limit was found, that is, a stress below which the material would stand an indefinitely large number of stress reversals, the McCook Field tests indicated that beyond an early endurance limit there is a further dropping off of the curve, at least in the case of duralumin tested "as received." It is concluded that the endurance limit of duralumin cannot be obtained by tests carried only to 10,000,000 cycles.

The endurance limit for these metals was not found to bear any constant relation to other physical test properties. The endurance limits from the tests are reported to be the following:

Manganese bronze	15,000 lb. per sq.in.
Electron metal	17,000 lb. per sq.in.
Duralumin, as received	14,000 lb. per sq.in.
Tempered at 920 deg. F.	12,000 lb. per sq.in.
Annealed at 700 deg. F.	10,860 lb. per sq.in.

Vibration was not found to affect the results materially. All the tests were run at a speed of 1,500 r.p.m., which is above the first critical speed for the size and shape of specimens tested, but yet resulted in considerable vibration in some of the specimens.

* * *

Effect of Wood Preservative Treatment Tested in Fungus Bed

Abstract of a Paper by Cloyd M. Chapman

TEST specimens of wood treated by different preservative methods were exposed in an outdoor fungus bed ten years ago. An initial report on this test rendered in 1915 is now supplemented by a final report. The fungus bed (outdoor) was prepared by mixing decayed wood and dry pulverized sheep manure with well sifted soil. Twelve-inch stakes, 1½ x ½ in., pointed at one end, were driven about 9 in. deep into this bed. Oak, cypress, spruce and yellow pine were used. The preservatives were applied in three ways: cold dip for 15 sec., hot dip for 1 min., and hot immersion for 1 hr. followed by cooling in the preservative. Thirty preservatives were used, including various tar products, mineral, vegetable and animal oils, and solutions of inorganic salts.

The results indicate, according to Mr. Chapman, that coal-tar and water-gas-tar derivatives are superior to the other classes of materials used. These creosotes show a higher average degree of protection than any other material tested. Among the creosotes themselves there are some considerable variations; in general, the higher-boiling fractions seem to be the more effective. None of the preservatives gave permanent protection against decay under the conditions of this test.

There seems to be but little difference between the cold-dip and the hot-dip treatment. Hot immersion, or boiling, is very much better (though at much higher cost), but even the approximate saturation which may at times be attained by the boiling treatment does not render the wood immune from decay in the course of time.

* * *

Properties of Slate

From a Paper by Oliver Bowles, Mineral Technologist, U. S. Bureau of Mines

A SERIES of roofing slate recently tested showed a modulus of rupture of 8,200 lb. per square inch, which is about five or six times the strength of average sandstone or limestone and three or four times that of average marble. Ribbons in the slate do not necessarily affect the strength, as was shown by fractures crossing the ribbons in a special set of tests of slabs of ribboned slate at the Bureau of Standards. The porosity of slate averages 0.38 per cent, which means that average slate is well adapted for sanitary uses. The cœfficient of expansion of the material is 0.000005 (Watertown arsenal tests).

Production and market requirements of slate do not permit of reducing the number of sizes of roofing slate. In Cincinnati, Ohio, and Galveston, Tex., the principal demand is for 10 x 12-in. slate; in Chicago, 10 x 16-in.; in Columbus, Ohio, 12 x 24-in. A variety of sizes permits the demands of various localities to be suited and also permits of utilizing the raw material to best advantages with a minimum of waste.

In laying slate roofs a 3-in. head lap should be the universal standard. The nails should be as permanent as the slate.

Abrasion resistance of slate has not been sufficiently studied, but experience shows that there are very great differences in the resistance of various slates to wear, when used as stair treads and the like.

Standardization is needed in many directions in connection with slate, and much experimental work should be conducted as a basis for correct and logical specifications. The need of specific requirements is outstanding in the matter of thickness, size, and color stability of roofing slate, quality of blackboard slate, strength and abrasion of structural slate, and insulating value of electrical slate.

* * *

A Successful Distant-Reading Extensometer

Abstract of a Paper by O. S. Peters and R. S. Johnston

A REMOTE-READING extensometer has been developed at the Bureau of Standards which utilizes the pressure-resistance or displacement-resistance characteristic of a stack of carbon plates. Heretofore attempts to utilize this

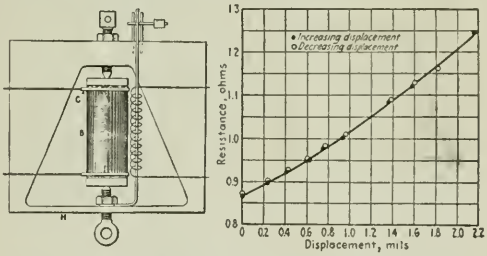


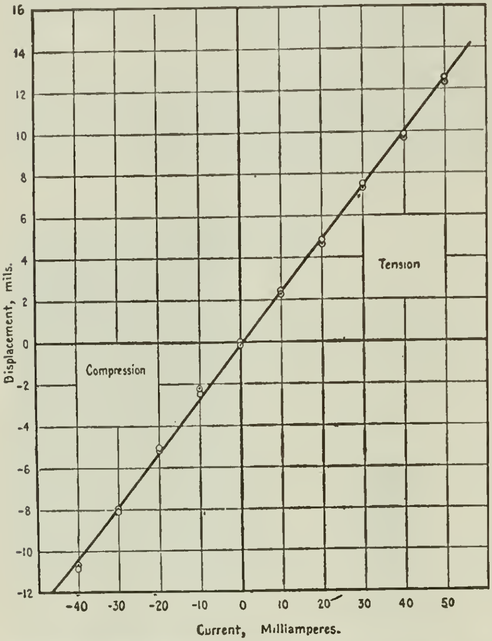
FIG. 1—SINGLE STACK OF CARBON PLATES AND ITS DISPLACEMENT-RESISTANCE CURVE

characteristic of carbon for engineering measurements have been unsuccessful because of erratic behavior of the resistance of the carbon stack, hysteresis effects, and the non-linear relation between displacement and resistance. The resistance of the stack has now been stabilized and changes of resistance with changes of pressure made reproducible, by mounting the stack in a frame in such a way that it is always under considerable pressure, and confining the range of change of pressure within narrow limits; the pressure on the stack is applied axially, and great care is exercised in assembling in order to make transverse forces on the carbon contacts as small as practicable. Hysteresis effects, which cause the resistance of the stack corresponding to a given pressure to differ for increasing and decreasing readings, have been made negligible by using a mounting frame without mechanical joints, as experiment showed that the cause of the hysteresis lay in these joints rather than in the stack itself. The non-linear characteristic has been made straight by mounting two stacks of plates in each instrument in such a way that the resistance of one is decreased and the other increased by the force or displacement under measurement; the cumulative change of resistance of the two stacks has been found to be proportional to the change of displacement or pressure, with the ultimate result that an instrument with substantially a linear calibration curve is obtained.

A single stack of carbon plates mounted in a steel frame as shown in Fig. 1 is placed under pressure from the spring-like part *H* of the frame, the pressure being adjusted by set screws at either end. The carbon plates *B* are ring-shaped pieces, about fifty in number, held between mica end plates and connected to a circuit by brass contact disks *C*. The mirror and magnetized rod at the right are an auxiliary

calibrating device. This stack gives the displacement-resistance curve shown in Fig. 1; the resistance changes about 46 per cent for a change in length of the stack of 0.00217 in., and is practically free from hysteresis effect, shown in coincidence of increasing and decreasing values.

A complete extensometer is shown in Fig. 2. The solid steel frame A has a cantilever arm B integral with the



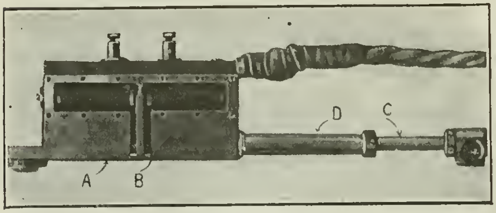


FIG. 2—STRAIN INDICATOR WITH DOUBLE STACK

frame and notched near its upper or fixed end. The rod C, threaded into the cantilever, moves in the guide tube D. The stacks of carbon rings, assembled on each side of the cantilever, are arranged as two sides of a Wheatstone bridge circuit; a three-conductor wire lead connects them to the indicating device. The span covered by the instrument shown is 8 in., though others have been made ranging in span from 2 to 24 in. with full-scale readings from 0.002 to 0.024 in.

For use the indicator is attached to a member by means of clamps, sharp steel points at either end of the instrument being forced into punch marks in the metal. The force required to operate the instrument depends largely upon the resistance of the cantilever to bending, but this need not exceed 10 lb. as a maximum, which is a small portion of the tensile stess usually involved.

A typical calibration curve for such an instrument is shown in Fig. 2, which exhibits the linear characteristic resulting from the use of the two stacks of plates. The hysteresis effects do not in any case exceed 4 per cent of the full range of the instrument and in most cases are less than 2 per cent.

Twelve instruments of this type have been in use at the Bureau of Standards in tests of 143 lattice girder members which were full-size duplicate parts of the duralumin frame construction of Fleet Airship No. 1, and on fourteen test specimens of large columns for the Delaware River Bridge Commission. Some tests on bridges have been made to verify the applicability of the instrument to field service. Records taken on a steel truss bridge while trains were passing showed vibrations ranging between 2 and 100 cycles per second. With vibrations of this character, repeated tests have shown very little effect on the calibration, and as the free period of the different parts of the apparatus which could introduce sympathetic vibrations was adjusted above 300 cycles per second, or three times the highest frequency recorded, it appears that the deflections must be proportional to the strains.

They have also been applied to the measurement of stresses in airplane stay cables during flight. A similar application has been made to airships. A carbon resistor device for recording the pull on the pressure arm of a machine for testing brake band material has been in service for some months with good results. Experimental applications have been made to the measurement of pressures ranging from a few millimeters of mercury to 40,000 lb. per sq. in.

* * *

Notes on Other Papers

IN *compression tests of babbitt metals*, John R. Freeman, Jr., and Paul F. Brandt, of the Bureau of Standards, tested the effect of varying length of specimen on resulting values of compressibility obtained. They found that the unit deformation is practically independent of length for ratios of length to diameter ranging from 1:1 to 3:1, and that the unit deformation for the central ½-in. length of a 3-in. specimen is the same as for the central 2½-in. length. The total deformation is a function of time of loading, but for loads below appreciable yield a loading time of 30 sec. to 3 min. is sufficient to give reasonably precise results.

Some *data on metallurgical coke* were given by G. S. Perrott and A. C. Fieldner, of the Bureau of Mines. The crushing strength of the coke is found to range from 400 to 2,000 lb. per square inch, which gives a large factor of safety, as the load on the coke in the hearth of a blast furnace averages only 35 to 40 lb. per square inch. The "shatter test" values for coke vary over a large range and depend upon the size of piece tested, so that "it would seem that considerable variations in the shatter test results have little influence on blast furnace performance." The true specific gravity of the metallurgical cokes ranges from 1.84 to 2.10, and the apparent specific gravity from 0.80 to 1.15. The porosity ranges from 40 to 60 per cent, averaging 45 per cent. It is concluded that aside from chemical analysis we are not at present in a position to write specifications for metallurgical coke. Practice shows that any coke having an ash content of less than 13 per cent, sulphur less than 1.25 per cent, true specific gravity over 1.80, porosity less than 55 per cent, and a shatter test over 40 per cent will be satisfactory for blast furnace use.

Quite variable relations between different *consistency tests* —the cube-in-water softening point, the ring-and-ball softening point, the float test, the needle penetration—were found in tests of a variety of tar residues, at the Michigan State Highway Laboratory, reported by J. W. Kennedy. The relation between the different test values depends largely on the amount of free carbon in the tar.

Discussing the question of whether chemical requirements should be included in *cast-iron specifications*, Robert Job and Richard Moldenke agreed that certain chemical specifications are necessary to assure proper results in the production of castings. The main point of the argument was that physical testing of cast iron is not capable of determining satisfactorily all the qualities expected of the finished article. Sulphur and phosphorus are the chief items that should be limited. Combined carbon may also have to be limited in such iron as car-wheel iron.

(Concluded next week)

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

A Notable Dam

Sir—Mr. Gutmann's description of the high multiple arch dam in Italy (*Engineering News-Record*, May 10, 1923, p. 820) is of great interest to hydraulic engineers.

This dam is remarkable not only for its great height but also for the economy combined with a large factor of safety which this type of dam possesses. Noteworthy is also the steep upstream slope (57 deg. as against the usual 45 to 50 deg.).

Mr. Gutmann refers to the dam as being 200 ft. high. As a matter of fact, the dam rises about 200 ft. above stream-bed, and the foundation of the five highest buttresses extends in an average approximately 28 ft. deeper, thus making the height of the structure 228 ft. Some portions of the buttresses had to be carried to still greater depth, as stated by Mr. Kambo, the designer of the dam. If, therefore, the height of dam is calculated according to the principles expounded in your recent editorial, "How High Is a Dam?" (Nov. 2, 1922, p. 728) the maximum height of the Tirso multiple-arch dam would be 242 ft. by figuring the overall height from the deepest point of the foundation (El. 39.0 m.) to the top of the solid parapet (El. 112.9 m.).

The use of hand-laid stone masonry for the buttresses may have been justified in a country which is noted for its highly skilled stone masons.

For our conditions, concrete would be much preferable both for economic and structural reasons. Mr. Gutmann states that in the construction of the Tirso dam about 20,000,000 lire (nearly $1,000,000 at the present rate of exchange) was saved as compared with the cost of a gravity dam. In order to fully appreciate this remarkable saving, it must be considered also that the factor of safety of a multiple-arch dam is much higher than that of a gravity dam, because by virtue of the sloping upstream face the direction of the water pressure is inclined towards the foundation, and overturning of such a multiple-arch dam is inconceivable. Furthermore, while engineers may argue with regard to the necessity of designing a gravity dam so as to resist under-pressure, there is hardly any need of considering uplift in the case of multiple-arch dams, if the arches are well keyed into deep rock-trenches. For obvious reasons, no under-pressure can exist under the buttresses.

The construction of the Tirso dam marks a great step forward in dam engineering and will pave the way for the construction of high multiple-arch dams also in this country.

San Francisco, Cal., May 24, 1923.

FRED A. NOETZLI, Consulting Engineer.

Unbalanced Bids

Sir—Under the caption "False Statement of Quantities Unbalances Bids," Clinton L. Bogert in *Engineering News-Record*, June 7, 1923, p. 998, discusses a question of great interest to all construction engineers and contractors. Obviously if the schedule of quantities submitted constitutes a correct statement of fact, there could be no possible advantage to a contractor in an unbalanced bid. Therefore, the schedule of quantities against which bidders are invited to set unit prices should cover only such items as are known with reasonable definiteness and accuracy. Minor items not susceptible of even preliminary determination may well be set down so as to afford an adequate conception of the magnitude and scope of the undertaking as a whole but should have set against them unit prices which the owner agrees to pay for the same. An owner is largely helpless in the hands of a dishonest or incompetent engineer or achitect, but if these trusted officials are honest and competent there should be little or no unbalancing of bids. It would be unwise for a contractor to accept any quantity estimate without satisfying himself that it is reasonable and, if his investigation leads him to suspect that the quantities are incorrect he surely could not be expected to set aside his own judgment for the sake of submitting a balanced bid.

Let every engineeer and architect, before he sends out a call for bids, endeavor to put himself in the place of the bidder with respect to each and every division of the work with the purpose of determining to his own satisfaction that the specifications and plans would enable him to prepare an accurate estimate of cost which he would be willing to back, not only with his reputation but with his money. When, as is frequently the case, his practical experience has not been such as to afford proper basis of judgment, let him call upon some one of the necessary practical experience to go over the proposition and advise him from a practical standpoint. If such were the practice there would be very few unbalanced bids submitted.

In conclusion it may be said that if every engineer and architect would undertake conscientiously to give his client even approximately that degree of responsible service that he expects to exact from the contractor, construction work would be much more economically done, owners would get greater value for their money and contractors would be enabled to make an honest living without being forced to pit their wits against those of agents in authority.

San Francisco, Calif., June 14, 1923.

E. T. THURSTON, Consulting Engineer.

Test of Acid in Dewatering Activated-Sludge at Plainfield Sewage-Works

Sir—In an article in *Engineering News-Record*, March 22, p. 522, C. Lee Peck refers to the "success" of sludge dewatering experiments at Plainfield making use of sulphur dioxide gas. The "success" was a great surprise to me but I passed the matter up at the time feeling that it was possibly within the limits of exaggeration permitted to "efficient sales engineers." However, it seems that the prestige of the *News-Record* together with the faith which has come to be attached to statements from the Plainfield plant has given the statement more weight than the facts will bear.

The only tests made at Plainfield were two runs of 50 and 110 minutes respectively. No pH or other control determinations were made. The sludge to be treated and the effluent from the machine were sampled every ten minutes during the runs for solids, and each wheelbarrow of dewatered cake was sampled and moisture was determined in the mixture of all samples with results as follows:

Length of Run, Minutes	Sludge Treated Gal. per Hr.	Percentage Solids in— Untreated Sludge	Cake from Dewaterer	Effluent from Dewaterer
110	2,000	4.0	12.0	3.4*
50	1,100	4.9	15.4	3.4*

* Solids in effluent from dewaterer constitute 80 and 70 per cent respectively of the original solids in the sludge and are in a colloidal state of division which would make their further treatment almost impossible.

These are positively all the data on the Plainfield tests and I consider them too limited to allow of deductions being made pro or con.

JOHN R. DOWNES, Superintendent Plainfield Sewage-Works.

Green Brook Park, Bound Brook, N. J., May 9.

[What Mr. Peck said about the Plainfield plant was embraced in a brief reference to experiments there and at Brooklyn and Indianapolis, as follows:

The Maclachlan process seems to have solved the problem of raw sludge disposal. Maclachlan's experiments at Indianapolis, Brooklyn and Plainfield, N. J., have demonstrated that such sludge can be rendered inoffensive and easily drainable. The sludge is acidulated by injecting hot sulphur dioxide gas. When a hydrogen-ion concentration of pH 3.8 is approached the sludge turns straw color, the colloids coagulate. In this condition it dewaters readily. —EDITOR.]

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The Alaska Railroad Has Organized a river boat service to operate boats from Nenana on navigable rivers and to connect with the small boats on the upper Tanana, Tolorana, Koyukuk, Iditarod, and Innoko Rivers.

At the Sherman Island Development, Glens Falls, N. Y., water was turned into the power canal on June 25. This is the preliminary step in puttng the first units of this 50,000 hp. power plant into operation.

Grade Separation on the Grand Trunk Ry. through the city of Detroit, Mich., will be started in the near future, and will be carried on until all the grade crossings from the river north to Ferry Ave. have been eliminated.

An Elevated Water-Supply Tank at Fox Lake, Wis., recently failed by the bottom falling out. According to W. G. Kirchoffer, consulting engineer, Madison, the tank had never been painted since its erection and corrosion of the bottom is believed to be responsible for the failure.

The Tax Exemption Period on new dwellings in New York City will be extended to Jan. 1, 1932 by an ordinance adopted by the Board of Aldermen on June 26, and signed several days later by Mayor Hylan. The extension is based on recent state legislation following two court decisions, the first of which denied and the second upheld the constitutionality of the original statute (See *Engineering News-Record*, March 29, p. 598, and May 24, p. 943.)

An Agreement Between the State of New York and the Federal Power Commission whereby the state can drop its suit against the federal water power act without the surrender of authority by either side, seems now assured. Such an agreement will be the result of a conference now in progress at Washington at which all the questions at issue are being discussed with a view to having the commission render certain opinions which will clarify the whole situation.

Another Trunk Railway From New York to the west is proposed by A. H. Smith, president of the New York Central, in suggesting that the Central Railroad of New Jersey be consolidated with the New York Central. Mr. Smith stated that traffic is increasing at such a rate that an additional through line will be necessary within the next four years; that the New York Central has a line from Ashtabula, Ohio, to Newberry Junction, Penn., which is not being used to full capacity, and that by connecting this line to the Jersey Central a new and direct line to the west could be developed.

City Managers Association To Meet With Municipal League

The City Managers Association and the National Municipal League will hold their meetings at the New Willard Hotel, Washington, D. C., Nov. 13 to 17, the conventions overlapping on Nov. 15. John G. Stutz, Lawrence, Kan., is secretary of the managers, and H. W. Dodds, 261 Broadway, New York City, of the league.

High Bridge Not to Be Destroyed

Owing to the report of an engineering committee that High Bridge, spanning the Harlem River near 160th St., New York, can be reconstructed so that navigation beyond it will be unimpeded, the Board of Estimate and Apportionment last Friday decided that the historic structure should not be torn down. The advisory board of engineers and architects headed by Edwin S. Jarrett, presented to the city a plan whereby three main river spans would be replaced by a single steel arch, thus eliminating from the Harlem channel the three piers now obstructive to navigation. This committee advised the city that it would cost about $1,000,000 more to tear down the structure and replace it by an invert or tunnel under the Harlem, reconnecting it with the Croton aqueduct system, than it would to remodel and reconstruct the existing bridge. The committee of engineers has estimated that it will cost only $716,000 to reconstruct, whereas a new structure, together with demolition of the old bridge, would entail an expenditure of about $1,700,000.

On the committee serving with Mr. Jarrett were Donn Barber, Ralph Modjeski, A. Lincoln Bush, J. Vipond Davies and William J. Wilgus.

East St. Louis Enjoins Sanitary Sewer Excavation

A temporary injunction restraining the East Side Levee and Sanitary District from continuing work of digging the drainage canal known as Project No. 12 within the city limits of East St. Louis, Ill., was issued June 23, by Judge Silas Cook of the East St. Louis City Court.

The city petition presented by Special Counsel Thomas Webb and Corporation Counsel R. V. Gustin contends that no permit to dig in the city limits has ever been obtained and that no condemnation proceedings were ever instituted to fix the value of the property which will be damaged by the construction. It further alleged that the crossing of State street would necessitate an excavation 100 ft. wide and greatly impede traffic between East St. Louis and Belleville, Ill.

The injunction is made returnable in September, and the city at that time will attempt to have it made permanent. A. V. Wills and Sons, and H. J. Sternberg, the contractors, have stopped work.

No New Light Shed on Cause of Elevated Disaster

Many Investigations Now Being Carried on By Prominent Engineers—Transit Commission Busy

There has been little progress this week towards the determination of the cause of the fatal accident of June 25 at Atlantic and Flatbush Aves., Brooklyn, in which a two-car elevated train derailed and fell 30 ft. to the street. The primary cause is generally conceded to have been the presence of some object on top of the frog of the crossover switch, and as a bolt was found to be missing from the brake rigging of the leading truck of the forward car, and as the motorman stated that the brake on that car failed to work, an effort is being made to prove that this missing bolt dropped on the frog and caused the derailment. The cause of the fatalities, the falling of the cars into the street, is also still unknown. The supposed "rotten" condition of the wooden guard rails has frequently been stated as the reason for this part of the accident, but in view of the fact that the derailed truck was kept on the deck by these very guard rails it is difficult to see how they are responsible. Moreover the guard rails were not in such a serious condition as some people would like to believe. The report of the Transit Commission inspectors made a few months ago states that out of 230 timbers on this section of the elevated only 3 needed renewal.

B-M. T. Investigation

The B-M T. Co. is conducting an investigation into the cause of the accident and have retained Dwight P. Robinson, J. Vipond Davies, and George H. Pegram to make an examination of the structure at the point of the derailment. The company has also engaged the firm of Parsons, Klapp, Brinckerhoff and Douglas, consulting engineers, to make an examination of the timber deck of the entire elevated structure.

The Transit Commission is also conducting an investigation and are turning over all their reports to the district attorney who in turn has engaged John C. Brackenridge to make a report.

Since the fatal accident on June 25 on the Brooklyn elevated railroad a rumor has been circulating to the effect that the Broadway line between Alabama Ave. and Cypress Hills vibrated so much under the steel trains as to be unsafe. Robert Ridgway, chief engineer of the Transit Commission, in commenting on this states that before the operation of steel cars was permitted on this line extensometers were used to determine the stresses in the structure under the increased loading and that the results of the tests so made indicated that steel cars could be operated on this line with safety. He also stated that since operation started further tests had been made which confirmed the results of the original tests.

Southwest Water-Works Association Meets

200 Attend Gathering at Wichita Falls, Texas—12 Technical Papers Are Presented

Engineering News-Record Staff Report

Two hundred water-works officials and others interested in the Southwest Water Works Association met June 18-21 at Wichita Falls, Tex., and discussed a dozen technical papers presented at the five sessions. The papers, which covered a wide range, were prepared almost entirely by operators and water-works engineers from the eight states comprising the association's field. Municipal versus private ownership and how to eliminate politics are still being discussed vigorously in the Southwest.

The accountants got real assistance from R. O. Grant who has just installed a combined billing and bookkeeping machine at Wichita Falls. His paper was followed by a demonstration. The chemists were served by a paper on "Algae Treatment at Fort Worth" by W. H. Mahlie, chemist, Fort Worth, as well as a discussion on tests for overdosing with alum and chlorine. V. M. Ehlers, state sanitary engineer of Texas, by cartoon effectively illustrated various means by which waters are polluted, particularly small well supplies, and proper methods of pump settings and well location and protection. For the superintendents perhaps the most appealing papers were by J. W. Hockaday, superintendent, Cleburne, Tex., on the "Dollar Value of Meter Maintenance" which gave the return for seven years, and another showing a new service distribution chart by S. L. Williams, superintendent, Wichita Falls.

Entertainment Features

The Southwest Association always makes much of its entertainment features and the hospitality of Wichita Falls permitted none but superlatives in describing these features. The high water mark was an all-day 100-mile automobile trip to the local water pumping plant and filters and then over the $4,500,000 Wichita County Irrigation Project comprising an 85-ft. hydraulic-fill storage reservoir (535,000 acre-ft. capacity) and an earthen diversion dam filled by teams, graders, gas and steam shovels and elevating graders with the compaction by irrigating the surface in 1-ft. layers. This project is financially carried by District 1 comprising the city of Wichita Falls which has little irrigated land. The city badly needed an augmented water supply. The barbecue provided by the Callahan Construction Co., contractors, at the storage dam camp furnished a fitting setting for a description of the project by R. A. Thompson, chief engineer, utilizing a truck for a rostrum. Two of the service gates in the dam, which is nearly completed and has been impounding some of the extraordinary floods of the southwest country, were opened for demonstration of the clockwise swirl in the outlet spillway. Although the main dam is being topped out by the hydraulic dredge the sheer-board method of building the lifts in the main structure, heavy 30-in. repropping of country rock and utilization of a gas shovel in throwing up the toes were visible but not the puddle core as the dam is above the spillway level. The whole work will be near completion in two months. The return trip afforded inspection in many places of the 1,000-sec. ft. 16½-mile canal and structures of which the special features are the consolidation of drops, crossings, wasteways and overflows in various combinations.

The newly elected officers are as follows: President, F. N. Lawton; vice-president, W. F. Anderson; governors, J. W. Hockaday, Texas; E. O. Fowler, Louisiana; R. M. Foster, Jr., Arkansas; H. A. Gallagher, Missouri; B. L. Ulrich, Kansas; G. F. Reinhart, Oklahoma, Joe W. Kelly, New Mexico. R. D. Morgan, Mexia, Tex., was reelected secretary-treasurer.

Exhibits were put on by twenty-seven members of the Waterworks Manufacturers Association including meters, meter boxes, hydrants, pump valves, chlorinators, chemicals, brass goods, air-lift pumps, filters, pipe cleaning, cast-iron and reinforced-concrete pipe, packing and calking material and pipe cutters. An evening session was given up to a description and moving picture of the making of centrifugal cast-iron pipe.

F. A. E. S. Protests Ousting Davis from Reclamation Service

The Federated American Engineering Societies, through its committee on public affairs, has filed a protest in the office of the Secretary of Interior against the ousting of Arthur P. Davis as director of the Reclamation Service (see *Engineering News-Record*, June 21 and 28, pp. 1099, 1110, 1138 and 1139). On the return of Secretary Work from his Alaskan trip with President Harding the committee will request Secretary Work to explain his action.

Exploding Brick Pavement Wrecks Auto in Illinois

Mr. and Mrs. Earl Rahel of Paris, Ill., narrowly escaped serious injuries June 22 when a section of brick paving on the Chicago road near Paris expanded and buckled under their automobile. The explosion of the road was heard for some distance, bringing farmers from their fields. The concrete foundation was torn out, the front wheels of the automobile were torn off, a tire was ripped from a rear wheel and the machine was thrown to one side of the road. Mr. and Mrs. Rahel were slightly injured by fragments of brick. The intense heat caused the accident.

To Remove Old Superior Viaduct

An order of the War Department has been served on the city of Cleveland to remove the river portion of the old Superior St. viaduct. This structure was superseded by the new High Level viaduct six or seven years ago, but continued in existence largely to serve one or two property owners who had obtained access rights to the deck of the viaduct many years ago. The structure deteriorated to the point of becoming unsafe, however, and was closed as unsafe last year by order of the mayor. The War Department's order is issued in the interests of navigation, and affects the draw span and its support and all parts of the structure that project over the river. The viaduct was built forty-five years ago.

A. G. C. Adopts Standard Form for Advertising Construction Work

The Associated General Contractors has, through its Executive Board, adopted the standard form of official advertisement for construction work which is herewith reproduced. The legality of the form has been verified, and an endeavor will be made by the Association to have the form, which it is believed, will reduce waste and expense, adopted throughout the country.

Proposed Standard Form of Official Advertisement for Construction Work

____
(Date Bids Are Wanted)

____
(Location of Work)

____
(Type of Work)

____
(Location of Authority for Advertising)

Sealed proposals for the construction of— ______ will be received by the ______ *(Public Authority)* of the ______ *(Political Subdivision)* at their office ______ *(Address) (Street) (City) (State)* until ______ M. ______ *(Hour) (Date) (Month) (Year)* and then publicly opened.

The principal (dimensions or) quantities involved are approximately as follows:

____

____

____

Payments to be made ______ *(When)* in ______ *(Cash, Bonds or Special Tax Bills)* retaining only ______% of the value of materials delivered and work performed. but not exceeding ______ Dollars ($______) until practical completion of the work.

Limiting funds available ______ Dollars ($______). The site or right of way for the construction work ______ *(Is or Will Be)* available ______ *(Immediately or State Date)*

Time of completion ______ *(Insert Date or Number of Working Days)*

Plans, specifications, also forms of proposal, contract and Surety Company Bond or Deposit of Public Securities, amounting to ______ *(Dollars or Per Cent of Bid)* may be secured by addressing the undersigned or the Designer ______ *(Address) (Street) (City) (State)* upon deposit of ______ *(Actual Cost of Printing and Postage)* Dollars ($______) which will be refunded upon return of plans within fifteen days after bidding date. Each bid must be accompanied by a statement of financial responsibility and previous contracting experience and references and ______ *(Certified Check or Bid Bond)* for ______ Dollars ($______) which will be returned to unsuccessful bidders within ten days after bidding date.

Right is reserved to reject any and all bids, or waive any informality in any bid.

____
(Signature)

____
(Title)

____
(Address)

Southern Appalachian Power Conference Meets

Nearly One Hundred Delegates Discuss Power Situation in the South—Recommendations to Congress

Special Correspondence

The second annual meeting of the Southern Appalachian Water Power Conference was held in Asheville, N. C., during June 25, 26 and 27. Nearly 100 delegates attended. The Federal Power Commission was represented by O. C. Merrill, the U. S. G. S. by N. C. Grover, chief hydrographer, and by W. E. King and W. E. Hall, division engineers. Col. H. B. Ferguson came from Washington as the personal representative of the Secretary of War.

Among the papers read, probably the most notable was that of O. C. Merrill on the subject: "Some Popular Fallacies Concerning Power Development." Mr. Merrill pointed out the fact that most of the controversies which are hindering the development of our resources and delaying the extension of utility service rest upon popular ignorance, which gives rise to fallacious opinions concerning the public utility business. Other papers of much interest were presented as follows: One by Maj. Harold G. Fiske, on "Methods Used in Surveying a Large River System;" one by Prof. Chas. E. Ferris, on "Possible Use of Large Crude Oil Engine Units for Stand-by Power Plants"; one by W. W. Ashe, upon the "Relation of Forest Cover to the Silting of Reservoirs."

During one evening the conference as entertained by a lantern slide address by F. G. Baum, in which he unfolded his scheme for a single national super-power system for the United States.

Feature of Convention

The outstanding feature of the convention was the adoption of the plan of reorganization presented by the executive committee. This plan contemplates the creation of three bureaus called the bureau of public relations, the bureau of industrial expansion, and the bureau of research. Believing that the scope of this organization is rather larger than its name implies, the conference voted to amend the name by dropping the word "water."

Among the resolutions adopted by the conference was one urging the Director of the Budget to recommend to Congress in its next budget that the original appropriation of $2,000,000 for the purchase of forest lands on the headwaters of streams, as provided by the "Weeks Law" be restored, and that Congress be urged to restore this original appropriation. The Director of the Budget was further urged to consider the necessity for increasing the appropriation for co-operation with the states in forest fire prevention under the "Weeks Law" to at least $1,000,000 a year.

Another resolution urges the importance of the extension of river navigation wherever possible by the building of navigation-power dams, particularly within the Appalachian South. Another resolution, addressed to the chambers of commerce and similar organizations of the section, calls attention to the fact that the early and full and effective development of water resources is being retarded by popular ignorance of the subject, resulting often in unwise legislation and urging that a campaign be carried on for the true enlightenment of the public.

The incoming officers of the Southern Appalachian Power Conference are as follows: President, J. H. Wills, Atlanta, Ga.; vice-president, Col. Edgar Jadwin; secretary, J. A. Switzer, Knoxville, Tenn.; treasurer, Thorndike Saville, Chapel Hill, N. C.; chairman of the Executive Committee, Dr. Jos. Hyde Pratt, Chapel Hill, N. C.

Destructive Bridge Floor Fire

Largest Part of Six-Span Bridge at Stevens Point, Wis., Destroyed by Burning of Timber Floor

On May 30 a six-span bridge crossing the Wisconsin River at Stevens Point, Wis., was practically destroyed by fire. It was an old structure, having been built in 1877, and originally carried an ordinary timber floor. But within recent years, according to M. W. Torkelson, engineer-secretary of the Wisconsin Highway Commission, a new floor was placed, consisting of wood blocks on planks on modern stringers, all creosoted.

"The fire was first reported by tourists," Mr. Torkelson writes, "and when the city fire department arrived it had gained sufficient headway in the stringers under the floor to make it almost impossible to direct a stream of water against it. It seems that the fire spread very rapidly along the stringers underneath the floor, and while the upper portion still was practically intact, a very hot blaze was in progress underneath, and no headway could be made in fighting it until boats had been secured by which the fire could be attacked from beneath. The writer visited the bridge on June 1. At that time the two west spans of the bridge were completely wrecked and had collapsed into the river. The floor was almost completely burned off the two central spans, which were badly distorted by the heat. The upper portion of the floor of the two east spans was practically intact, but an examination of the stringers underneath the floor revealed that they were about two-thirds or three-fourths destroyed. The statement of the firemen who had assisted in fighting the fire was that water seemed to have very little if any effect."

FIG. 1. WISCONSIN RIVER BRIDGE AT STEVENS POINT, WIS., AT HEIGHT OF FIRE, MAY 30

FIGS. 2 AND 3. EFFECT OF FIRE ON BRIDGE
At left, the two west spans which collapsed. At right, floorbeam damage in central spans.

To Straighten Chicago River

Plans for improving railway terminals and developing an industrial district by straightening the bend of the Chicago River between Polk and 17th Streets, have been advanced by the passage of a State bill which grants to the city the State's title to the present river bed, if the city provides a new channel. This bill was prepared because it had been held that in such a change the abandoned river bed would become the property of abutting landowners, so that the city would not be able to carry out the plans for the development of the new area by streets, terminal facilities and an industrial district as outlined in *Engineering News-Record*, May 19. 1921, page 845.

Railway Bridges Damaged in Two Unusual Fires

In One, Fire Starts in Cantilevered Roadway Under Bridge—In Other Oil Cars Burn in River

Two bridges of the Atchison, Topeka & Santa Fe Ry. were damaged by fire recently in unusual manner. The Mississippi River bridge at Fort Madison, Iowa, was damaged by burning of part of the highway deck cantilevered out from the railway portion, requiring difficult repairs which were carried out very rapidly. At Guthrie, Okla., a bridge over the Cimarron River was partly destroyed by gasoline and oil from wrecked tank cars which went into the river as the result of a derailment at the approach to the bridge. This same fire also wrecked a county highway bridge 600 or 700 ft. downstream. Details of the accidents as given by A. F. Robinson, bridge engineer of the system, follow.

The Fort Madison bridge, 2,960 ft. long, has about 1,000 ft. of pile structure with creosoted ballast deck, at the east end. On either side of the railway deck is a wagon driveway, which in the trestle portion descends on a 4 per cent grade to the east until low enough to pass under the railway trestle, from which point it joins the south roadway. On May 24 fire was discovered in the sag of the roadway where it crosses under the railway deck. A strong wind prevailed, and when the fire was put out some 400 lin.ft. were burned and both wagon driveways from the middle of the east steel span to the east bank of the river. It is believed that the fire originated in trash which accumulated in the sag of the roadway, ignited by a cigar or match; it is known that the fire did not originate on the railway deck. The easterly span, 234 ft. long, had the cantilevered driveways and the timber deck burned for about half the span length. Two vertical posts of the downstream truss were badly crippled by heat and many of the jack stringers carrying the wagon driveways were so badly warped that they had to be replaced. This entire span was placed on falsework after the fire. Seventy-foot piles were required, the water being 45 ft. deep. By means of the gates of the Keokuk Dam the water was lowered 18 in. to prevent sawing over the piles and tapping them below permanent water level. A framed timber trestle was built on the caps. Railway traffic across the bridge was restored within four days after the fire, and in another week the wagon driveways were completed. Permanent repairs to the steelwork involved, besides minor work, cutting out about 3 ft. of the two vertical posts which were damaged, and splicing in new material. When this was completed the span was swung by releasing the wedges on the falsework, but it was watched for some time to detect any abnormal deflection as a result of the heating of the steelwork. No trouble of the kind developed however.

The Cimarron River bridge fire occurred on June 6. This bridge has two 210-ft. through truss spans at the north end, followed by four 80-ft. deck girder spans. A southbound freight train approaching the bridge had a car leave the rails, and the portion of the train behind this car did considerable damage to the northerly span in crossing. It knocked the southerly span off the piers and into the water, and eighteen cars of oil went down. Oil and gasoline in the river took fire. Subsequent inspection showed the south span to be a total loss while the north span was so much damaged as to make it uneconomical to attempt to reuse such of the old material as could be repaired. Besides these two spans, the pier between them had its limestone shafts so completely damaged by the heat that it will have to be rebuilt above the water line. In reconstruction, pneumatic piers will be sunk in the middle of the two truss span openings, and 106-ft. girders spans will be placed. Temporarily traffic is being taken care of by a pile bridge upstream of the present bridge, the full length of the crossing. The new bridge is to be built during the present year.

High Brick Wall Collapses in Wind Storm

During a severe wind and thunder storm which swept over Brooklyn, N. Y., during the afternoon of June 26, the whole central section of the northeast wall of the B. M. T. repair yards on Bushwick Parkway was blown over. In falling it crushed an automobile standing near the wall, killing one of the occupants and seriously injuring the other two. The portion of the wall blown over was approximately 240 ft. long and 24 ft. high. It was of brick, 12 in. thick, with 4-in. pilasters at about 10-ft. intervals. There also were two larger pilasters which had evidently been supports for machinery or roof trusses in some structure no longer in existence. Otherwise the wall was unsupported. There were three or four window openings in the wall and one large door opening. An examination of the portion of the wall still standing indicates that the central portion in falling started to rotate about the top of the foundation wall, opening a crack along the inside of the wall at that point, but finally failed along the line of the window sills, falling outward across the sidewalk and well out into the street.

Order Against Chicago Sanitary District Entered

A formal order against the diversion from Lake Michigan of more than 4,167 sec.-ft. (250,000 min.-ft.) of water was entered on June 20 by Judge Carpenter of the federal district court against the Sanitary District of Chicago but the district was given six months to appeal the case to the Supreme Court. The suit was started in 1908. In 1914 the case was tried before Judge K. M. Landis, who did not announce his decision until 1920. Even then he merely handed down an oral decision, with a statement that to give the district a chance to appeal to the War Department for relief he would not put the decision into effect. On the retirement of Judge Landis from the bench without having issued an order the case went to Judge Carpenter, who has been over the testimony and arguments with the result indicated. The oral opinion by Judge Landis, a summary of the case, and a statement of the viewpoint of the Sanitary District officials, appeared in *Engineering News-Record*, July 15, 1920, p. 129; editorial comment was made on p. 99 of the same issue.

Proposed Power Projects Cover Wide Area

Ford Interests Busy on High Dam Plans —Developments Planned in Pennsylvania and the Carolinas

Every effort is being made to push the completion of the plans and the granting of the license for Ford's new dam on the Mississippi at St. Paul. It is probable that the Federal Power Commission will so word the permit as to allow Mr. Ford to erect a steam plant immediately adjacent to the hydro plant. His original plan of having the steam plant in the same building and directly over the hydro plant was abandoned due to the possibility of foundation trouble. The Ford interests are attempting to have the Federal Power Commission reduce the interest rate on the value of the dam from 5 per cent to 4 per cent. The figure 5 per cent was made to conform with that applied to the dam at Troy, which is under a similar lease to Mr. Ford. At present the annual fixed charge is set at $95,000, an amount made up of 5 per cent interest on the value of the structures, which is $1,200,000, 1½ per cent maintenance, and 1½ per cent depreciation.

The Pennsylvania Power & Light Co., a subsidiary of the Electric Bond & Share Co., has made application for a license to develop 47,000 kw. on the Wallenpaupack River near Scranton, Pa. They also propose to construct a reservoir with a storage capacity of 9,000,000,000 ft. As the Wallenpaupack is a tributary of the Delaware, the construction of this large storage reservoir will have a considerable effect upon the proposed development along that river. The latter developments are being held up on account of the fact that New York, Pennsylvania, and New Jersey, having jurisdiction over different sections of the Delaware River, have not been able to agree on their hydro-electric power plans.

Plans for the diversion of the Santee River through a 15-mile canal to the upper reaches of the Cooper River near Moncks Corner are being prepared by the Columbia Railway & Navigation Co. The initial installation will be between 30,000 and 50,000 hp. and will call for a dam which will raise the head to 55 ft. Future installations call for a dike and a higher dam which will raise the head to 70 ft. and permit an installation of 150,000 hp. The feasibility of the project has been enhanced by the progress of the construction of hydro-electric plants and storage reservoirs on the upper tributaries of the Santee, which have raised the low flow of the Santee River from 3,000 to 10,000 cu.ft. per second. The only adverse circumstance affecting the development is the requirement of the War Department that sufficient water pass the dam to maintain navigation on the Santee River.

Contract Let for $6,000,000 Railroad Line in Mexico

For the construction of an 85-mile single-track railroad between La Quemada and Tepic, Mexico the Southern Pacific Railroad has awarded to the Utah Construction Co. a contract amounting to about $6,000,000. This line will give the Southern Pacific an entrance into Mexico City in connection with the National Railways.

Golden Gate Bridge Discussed in San Francisco

At a well attended meeting in the city hall at San Francisco, called to consider the question of bridging the Golden Gate, M. M. O'Shaughnessy, city engineer, explained details of a combined cantilever and suspension bridge for which he had made the foundation explorations, and the superstructure design of which was prepared by J. B. Strauss. This bridge would have a center span of 4,010 ft. with two 1,345-ft. approach spans. The bottom chord would be about 200 ft. above water level and the top chord over the piers would be about 780 ft. above water level. The structure would be designed to carry 30-ton electric cars and the roadway would be 52 ft. wide between curbs. The two piers would be founded on bedrock in 50 ft. of water. The cost of the structure complete with the necessary highway approaches Mr. O'Shaughnessy estimated at $25,000,000.

Other bridges, proposed by Capt. John G. Little as alternative types and estimated to cost $11,000,000 and $14,000,000 respectively, would involve a combination trestle-and-tube structure or a high-level bridge with three 1,100-ft. spans. Either of these structures would be some distance inside the Gate proper, where the water is not nearly so deep, and each would have a length of about four miles. The high bridge would clear the water by 200 ft. and in the other type, the tube, would afford a 1,500 or 2,000-ft., unobstructed channel of a 50-ft. depth.

Details of the enabling act (Assembly bill 1288) passed by the recent legislature authorizing counties to join in assessing a tax levy and issuing bonds for the bridge were explained. Before adjournment, the meeting passed resolutions directed toward petitioning for a hearing before the War Department to determine whether permission for the proposed crossing could be secured.

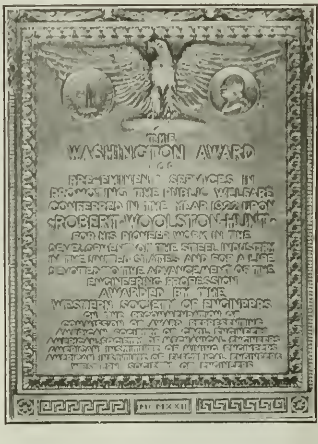
Bids for Laying Los Angeles Sewer Outlet in Ocean Wanted

Bids for laying 5,184 ft. of 84-in. pipe extending into the Pacific Ocean to a water depth of about 50 ft. and for two 60-in. branches each 283 ft. long ending in some 56 ft. of water, laid at angles of 45 deg. from the 84-in. pipe, are to be received by the Board of Public Works of Los Angeles, Calif., up to 10 a.m. July 30. The pipe will be supplied by the city of Los Angeles at the Hyperion railway siding, free of charge to the pipe-laying contractor. This work constitutes the ocean outlet of the new North Outfall sewer shown on a map printed in *Engineering News-Record*, June 7, p. 1,000.

Alternative bids are invited for Class D standard bell-and-spigot cast-iron pipe and for submarine reinforced-concrete pipe having a special bell-and-spigot joint. The pipe will be laid just below the ocean bottom which has a slope of about 1 per cent from the high-tide line outward. Borings indicate that the bottom consists almost wholly of sand. Piling is required for a distance of 700 ft. through the surf and concrete aprons must be laid around each of the two special outlet fittings, which latter will discharge upwards at a level about 4 ft. above the ocean bottom. John A. Griffin is city engineer and W. T. Knowlton is engineer of sewers.

Washington Award Conferred on Capt. Robert W. Hunt

The Washington Award for 1922, for "pre-eminent services in promoting the public welfare" has been awarded by the Western Society of Engineers to Capt. Robert W. Hunt, Chicago, and the presentation of the heavy bronze tablet mounted on a marble slab was made at the annual dinner of the Society, June 18. The award was



founded in 1916 by John W. Alvord and the recipient is selected annually by a commission representing the Western Society and the four national societies of civil, mechanical, mining and electrical engineers. This distinction is conferred upon Captain Hunt, "for his pioneer work in the development of the steel industry in the United States and for a life devoted to the advancement of the engineering profession."

C. E. Ashburner City Manager of Stockton at $20,000

Charles E. Ashburner, city manager of Norfolk, Va., will become city manager of Stockton, Calif., Sept. 1 at a salary of $20,000 a year, a $4,000 advance over his present salary. Mr. Ashburner is the pioneer city manager of the country, having served as general manager of Staunton, Va., from April, 1908, to July, 1911; and city manager of Springfield, Ohio, from 1914 until he went to Norfolk in the same capacity in 1918. From 1911 to 1914 he was with the American Railways at Lynchburg, Va. Stockton adopted the commissioner-manager plan recently, to go into effect July 1. The population of the city in 1920 was 40,296 against 23,253 in 1910 and 17,506 in 1900. The Staunton general manager plan, which antedated by several years the city manager plan, was described in *Engineering News*, July 8, 1909, p. 32.

Plan Another Rail Line in Mexico

The National Railways of Mexico is contemplating the construction of a 30-mile line southeast from Mexicali, which is on the California-Mexican line in the Imperial Valley, to San Felipe on the Gulf of California, according to an announcement made in San Francisco by J. M. Carpio, assistant director general of the National Railways.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York, Annual Convention, Chicago, July 11-13.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

The Rochester, N. Y., Engineering Society elected the following officers at its annual meeting June 8: Waldo G. Wilds, president; Stephen B. Storey and Gloster P. Hevenor, vice-presidents; Walter S. Burch, secretary; and Leonard A. Waasdrop, treasurer.

The Engineers' Society of Pennsylvania at its meeting June 11 installed its officers for the coming year, as follows: Robert W. Moorhead, president; R. L. Gillespie and Charles Haydock, vice-presidents; Howard E. Moses, secretary; and Paul E. Fickenscher, treasurer.

The Engineers' Club of Baltimore is co-operating with a committee on efficiency and economy which has been appointed by Mayor Howard W. Jackson to suggest plans for the reorganization of city departments. Ezra B Whitman, a member of the Public Service Commission of Maryland, and an engineer, is chairman of the committee named by the Mayor. He has asked Engineers' Club members for suggestions. The club has sent out postals to all its members asking that they make practical suggestions for improvement in the various city departments.

The Dayton, Ohio, Engineers' Club recently elected president Charles H. Paul, chief engineer of the Miami Conservancy District. The vice-presidents are: John H. Hunt, O. B. Reemelin, and C. D. Putnam; J. C. Matthieu is secretary, and Fred L. Kohnle is treasurer.

Personal Notes

L. A. Boulay, of L. A. Boulay Co., civil and sanitary engineers, Toledo, Ohio, assumed office July 1 as director of highways and public works for the state of Ohio, succeeding Leon C. Herrick. Mr. Boulay, who has lived in Ohio seventeen years, was first deputy engineer in the office of the Lucas County surveyor and later sanitary engineer for Lucas County, after which he organized his own company. His previous service had been varied. He served as civil engineer for the U. S. General Land Office in Utah and in Arizona. As chief engineer Mr. Boulay had charge of the construction of the Benguet R.R., a 40-mile electric line in the Philippines. He was an engineer for the Canton-Hankow R.R. in China, and constructed a 20-mile railroad in Mexico for the Pan

American Co. of New York. For a short time he was a engineer for the District of Columbia on grade crossing elimination and building of the new Washington depot. He was also engineer in charge of construction of the Holguin branch and of the San Luis Potosi railroads in Cuba.

T. C. DESMOND & Co., INC., general contractors, have moved their offices to 247 Park Avenue, New York City, the building being a new twenty-story office building just completed by this company.

SALISBURY & BRADSHAW, consulting engineers, Los Angeles, Calif., announce the association with their firm of ARTHUR TAYLOR, under the firm name of Salisbury, Bradshaw & Taylor. Mr. Taylor has been associated with Mr. Salisbury for many years on several irrigation and development projects, and the three members headed the engineering and construction staff on the Lake Arrowhead project in 1921 and 1922.

GEORGE W. CRAIG, formerly city engineer of Calgary, Alta., has been appointed district engineer for the Asphalt Association, with offices in Chicago, instead of the Portland Cement Association as stated in these columns June 14.

H. A. NOBLE, formerly assistant engineer on irrigation work with the Valier Montana Land & Water Co., Valier, Mont., has joined the force of H. M. Byllesby Engineering and Management Corp., Chicago, as draftsman for concrete and steel.

E. L. CHANDLER, who formerly was division engineer with the Miami Conservancy District on channel improvement work, is now engineer in dam construction in Iowa for Price Brothers Co., contractors, Dayton, Ohio.

M. N. YANCEY has been appointed engineer on construction for the Florida State Road Department. Mr. Yancey was formerly superintendent of bridge construction for the Talbert onstruction Co.

LT. WILLIAM S. KILMER, U.S.A., has been transferred from the Field Artillery to the Corps of Engineers, LT. HUBERT S. MILLER and LT. EDWARD H. COE have been transferred to the Corps of Engineers from the Infantry, LT. EUGENE L. VIDAL has been transferred from the Corps of Engineers to the Air Service and LT. FRED W. MARLOW and LT. THEODORE T. KNAPPEN have resigned from the army.

ANDREW J. PROVOST, JR., consulting engineer, 39 West 38th St., New York City, has been elected chairman of Committee C-4, American Society for Testing Materials, on clay and cement sewer pipe, to succeed Dr. Rudolph Hering, who, at the time of his recent death, had served as chairman for eighteen years.

J. J. ROSEDALE has resigned from the position of chief construction engineer, Department of Safety, California Industrial Accident Commission, and has opened an office in the Sharon Building, San Francisco, as representative of manufacturers of safety and sanitary devices and fire prevention equipment.

MAJOR DONALD H. CONNOLLY, of the Corps of Engineers, has been ordered to Memphis.

MAJOR MILO P. FOX has been ordered to Washington to serve as assistant to Brig. Gen. Harry Taylor. He succeeds Lieut. Col. George D. Pillsbury, who will take a course at the engineer school.

Dr. ELLSWORTH HUNTINGTON has been appointed delegate of Yale University to the Pan-Pacific Scientific Congress to be held in Australia during the summer. Dr. Huntington is the author of "Climatic Changes," "Civilization and Climate," and of a new book, "The Earth and the Sun," which is to appear this fall.

CHARLES G. YALE, who recently retired from active charge of the San Francisco office of the U. S. Geological Survey, was the guest of honor at a banquet given by the San Francisco Section of the American Institute of Mining and Metallurgical Engineers. Mr. Yale had been forty years in the survey office.

W. G. EAGER has been appointed consulting and supervising engineer at Valdosta, Ga., to take charge of the construction of new waterworks planned for that city.

CHARLES LYBROOK, Logansport, Ind., former county surveyor, has been named city engineer to succeed John Paul Davis whose resignation went into effect June 1.

PAUL HAMILTON has been appointed assistant chief engineer of the Cleveland, Cincinnati, Chicago & St. Louis, W. C. KEGLER has been made engineer, track and roadway, of the same road, E. H. MCGOVERN and J. E. KISSEL engineers, maintenance-of-way, and W. B. HODGE office engineer.

JAS. A. OGDEN, rancher and oil operator of Kern County, has been named city manager of Bakersfield, Calif.

W. E. WHALIN, building contractor, has been appointed to suceed Wilfred N. Ball, resigned, as superintendent of construction for the Oakland, Calif., Board of Education.

FRED B. COLE and H. F. KIMBALL, for many years with Charles T. Main, Boston, Mass., and H. E. Osgood, recently representative of the Sanford Riley Stoker Co., have formed a partnership, Cole, Osgood & Kimball, Boston, Mass., to do general engineering work and specialize in power plants, textile and industrial lines.

C. C. CARPENTER has resigned as professor of civil engineering at Ohio Northern University and will devote all his time to structural work, specializing in highway bridges.

HOWARD S. REED has resigned as city engineer at Phoenix, Ariz., and Henry Rieger, assistant city engineer, has been appointed to the position temporarily.

L. C. FRITCH, vice-president of the Chicago, Rock Island & Pacific Ry., has been appointed vice-president and general manager, succeeding T. H. Beacom, resigned.

J. O'NEILL has resigned from the staff of the St. Lawrence Paper Mills at Three Rivers, Quebec, to accept a position with the Thompson-Starrett Co., New Haven, Conn. Mr. O'Neill attended the University of New Brunswick. He has been city engineer of Fredericton, N. B., and assistant engineer with the Henepin Bridge Co., Minneapolis.

W. G. FOWLER has been appointed bridge designer and draftsman with the Missouri State Highway Commission; he previously held a similar position with Heyl & Patterson, Inc., Pittsburgh, Pa.

Obituary

DR. HERMAN M. BIGGS, commissioner of health of the state of New York since 1914, previously known the world over for his bacteriological and pathological work in the field of public health, died in New York City on June 28. He was born at Trumansburg, N. Y., in 1859; graduated from Cornell University and Bellevue Hospital Medical College with the degrees of A.B. and M.D., and continued his studies abroad. From 1892 to 1901 he was pathologist and director of the bacteriological laboratory and from 1901 to 1914 was general medical officer of health of the New York City Health Department.

DR. C. LINCOLN FURBUSH, director of the Department of Health of Philadelphia since 1919 died on June 26. He was born in New York City in 1863. From 1898 to 1902 he was in the medical service of the United States Army. He also served in various capacities during the World War as a colonel in the Medical Corps, U.S.A.

HUGH DOHENY, contractor, president of Hugh Doheny & Co., Ltd., and vice-president of the Canada & Gulf Terminal R.R., died recently at the age of 59. Mr. Doheny was one of the well-known railway builders in Canada. He had built many lines including sections of the Canadian Pacific R.R., the Soo line, the New Hampshire R.R., sections of the Quebec Central, the Sault Ste. Marie Canal, lines in Cape Breton, part of the Temiskaming and Northern Ontario R.R., and many others.

FRANK W. BROOKS, who retired two years ago from the presidency of the Detroit United Rys., died June 28 after a long illness. He was born in Texas in 1864 and his early railroad work was in the engineering department of the Texas & Pacific R.R.

BRIG. GEN. LEWIS T. BRYANT, New Jersey state commissioner of labor, and a graduate civil engineer, died June 27 in Trenton, N. J., aged 49 years. General Bryant was born in Atlantic County, N. J., graduated from the civil engineering department of Pennsylvania Military College at Chester, Pa., and was mustered into the United States Volunteer Army in 1898, being advanced within a few years to brigadier-general In 1904 he was appointed inspector of factories and workshops for the state of New Jersey, and the title was changed that year to commissioner of labor, General Bryant receiving appointments by succeeding governors that carried his term to the present time.

W. A. CAMPBELL, reclamation engineer, died at Jacumba, Calif., June 20. Mr. Campbell was a graduate of the University of Pennsylvania and in 1908 was employed in the construction of Laguna Dam; for several years he was identified with engineering work in the lower Colorado district and for the last five years has been on the Imperial irrigation district engineering staff.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Concrete Mixer Conference Discusses Standards

Manufacturers and Contractors Consider Limiting Building Mixers to Four Sizes and Pavers to Three Sizes

Engineering News-Record Staff Report

TO FURTHER the movement for standardizing construction machinery in the interests of economy and efficiency for both contractor and manufacturer a meeting of concrete mixer manufacturers, contractors and engineers was held in Chicago, June 27 to 29, under the auspices of the Associated General Contractors of America. It was agreed, pending final ratification, to limit building mixers to four sizes and paving mixers to three sizes. A uniform method of measuring and rating mixer drums was approved and standards were fixed for the capacities of water tanks on mixers of various sizes.

In explanation, it may be said that as a result of a conference of construction equipment manufacturers and the Associated General Contractors in January, a standardization steering committee of contractors and mechanical engineers was appointed to arrange discussion with the manufacturers of such equipment as appeared capable of some standardization and to formulate with them a program for carrying on the work. The next step was at a meeting of this committee and a number of concrete mixer manufacturers held in Cleveland, May 21, when an outline was drawn up of the various factors requiring consideration. This outline was then submitted to mixer manufacturers throughout the country with a request that they attend a general meeting for the purpose of making recommendations.

Measurement and Rating

At the Chicago meeting this outline was discussed and comments, prepared in advance by contractors and a committee of mixer manufacturers, were also submitted. Some of the principal points of discussion are noted below:

1. *Standards of Measurement*—As amended in discussion, the report provides that the standard of measurement of drum capacity shall be a cubic foot of water at 60 deg. F.; that tank capacity shall be measured by the U. S. gallon; that boilers, steam engines and gas engines shall be based on the rating of the American Society of Mechanical Engineers, and electric power apparatus on the ratings of the American Institute of Electrical Engineers.

2. *Method of Measuring Drum*—The steering committee stated that there is a question among manufacturers as to whether measurement should be made with the drum rotating or at rest and whether it is wise to include the carrying capacity of the pick-up buckets, which is available while mixer is in operation.

Both the manufacturers and the contractors agreed that the drum should be at rest and the contractors' statement included the further remarks that the drum should be absolutely level, that the loading device should not be the unit of measurement and that the capacity of the pick-up buckets should not be included, as it is too indefinite and is not easily measured in the field by the purchaser. The conclusion, as adopted after discussion, was that: "The water level capacity of the drum standing still shall be used as the capacity of the drum."

3. *Rating of Drum*—Four types of drums were listed by the steering committee: (A) horizontal drums with opening at both ends; (B) same as (A) but with discharge opening closed during mixing action; (C) tilting drum with vertical axis and single opening; (D) tilting drum with horizontal axis and double opening. The contractors' statement remarked that: "The capacity of mixer drums as given in catalogs is sometimes not dependable. Different makes of mixers with the same rating, handle quite different quantities of material. It would seem, therefore, that mixers of the same type should have the same diameter, same speed, same size of openings and same number of buckets with the same pitch."

> **Lubrication of Equipment**
>
> *On account of the space needed in this department this week for the report on the concrete mixer conference it is necessary to postpone until next week the second installment of the article, "The Lubrication of Construction Equipment," which began in the June 28 issue, p. 1144.*—Editor.

As to class A, or non-tilting mixers, it was concluded that for both building and paving mixers the water level capacity of single-opening drums should be approximately, but not more than 107 per cent of, the nominal capacity or rating; and approximately 50 per cent for double-opening drums. Consideration of tilting drums in classes C and D was referred back to the committee of the manufacturers association, as this type of mixer was not represented. Another conclusion adopted was: "The maximum operating grade to be considerer in the rating of paving mixers is 5 per cent."

4. *Table of Aggregate Proportions*—The steering committee proposes to gather information as to the volume of wet concrete produced from various proportions of batches with varying water content and varying voids in the aggregate. The manufacturers' association proposed that a new table be prepared, utilizing the data in the tables of Abrams, Taylor and Thompson, this table to indicate specifically the quantity of water to be considered in rating mixers, together with the voids in the aggregate used. After some discussion this subject was referred back to the steering committee, and was afterwards adopted substantially as above.

5. *Standard Sizes of Mixers*—Protracted discussion from varied points of view followed the presentation of the subject of standard sizes. The advantages to both manufacturer and contractor which will result from the reduction in sizes of mixers was pointed out, but there was evidently much doubt as to two particular points: (1) Whether some manufacturers might seek to retain certain individual advantages by making sizes other than standard; and (2) whether the number and sizes of standard mixers would satisfy the contractors. One maker stated that a certain size proposed to be excluded is one of his best sellers, but he would sacrifice it if assured that no other manufacturer would continue to produce that size. Another maker thought that the contractors are the best judges of what contractors want and will demand, and he would not accept any list of standard sizes unless it was approved by the contractors.

Seven Sizes Approved

It was suggested that for general and building work there should be four sizes: Nos. 4, 7, 14 and 28. But there was wide diversity of opinion as to whether four sizes are sufficient and what these sizes should be. The question of mix came up and it was pointed out that it is very desirable to avoid sizes which would require a half-sack of cement to complete the batch.

A limit of four sizes of mixers for general and building work was approved, but discussion developed some objection to No. 4 and preference for No. 5, so that eventually it was decided to refer the selection of the smallest size to a committee of manufacturers. The possibility of adopting No. 21 as a fifth size was also considered. For paving mixers, two sizes were suggested originally: No. 21 and another approximately half that size. The final action, however, was the adoption of three sizes: No. 7, No. 12 and No. 21.

6. *Measuring Drum Speed*—The suggestion was made that for single-opening drums peripheral speed is preferable to revolutions per minute and that this speed should be measured at the center of mass of the batch. Both speeds to be given by the manufacturer. Finally this was referred back for further consideration.

7. *Water Tanks*—Tanks are to be rated on the amount of water discharged per batch and are to be of the following capacities for standard size of mixers: No. 7, 12 gal., with ¾-in. hose nipple for water supply connection; No. 14, 22 gal. with 1¼-in. pipe; No. 21, 32 gal., with 1½-in. pipe, and No. 28, 42 gal., with 2-in. pipe connection.

Numerous other subjects which were discussed more briefly and will be covered by the final report included the following:

Building Mixers: Sizes to which

Contractors Deny Padded Estimates for Cement

Tell Hoover That Manufacturers Dodge Responsibility for Deliveries in Present Form of Contract

A DENIAL of the accusations, made by cement manufacturers, that contractors over-estimate requirements and duplicate orders for cement for purposes of speculation is made in a letter to Secretary of Commerce Hoover, dated June 25, from J. W. Cowper, president, and other members of the Associated General Contractors of America. The communication is in answer to an earlier letter (dated April 9) received by the Secretary of Commerce from six cement manufacturers (Atlas, Hercules, Penn Allen, Dexter, Lehigh and Alpha). To the statement made by the cement companies that 40 per cent of the cement contracted for on engineering and construction work in 1920 was not required, the contractors reply that this estimate is excessive and that over-ordering during the year did not exceed 10 per cent of production.

The cement manufacturers' letter begins with an explanation of its "specific job contract" under the terms of which the manufacturer agrees to deliver the cement required during the entire construction period of the project at an agreed price. These contracts, the manufacturers state, are made to minimize speculation to the detriment of the public. Padded contracts for cement, it is claimed, are common practice among purchasers, as are also duplicate orders on different manufacturers. This year, the letter states, there is no doubt of an outstanding duplication or padding of contracts for cement running into many million barrels that will not be called for delivery. If it were possible to eliminate them, it is pointed out, this additional amount of cement would be available for sale. This year, cement production is estimated at 125,000,000 bbl. The cement manufacturers close their case with pleas for avoidance of duplicated orders, for limiting estimates for cement to actual needs, and for spreading purchases throughout the year.

Contractors Reply

In their reply the contractors admit that over-ordering or duplicating of orders does occur to a very limited extent, but not as a means of speculation. Cement, the contractors assert, is almost universally sold under a loose form of contract which guarantees the price but which does not bind the seller to deliver a given quantity of material within a given time, a matter of vital importance on highly organized construction work, notably highways. "If the manufacturer and the dealer, who receives a commission on all cement used in his territory, will assume responsibility for delivery at a given time," the letter from the contractors states, "the practice of over-ordering or duplicating can doubtless be eliminated. It has its birth in the trade practices of cement selling, and upon revision of these practices depends its correction. Since the manufacturer does not agree to deliver at a given time or rate, and since the owner demands his project at a given time, the construction company is obliged to accept responsibility for contingencies which neither of these will assume."

The construction companies, it is claimed, are frequently injured by the form of contract insisted upon by the cement manufacturers and have sought its abandonment in favor of a bona fide mutual non-cancellable contract, guaranteeing delivery and acceptance, and relieving the seller from delays of transportation. This offer, it is stated, has been declined by the cement producers.

The general tone to the cement manufacturers' letter and its date lead the contractors to infer that it was conceived in opposition to a construction conference. The contractors' communication to Secretary Hoover concludes with the statement that "the trade association is casting aside many features of the competitive system and has reached that stage of group co-operation where the principal evils of the competitive plan still survive, but where the public has not derived its share of benefit from the co-operation." Industries, the contractors believe, must exercise proper government of themselves. If this course is not followed voluntarily they predict that "it will doubtless be followed under the distasteful pressure of law."

(*Concluded from p. 36*)

power discharge, extension loaders and rubber tires may be applied. Discharge control from one or both sides. Open or closed ends for skips. Size of skip and rating by heaped load or level load. Standards for wheels will be referred to wheel manufacturers.

Paving Mixers: Sizes to which caterpillar equipment may be applied. Width of skip. Hand or power steering and boom swing. Forward and reverse speeds.

General: Drum gearing. Quality of material. Safety devices. Standardizing of motive power. Standard names for parts. Name plates showing standard rating.

On the basis of the extensive discussion during the three-day meeting the proposed rules for standardization will be revised and submitted for approval.

Business Notes

GRAHAM B. BRIGHT CO., Richmond, Va., has been appointed Virginia representative for the T. L. Smith Co., Milwaukee, manufacturer of concrete mixers, pavers, excavators and loaders.

C. E. ROWLEY has resigned as advertising manager of the Novo Engine Co., Lansing, Mich., and is succeeded by R. P. Ostrander.

B. L. G. REES, who joined the business staff of *Engineering News-Record* Feb. 2, has resigned, effective July 1, to become New England advertising manager of *The Nation's Business*, the monthly publication of the Chamber of Commerce of the United States. He will cover the New England and half of the New York territory, with headquarters in New York City.

EDWARD W. BUCKLEY has been appointed by the Mayor to the newly created position of Commissioner of Purchase of the City of New York, effective July 1. He was formerly deputy state tax commissioner.

Equipment and Materials

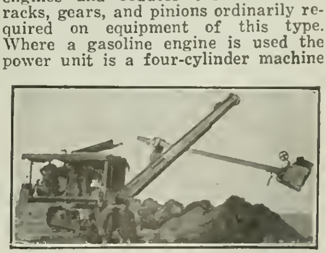
Electric Capstan Car Puller

A new product of the Gifford-Wood Co., Hudson, N. Y., is an electric capstan car puller for use in spotting freight cars to be loaded or unloaded on sidings at industrial plants. The equipment is inclosed by cast-iron housing and consists of a 5-hp., 1200-r.p.m. electric motor operating the capstan head through either gear or belt drive. The base is held down by five bolts

and occupies an area of 2 ft. 8 in. by 2 ft. 9 in. The housing is split and bolted together so that the upper section, with capstan and bevel gear, may be lifted off to expose all working parts. The equipment produces a rope speed of 44 ft. per minute and a pull on the rope of 2,630 lb. The capstan will pull two loaded cars of 75 tons weight or seven empties of 25 tons each on level track. The device is operated by simply hooking the rope onto the freight car to be pulled, giving it a few turns around the capstan head and throwing the motor switch.

¾-Yd. Revolving Shovel Operates With Only One Motor

Only one motor, gasoline or electric, for all operations is a feature of the design of the ¾-yd. revolving, crawler-mounted shovel developed recently by the Northwest Engineering Co., Chicago. The new design involves a form of cable control that eliminates auxiliary engines and reduces the number of racks, gears, and pinions ordinarily required on equipment of this type. Where a gasoline engine is used the power unit is a four-cylinder machine



developing 57 b.hp. at 800 r.p.m. In the case of electric power a 40-hp. squirrel-cage type motor drives the first reduction gear through a full universal joint, thus relieving the motor bearings of any loads due to disalignment resulting from wear or other causes.

A patented dipper control, by cables, makes possible a simple electrical installation. Current is delivered to the travel base through suitable plug-in connections and is transmitted to the

rotating base by means of a set of large collector rings, all wiring being in conduits.

The weight of the shovel, complete, is 53,000 lb., the length of boom between centers 23 ft., and length of dipper stick 14 ft. 3 in. The crowding motion is controlled by cables from the same drums as are used in clamshell or dragline work. The operation of crowding has no effect in reducing the net available digging force which, the manufacturer claims, is the case with crowding mechanism operated by chains or gears.

In the design of the crawler traction the double flanged rollers which ride on the crawler track are of manganese steel and run on 2⅜-in. pins of chrome-manganese alloy steel. This combination of metals, the manufacturer states, eliminates the objection of using bronze bushings at this point, for the manganese roller will not freeze to the pin even if lubrication is neglected. The final drive to the crawlers is through a roller chain and socket which is said to be superior to gears on account of the grit and mud usually present in the operation of a power shovel.

The power shovel equipment is interchangeable for operation as a clamshell bucket, dragline, piledriver hammer, lift magnet, or trench hoe.

Concrete Mixers of Record Size Shipped to Canada

T. L. Smith Co., Milwaukee, has just shipped to Hebertsville, Canada, two 4-yd. (112-S) tilting mixers for use on the dam and hydroelectric project at Hebertsville. These mixers are duplicates of the two that were used at the Muscle Shoals project in Alabama and are claimed by the company to be twice as large as any other concrete mixers ever built.

Four 56-S (2-yd.) mixers of this same type are now being built for use on the Wilson Dam project across the Tennessee River, at the foot of Muscle Shoals, on which two of the Smith 4-yd. and two 2-yd. tilting mixers were formerly used.

Publications from the Construction Industry

Road Rollers—HUBER MANUFACTURING Co., Marion, Ohio, features in a 16-p. pamphlet its motor road roller operated by four-cylinder, 50-hp. gasoline engine. The roller has one front and two rear rolls and weighs 20,000 lb. It can be used also as a tractor for pulling road graders.

Welded Pipe Joints—OXWELD ACETYLENE Co., Newark, N. J., has published a 40-p. illustrated booklet containing reprints of articles dealing with the use of welded joints instead of threaded or coupled joints for pipe lines. The ground covered is largely in the oil and gas fields.

Turbines—KERR TURBINE Co., Wellsville, N. Y., has issued an illustrated bulletin describing its plant for the manufacture of steam turbines and gears. The bulletin, which contains 12 p., is the first of a series which will tell the story of the various sizes and types of turbine built by the company in the same way that the present bulletin describes the company's plant.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Lumber Production Steady

The national lumber movement, as observed by the National Lumber Manufacturers Association, declined quite noticeably during the week June 3-9 as compared with the preceding week, though allowance should be made for the fact that reports were received from 26 fewer mills. Production is still much in excess of what it was at this time last year, and is more than normal; shipments are about the same and new business about 15 per cent less.

For all the 396 reporting mills shipments were 89 per cent and orders 70 per cent of production. The corresponding percentages for the Southern pine group were 90 and 69, and for the West Coast 100 and 88. The 359 of the reporting mills that have a normal production figure for the week show actual production to have been 108 per cent of normal, shipments 100 per cent of the same, and orders 80 per cent. Unfilled orders of 133 Southern pine mills are 12,298 cars, equivalent to 261,959,698 ft., a reduction of about 40,000,000 ft. from the previous week. Unfilled orders of the West Coast Lumbermen's Association mills are given as 250,608,857 ft. of cargo business and 7,365 cars of rail trade business.

The following table summarizes the lumber movement for the week, June 3-9, the corresponding week of 1922 and the preceding week of 1923:

	Past Week	Corresponding Week 1922	Preceding Week 1923 (Revised)
Mills......	396	379	422
Production.	265,825,535	228,007,506	281,543,261
Shipments..	235,495,586	231,598,304	268,747,524
Orders.....	186,025,245	220,878,037	208,077,032

The following figures compare the lumber movement so far this year with the same part of last year:

	Production, Ft.	Shipments, Ft.	Orders, Ft.
1923....	5,512,486,896	5,925,685,551	5,933,893,770
1922....	4,531,450,101	4,640,944,156	5,060,336,049
1923 Increase	981,036,795	1,284,741,395	873,557,721

Production of Paving Brick

Production of No. 1 paving brick during May, according to the monthly report of the National Paving Brick Manufacturers Association, Cleveland, based on returns from 24 companies, totalled 34,382,000 brick, a slight gain over the April figures. Shipments in May amounted to 26,209,000, while stocks on hand at the end of the month were 77,662,000 brick. Unfilled orders aggregated 96,752,000 brick.

Pig Iron Production in May

Pig-iron production in May, according to figures received by the Department of Commerce, amounted to 3,868,000 tons, as against 2,307,000 tons in May a year ago. Production of merchant pig iron totaled 600,000 tons, as against 250,000 tons in May, 1922. Steel-ingot production, allowing for companies not reporting, amounted to 4,205,000 tons, as compared with 3,948,000 in April and 3,223,000 tons in May of last year.

Building Cost Index Higher

The index, for May, of the cost of building materials entering into the construction of a six-room brick house, as compiled by the Department of Commerce, stood at 214, on a 1913 base, as compared with 209 in April and 176 in May a year ago. Production of oak flooring in May amounted to 34,636,000 ft., as compared with 21,914,000 ft. in May a year ago. Cement production in May amounted to 12,910,000 bbl. and shipments totaled 14,257,000 bbl. for the month. The estimated total bookings for fabricated structural steel in May amounted to 145,000 tons, as against 202,500 a year ago.

Malleable Castings

The Department of Commerce announces 61,950 tons as the total production of malleable castings manufactured for sale during the month of May, 1923, as shown by reports received by the Bureau of the Census. The returns include only those castings manufactured for sale as such and does not include those used in the plants or finished and sold as other products. The returns include the production of 85 establishments and show that these plants were operarted at 70.9 per cent of their total capacity during the month of May. Total shipments for the month were 60,221 tons; orders booked were 49,730 tons; and monthly plant capacity was 87,419 tons.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 1 to 10, are the following:

Tunnel, New York, N. Y., to Rodgers & Hagerty, Inc., $3,467,414.

School, New York, N. Y., for Board of Education, $1,185,000.

Packing plant, Denver, Col., to C. S. Lambie, $1,000,000.

Commercial building, Pittsburgh, Pa., to Dwight P. Robinson Co., Inc., New York, N. Y., $1,000,000.

Cement mill, Manitowoc, Wis., to MacDonald Eng. Co., Chicago, Ill., $1,000,000.

Hotel Madison, Wis., to S. M. Siesel Co., Milwaukee, $1,000,000.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 1 to 10, are the following:

Railway, 22 mi., Orchard to Perkins, Idaho, for Oregon Short Line R.R., $3,000,000.

Hospital, Kansas City, Mo., for Heart of America Hospital, $2,000,000.

Hospital, Louisville, Ky., for St. Joseph's Infirmary, $1,500,000.

Gas pipe line, from Ranger-Eastland to Judd, Texas, for Lone Star Gas Co., $1,350,000.

Hotel Milwaukee, Wis., for Hotel Wisconsin, $1,000,000.

Wharf and terminal, Corpus Christi Tex., for Neuces Co., $1,000,000.

Temple, Milwaukee, Wis., for Elks Bldg. Comm., $1,000,000.

Average Weekly Value of June Contracts Let Over Thirty Per Cent Heavier Than in 1922

Total of 2,763 Awards During June, Average Value $68,326 Compared With 1,016 in May, Averaging $215,267

Contracts awarded in the four issues of *Engineering News-Record* during June, totaled $188,786,000 as compared with $218,712,000 in the five issues of May. This represents an average weekly value of $47,196,500 for June, against $43,742,000 during the preceding months.

The weekly average of $47,196,500 for the months of June represents an increase in money value of over 30 per cent above the weekly average for the corresponding period in 1922.

The number of awards totaled 2,763 during June, with an average value of $68,326 as compared with 1,016 in May averaging $215,267 per contract.

Minimum costs observed in Construction News on each class of constructions are as follows: Water-works, $15,000; other public works, $25,000; industrial construction, $40,000; and commercial buildings, $150,000.

Of the $188,786,000, a total of $10,199,000 represented Canadian awards, which fell off heavily from the May totals.

The gain during June may be attributed principally to large private building construction. A general falling off in public building construction has been evident during the last month. The marked gains in private projects are exemplified by such instances as the New York Telephone Exchange building, thirty stories, $11,250,000; a twenty-four story office building also in New York, $5,000,000; a twenty-one story bank and office in Chicago, $5,500,000, and a twenty story office also in Chicago, $7,000,000. Other projects include a packing plant, a cement mill, schools, commercial buildings and hotels.

Engineering News-Record Construction Cost Index Number

July, 1923	222.10
June, 1923	220.70
July, 1922	169.70
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number advanced 1.4 points since last month due to stiffening in labor rates. Prices of basic materials remained unchanged during month except for slight drop in lumber. The average rate for common labor is now 54c. Thus, general construction cost is 31 per cent higher than one year ago and 19 per cent under the peak; it is 122 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
June, 1923 *(4 issues of E. N.-R.)*	148
May, 1923 *(5 issues of E. N.-R.)*	171
June, 1922 *(5 issues of E. N.-R.)*	187
1913	100
Yearly	
1922 (entire year)	130
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 148 for the month of June, and 130 for the whole of 1922, as against 100 for 1913. This means that the actual volume of construction in 1922 (not the mere money-value of the contracts let that year) is 30 per cent above the volume of construction for 1913. Our monthly volume number, 148 for June, 1923, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING JUNE, 1923

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total United States	Canada	Total
Waterworks	....	$198,000	$253,000	$2,031,000	$1,160,000	$186,000	$3,828,000	$217,000	$4,045,000
Sewers	$295,000	2,360,000	567,000	2,459,000	493,000	249,000	6,423,000	78,000	6,501,000
Bridges	28,000	154,000	178,000	518,000	913,000	241,000	2,032,000	258,000	2,290,000
Excavation, drainage and irrigation	......	173,000	25,000	174,000	745,000	....	1,117,000	57,000	1,174,000
Streets and roads	1,201,000	5,538,000	6,354,000	12,202,000	7,352,000	2,984,000	35,631,000	2,409,000	38,040,000
Industrial works	1,755,000	1,648,000	1,970,000	6,969,000	7,183,000	1,857,000	21,382,000	885,000	22,267,000
Buildings	6,516,000	25,198,000	3,923,000	31,744,000	8,299,000	5,998,000	81,678,000	3,012,000	84,690,000
Federal Government	100,000	1,155,000	314,000	112,000	773,000	1,109,000	3,563,000	....	3,563,000
Miscellaneous	298,000	6,933,000	1,789,000	2,574,000	3,027,000	8,312,000	22,933,000	3,283,000	26,216,000
June, 1923	$10,193,000	$43,357,000	$15,373,000	$58,783,000	$29,945,000	$20,936,000	$178,587,000	$10,199,000	$188,786,000
May, 1923	16,059,000	50,418,000	23,813,000	45,360,000	25,589,000	30,793,000	192,032,000	26,680,000	218,712,000
April, 1923	13,627,000	58,149,000	17,936,000	39,941,000	36,385,000	20,735,000	186,773,000	11,892,000	198,665,000
March, 1923	10,844,000	52,520,000	15,734,000	51,373,000	50,648,000	48,676,000	229,795,000	10,554,000	240,349,000
February, 1923	3,546,000	32,433,000	11,481,000	37,359,000	21,450,000	16,096,000	122,365,000	1,377,000	123,742,000
January, 1923	10,797,000	37,648,000	10,146,000	42,329,000	25,391,000	11,367,000	137,678,000	4,921,000	142,599,000

Labor Rates and Conditions Throughout the Country

Three factors dominate the construction situation: (1) scarcity of certain basic materials and labor, which causes (2) very high cost, which is causing (3) curtailment of building. With these three factors, three others of a a more general nature must be considered: (1) heavy freight traffic caused by (2) heavy production of materials to fill orders already placed. The third general factor is the uncertainty of the stock market.

As proving that present conditions remain favorable to labor, the common-labor rate for the nation, as applied to pick-and-shovel men is placed at 54c. per hour as against 53c. last month, according to *Engineering News-Record* figures. Local building conditions are as follows:

Atlanta—Building continues active with plenty of materials.

Baltimore—Scarcity of skilled building trades mechanics.

Birmingham—Scarcity of hodcarriers and common laborers, due to migration of negro labor to the North.

Boston—Plenty of building trades mechanics except common laborers and bricklayers, latter threaten strike. Construction falling off.

Dallas—Excessive demand for bricklayers; fair demand for carpenters; slight unemployment in common labor. No falling off in building construction.

Denver—Building trades 100 per cent employed.

Detroit—More men available for construction work because of slight unemployment at industrial plants. Demand for men on some jobs causing a "bidding up" of wages in special cases.

Kansas City—Shortage of bricklayers; plenty of other crafts. Structural iron workers granted rise.

Minneapolis—Postponement of many large building projects because of high materials prices.

CURRENT BUILDING TRADES WAGE RATES PER HOUR

(Higher rates indicated by +, decreases by—)

Cities	Brick-layers	Car-penters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.90	$0.70	+$0.50	......	+$0.75	$0.30@ 35
Baltimore	1.50	1.00	.80@1.00	.87½	$0.65	.80@1.00	.30@.50
Birmingham	1.00	+1.00	.50@1.00	+.30@.40	......	+1.25	+.30@.40
Boston	1.25	1.05	1.00@1.25	.82½	+1.05	1.12½	.55@.70
Cincinnati	1.25	1.05	1.05¾	.82½	1.05	1.05	.45
Chicago	+1.25	1.15	+1.00@1.25	.88¾	1.10	+1.25	.82½
Cleveland	1.40	1.25	1.25	.87½	1.00	1.25	.87½
Dallas	1.50	1.00	1.00	.40	.87½	1.00	.30@.50
Denver	1.37½@1.50	1.12½	1.12½@1.18¾	.75@.81¼	1.00	1.15⅝	.35@.55
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.37½	1.00	1.00@1.25	.90	1.00	+1.15	.35@.60
Los Angeles	1.25	.87½@1.00	87½@1.00	.62½	......	1.00	.50
Minneapolis	1.12½	.87½	.87½	.71½	......	.87½	.55
Montreal	1.00	.65	.50	+.40	.50	.65	+.30@.35
New Orleans	1.00	+.90	.90	.65	.80	1.00	.35@.40
New York	1.50	1.25	1.50	1.00	1.00	1.12½	.50@.75
Pittsburgh	+1.40	1.20	1.12½	1.00	......	1.25	.60
St. Louis	1.50	1.25	1.25@1.37½	1.25	+1.25	1.25	.45@.90
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	1.12½	1.00	1.00	93¾	1.00	1.12½	.50@.62½
Philadelphia	1.37½	1.12½	1.00	.75@1.00	1.10	1.10	.50@.65

Montreal—Scarcity of bricklayers; other crafts plentiful. Hodcarriers and common laborers granted wage advance.

New Orleans—Bricklayers demand wage advance of 25 per cent above present scale, effective July 7. Carpenters granted advance of 5c. per hour without signed agreement. This craft voluntarily reduced its own wage scale during the recent depression, when the matter of wage reductions was being agitated. Negotiations pending with other trades.

New York—Bricklayers awarded contract of $12 per day for two years, an advance of $2 per day above the 1920 basic wage scale, thereby ending the strike begun on May 21. Hodcarriers will also receive $8 against $7 per day during the same period. Inside ironworkers are on strike for forty-four-hour week and abolition of the open shop. Cement and concrete workers are also on strike, demanding $7.50 per day, an increase of 30c. over the rate offered by the employers.

Pittsburgh — Scarcity of hoisting engineers; other crafts plentiful. Very slight slowing down in steel mill operations due to hot weather.

St. Louis—Bonuses of $1 to $3 per day offered bricklayers. Basic wage $1.50 per hr., same as New York. Plasterers who went on strike two weeks ago granted advance from $12 per day to $14. Helpers also granted rise of $1 per day, making present rate $10.

San Francisco—Plenty of work for all trades. Threatened strike of carpenters held up, settlement not yet effected.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Recent declines due mostly to increased production and unusually large old-material supply. Present market, however, trifle steadier. Birmingham base on No. 2 foundry, still $27 per gross ton.

Railway Supplies—Car materials still hold lead in demand at mills. Track supplies higher at Birmingham. Spikes and bolts declined in St. Louis; track bolts somewhat lower at Pittsburgh mill. No change in rails and ties.

Pipe—Birmingham mill base on 6-in. cast-iron pipe remains at $49 per ton. San Francisco warehouses, however, advanced 4-in. and 6-in., $2 per ton. Stiff advances in wrought steel pipe and clay drain tile in St. Louis. Sewer pipe higher in Birmingham, St. Louis and Atlanta, due to increased labor costs.

Road and Paving Materials—Road-oils and asphalt prices firm during month. Expected cut in crude-oil prices due to heavy production and reserve stocks. Granite paving blocks advanced $5 per M. in Boston and 5c. per sq. yd. in St. Louis. Wood blocks higher in Minneapolis and Boston; lower in St. Louis.

Sand, Gravel and Crushed Stone—Gravel, 1 ½-in., up 15c. in Kansas City; ¾-in. down 25c. per cu. yd. in Minneapolis. Sand declined 20c. in Cincinnati and 15c. per ton in Birmingham, during month. Crushed stone declined, somewhat, in Cincinnati, St. Louis and Boston.

Lime—Hydrated finishing, advanced 50c. in Boston and declined 50c. per ton in Dallas. Hydrated common rose 50c. in Boston and 90c. per ton in Cincinnati. Common lump lime dropped 15c. per bbl. in Dallas and $1 per ton in Montreal, during month.

Cement—Prices firm throughout the country. Birmingham quotes advance of 20c. per bbl., due mainly to higher labor costs. Twenty-eight other cities report no change.

Structural Steel—General price level remains unchanged. Bars still quoted at $2.40 per 100 lb., with plates and shapes at $2.50, on new contracts. Price tendency on structurals has been slightly lower recently; inquiries, however, have improved during the last week. Mill operations at about 89 per cent of capacity, against 94 per cent two months ago. Considerable improvement in new plate business, mostly in small lots.

Brick and Hollow Tile—Common brick advanced 20c. in Dallas, 50c. in Detroit and from 50c. to $2.50 per M. in Birmingham, due to increased demand and higher labor costs. Cincinnati, however, reports slight drop in brick. Hollow tile advanced in Cincinnati, Boston and St. Louis. Declines reported in Chicago, Cleveland and Minneapolis; in last mentioned city, drop due to lower delivery charges.

Lumber—Price tendency downward throughout the country, due to falling off in demand. Postponement of building projects responsible for lessened demand. Slight increases in pine, however, reported in Boston and Dallas, with fir tending upward in Cincinnati.

Explosives—Declines reported in New York, St. Louis, Denver, Atlanta and New Orleans on 40 and 60 per cent gelatin dynamite. Dallas, however, quotes slight advance during month.

Scrap—Prices to dealers and producers down $2 per gross ton f. o. b. New York, during month.

Linseed Oil—Raw oil (5 bbl. lots) quoted at $1.13 f. o. b. New York, against $1.16 per gal, one month ago. Chicago quotes $1.28, compared with $1.37, as of June 7. Downward tendency reported in Dallas and Atlanta.

Price advances since last month are indicated by heavy type; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	July 5	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	*$31.06*	$23.50
Northern Basic	*29.77*	26.50
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	*30.27*	29.16
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	**36.25**	29.16
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	**27.00**	18.50
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	*30.76*	27.32
Virginia No. 2 (silicon 2.25 @ 2.75)	*34.17*	28.74
Basic	*28.26*	25.50
Gray Forge	*28.76*	25.00
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	*31.61*	23.50
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	*32.61*	25.17
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	*29.77*	25.00
Basic	*28.77*	25.00
Bessemer	*30.27*	25.00

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh July 5	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$40.00	.	$43 00	$43.00
Standard openhearth rails	43 00	40.00	$43 00	43 00	43.00
Light rails, 8 to 10 lb	45 00	28@32	2 00*	43 00	43@45
Light rails, 12 to 14 lb	45 00	30@35	2.00*	43.00	43@45
Light rails, 25 to 45 lb	45 00	30@35	2.00*	43.00	43@45
Rerolled Rails	39.00	28.00	.....	......	......

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.50	$1.65
Chicago, Hardwood and Red Oak	1.25	1.40
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco...... Green Douglas Fir	.84	1.14
San Francisco, Empty Cell Creosoted, Douglas Fir	1.70	2.25
St. Louis, White Oak	1 30	1.55
St. Louis (creosoted) (zinc treated)	1.70	2.05
St. Louis, Red Oak, plain	1.20	1.45
St. Louis, Sap pine-cypress	1.05	1.30

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh July 5	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, 9/16-in. and larger	$3.15	$2.25@2 35	$3.00	*$4 00*	$5.00	**$3.75**
Track bolts	*4.00@4 25*	3.25	4.00	*5.00*	6.20	**4.70**
Standard section angle bars	2.75	2.40	2.75	4.00	4 25	**3.20**

PIPE

WROUGHT PIPE—The following mill discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	62	50½	¾ to 1½	30	13

LAP WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
2	55	43½	2	23	7
2½ to 6	59	47½	2½ to 4	26	11
7 and 8	56	43½	4½ to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	¾ to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	48%	50%	49%
2½ to 6 in. lap welded	44%	47%	46%

	Galvanized New York	Galvanized Chicago	Galvanized St. Louis
1 to 3 in. butt welded	34%	37%	36%
2½ to 6 in. lap welded	30%	34%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 15%. Cast iron, standard sizes, 27½% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York July 5	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	$53.00	$67.30	$55.80	$64 20	$61 60	**$66.00**
6 in. and over	49.00	62.30	50.80	60.20	57.60	**62.00**

Gas pipe and Class "A," $5 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York July 5	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$40 00	**$50 00**	$62.50	....	$73.00
4	55.00	50.00	**50 00**	75.00	$76.50	83 00
5	80.00	80.00	.	100.00	97.75	108 00
6	105.00	100.00	**85 00**	175.00	127.50	133.00
8	170.00	150.00	**295 00**	187.50	212.50	199.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	...	$0 114	......	...	$0.15	$0.12	......
4	...	.114	**$0 11**	**$0.1175**	.15	.15	$0.12
5	..	.171	**.1375**	.	.23	.18	.16
6	$0.24	.171	**.165**	**.1645**	.23	.21	.185
8	.38	.266	**.26**	**.26**	.35	.30	.30
10	.57	.399	**.338**	**.364**	.53	.42	.441
12	.72	.513	**.442**	**.468**	.68	.54	.567
15	1.13†	.684	**.65**	**.78†**	.90	.90	.819
18	1.65†	.95	**85**	**1.092†**	1.25	1.32	1.071
20	1.98†	1.14	**1.125**	....	1.50	......	.....
22	2.64†	1 52	**1.375**	**1.456†**	2 00	......	1.44
24	2.97†	1 71	**1.626**	**1.872†**	2.25	2.16	1.89
27	4.81†	2 99	....	**2.95†**	4.69†	3 00	3.34
30	5.33†	3.312	....	**3.65†**	5.94†	3.60	4.06
33	6.93†	4.41	....	**4.45†**	6.88†	......	4.99
36	7.91†	5.0225	....	**4.80†**	7.50†	......	5.42

	3	5	8	12	24	36
Boston	$0.127	$0.195	$0.308	$0.595	$1.975†	$5.90†
Minneapolis	....	......	.40	.72	2.55	5.66†
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.13	......	.36	.72†	2.60†	.....
Los Angeles	.13	.165	.275	.495	1 65	.....
New Orleans	.112*	.168*	.28	.476	1.182	.....
Cincinnati	.12	.18	.28	.54	1 80	4.10†
Atlanta	**.11***	**.165***	**.275**	**.4675**	**1.7875**	.....
Montreal, *delivered*	.68‡	.45†	.70	1.35	4.50†	. .
Detroit	.117	.1755	.273	.5265	2.34†	6 15†
Baltimore	126	.189	.294	.567	1.89	5.4375
Kansas City, Mo.	.15*	.21	33	.40	1 60	.....
Philadelphia	......	......	....	....		.. ..

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

	July 5	One Year Ago
New York, 45% asphalt......(at terminal)	$0.0525	$0.05
New York, 65% asphalt......(at terminal)	.0525	.045
New York, binder..........(at terminal)	.06	.0575
New York, flux.............(at terminal)	.0575	.055
New York, liquid asphalt....(at terminal)	.06	.06
St. Louis, 50@60% asphalt	.0565	.05
St. Louis, 40@50% asphalt	.0535	..
Chicago, 40–50% asphalt	.0525	.0525
Chicago, 60–70% asphalt	.055	.055
Dallas, 45% asphalt	.049	.10
Dallas, 55% asphalt	.0455	.13
Dallas, binder	.061	.15
San Francisco, binder, per ton	9.50*	13.00*

* F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Mexican*)	$19 00	$15.00
Boston (*Mexican*)	21 00	17 00
Chicago (*Stanolind*)	22.25	16 00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	17.00*	11.00*
Dallas, (*Texas*)	27 10	21.10
Seattle, "*D*" *grade* (*California*)	24 75	20.50†
Denver (*California*)	24 00	...
Minneapolis *f.o.b. Twin Cities* (*Stanolind*)	25 45	19.10
St. Louis (*Mexican*)	*29 50*	*24 50*
Baltimore (*Standard Oil*)	21.00	15.00
Montreal (*Imperial*)	28 00	21.00
Atlanta (*Mexican*)	26 00	23 50
Detroit (*Mexican*)	22 47	18.40
Cincinnati (*Kentucky Rock*)	22.50	19.50
Maurer, N. J. (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	21.50	18.50
Philadelphia (*Mexican*)	.	.
Kansas City (*Texas*)	27.30	22 30
Los Angeles "*D*" *grade* (*California*)	17.00‡	11 00‡

*Freight to San Francisco, 80c. per ton.
†F.o.b. Richmond, Cal.
‡F.o.b. El Segundo refinery.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade 1)	5-in. granite, 30 blocks per sq.yd.	$134.50 per M.
Chicago	About 4x8x4 dressed	3.50 per sq.yd.
	About 4x8x4 common	3.10 per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M.
Boston	5-in. granite 28 blocks per sq.yd	135 00 per M.
Atlanta	Granite	2.66 per sq.yd.
Detroit	5-in. Granite	106.00 per M.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	100.00 per M.
New Orleans	Granite, 4 x 8 x 4	3.25 per sq.yd.
Cincinnati	Granite	138.00 per M.
St. Louis	4x8x4 dressed	3.15 per sq.yd.
	4x8x4 common	2.95 per sq.yd.
Kansas City	Granite	3.55 per sq.yd.
Philadelphia	Granite	.... per M.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft wide	$0.22 per sq.ft.
	Manhattan, 4 ft. wide	.22 per sq ft.
	Queens, 5 ft. wide	.24 per sq.ft.
	6x24-in. cross-walk	1 10 per lin.ft.
Chicago	1? in. wide	.. per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 80c.; 5 x 20 in., Queens, 85c. *St. Louis*: Class "A" straight, delivered, 5 x 16 in., $1.45 per lin.ft. *Chicago*: 5 x 8 in., $1.65; 6 x 8 in., $1.95 per lin.ft. delivered.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	*$2 63*
New York (*delivered*)	3½	16	*2 79*
Boston	3½	18	2 70
Chicago	4	16	3.00@3.25
Chicago	3½	16	2 50
St. Louis	3½	16	*2.55*
St. Louis	4	16	*2 90*
Seattle	4	16	Off market
Minneapolis	3½	16	2 73
Atlanta	3½	16	2 00
New Orleans	3	16	2 45
New Orleans	3½	16	2.65
New Orleans	4	16	2.95
Dallas	4	18	3.90
Baltimore	3½	16	none used
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	3½	16	2.38
Kansas City	4	16	2.75
Philadelphia	4	16	....

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. July 5	Gravel 1½ In. One Year Ago	Gravel ¾ In. July 5	Gravel ¾ In. One Year Ago	Sand July 5	Sand One Year Ago
New York	$2 25	$1.75	$2.25	$1.75	$1.25	$1.00
Denver	1.90	1.75	1.90	1.75	1.00	0.75
Chicago	2.00	1.80	2.00	1.80	2.00	1.80
St. Louis	2.40	1.25†	2 45	1.30†	2.10	1.10†
Seattle	1.25	1.10	1.25	1.10	1.25	1.10
Dallas	2.25	2.25	2.25	2.25	1 95	2.25
Minneapolis	1.85*	1.50	*1 85**	1.50	1.25	1.00*
Cincinnati	1.50†	1.87½	1.50†	1.87½	*1.30*†	1.43
San Francisco	2.15	2.25	2.15	2.25	1.50	1.50
Boston	1.50†	2.40	1.50†	2.40	1.20†	1.65
New Orleans	2.85	2.08½	2.85	2.08½	1.25	1.35
Los Angeles	1.35†	1.50†	1.45†	1.50†	1.10†	1.35†
Atlanta	1.90†	1.85†	1.90†	1.85†	1.24†	1.15†
Detroit	1.62	2.00	1.62	2.00	2.02½	2.00
Baltimore	1.86	1.40	2.06	1.60	0.80†	2.00
Montreal	1.25†	1.25†	1.50†	1.50†	1 25†	1.25†
Birmingham (Crushed slag used instead of gravel)					*1.30*†	1.28†
Philadelphia	..	1.55	....	1.60	....	1.60
Kansas City	1.75	2.00	1.60	2.00	0.66†*	1.29

New York—Grit, $1.75 per cu. yd.; ready mixed, $2.25
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit.
† Per ton

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. July 5	1½ In. One Year Ago	¾ In. July 5	¾ In. One Year Ago
New York	$1.65	$1.65	$1 75	$1.75
Chicago	2.00	1.60	2.00	1.60
St. Louis	*1.75*	1.65	*1.65*	1.65
Dallas	2.50	2.73	2.50	2.73
San Francisco	2.15	2.25	2.15	2.25
Boston	*1.70**	3.00*	*1.70**	3.00*
Minneapolis, *at plant*	2 00	2.00	2.25	2.25
Kansas City	1.50	2.10	1.50	2 10
Denver	3.50	3.50	3.50	3.50
Seattle	3.00	3.00	3.00	3.00
Atlanta	2.00*	1 90*	2 00*	1.90*
Cincinnati	*1.65**	1 75	*1 65**	1.75
Los Angeles	1.60	1.75*	1 60	1.85*
Detroit	1.75	1.90*	1 75	1.90*
Baltimore	2.50	1.75*	2.55	1.65*
Montreal	1.80*	1.90*	1 90*	2.00*
Birmingham *delivered*	3.20	3 20	3.10	3.10
Philadelphia	..	1.70*	.	1.55*
Pittsburgh	2.85	2 85	2.85	2 85
Cleveland	3.25*	3.00*	3.25*	3.00*

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa.	0.85	0.90	2.50	
Birmingham, Ala.	1.05	1.15	2 05	0 80
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1 25
Cleveland, Ohio.	1.45	1.45	1.45	1 25
Eastern Pa. and Northern N. J	1.20	1.20	2.50	1 20
Western Pennsylvania	1.25	1.25	2.00	1 25
Longdale and Glen Wilton, Va	1.25	1 25	2.50	1 00
Toledo, Ohio	1 50	1.50	1.50	1 50

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$18 20	$13.10	$3.75*	$3.00@3.25*
Chicago	20.00	20.00	1.50†	1.50†
St. Louis	23 20	20.00	3.75*	3.00*
Boston	22.50	15.50	4.25*	2.50*
Dallas	*22 00*	22 00	...	*2.35*†
Cincinnati	16 80	14.30	....	
San Francisco	22.00	16.00	....	1.75†
Minneapolis	25.50	21.00 (white)	1.70†	1.50†
Denver	24.00	.....	....	2.70†
Detroit	21.00	20.00	....	20.00‡
Seattle *paper sacks*	24.00	.....	2.30†	...
Los Angeles	.....	...	....	*2.60**
Baltimore	24.25	17.25	2.55	...
Montreal	21 00	21.00		10.00‡
Atlanta	23.50	15.00	2.35†	1.50†
New Orleans	.....	.....	2.40†	....
Philadelphia	...	.	....	.....
Kansas City	28.00	24 00	3.12*	2.96*
Birmingham	14 25	13.50	1.90†	1.65†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.80, Sheboygan $1.70. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	July 5	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.50	1.60
Cincinnati (Utica)	1.72	1.77
Boston (Rosendale)	2 70	0.80 per bag
St. Louis (Carney)	2 85	2.10
Birmingham (Magnolia)	2.10	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b points listed *without bags*. Cash discount not deducted.

	July 5	One Month Ago	One Year Ago
New York, del. by truck	$2.70@2.80	$2.70@2.80	$2.40@2 50
New York, alongside dock to dealers	2.30	2.30	2.10
Jersey City	2.48	2.48	2.28
Boston	2.80	2.80	2.50
Chicago	2.20	2.20	2.05
Pittsburgh	2 24	2.24	2.09
Cleveland	2.46	2.46	2.31
Detroit	2 48	2.48	2.33
Indianapolis	2.41	2.41	2.26
Toledo	2.48	2.48	2.33
Milwaukee	2.37	2.37	2.22
Duluth	2.14	2.14	2.02
Peoria	2 41	2.41	2.26
Cedar Rapids	2.48	2.48	2.33
Davenport	2 43	2.43	2.28
St. Louis	2.35	2.35	2.20
San Francisco	2.71	2.71	2.63
New Orleans	3.30	3.30	3.20
Minneapolis	2.39	2.39	2.29
Denver	2.84	2.84	2.90
Seattle	2.90	2.90	2.90
Dallas	2.25	2.25	2.25
Atlanta	2.85	2.85	2.34
Cincinnati	2.54	2.54	2.39
Los Angeles	3.20	3.20	3.30
Baltimore	2.65	2.65	2.50
Birmingham	2 70	2.50	2.10
Kansas City	2 45	2.45	2 40
Montreal	2.25	2.25	2.88
Philadelphia	...	2.41	2.31
St. Paul	2.39	2.39	2 29

NOTE—Bags 10c. each. 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind.	$1.95	Hudson, N. Y.	$2.20
Universal, Pa.	2.00	Leeds, Ala.	2.20
Steelton, Minn.	1.95	Hannibal, Mo.	2.10
Fordwick, Va.	*2.10*	Lehigh Valley District	2.10
Mitchell, Ind.	2.10	Wyandotte, Mich.	2.30
Iola, Kan.	2.10	Alpena, Mich.	2.10
Mason City, Ia.	2.10	Richard City, Tenn.	2.20
La Salle, Ill.	2.10	Kingsport, Tenn.	2.20

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago Mill	Warehouse: New York	St. Louis	Dallas	San Francisco
032	22	$0 95	$1 02	$1.24	$1.04	$1 12	$1 16
049	28	1 20	1.30	1 58	1.32	1.38	1 47
068	35	1 47	1 59	1 94	1.62	1.67	1 81
093	45	1 89	2 04	2 50	2 08	2 00	2 32
126	57	2 34	2 53	3 09	2.59	2 55	2.88
153	68	2 79	3 02	3 60	3.08	3.15	.....
180	78	3 20	3.47	5 22	3.54	3.47	.....
245	103	4 22	4.57	4 60	4 66	4.58	.....
287	119	4 88	5 28	6 44	5 39	5.26	6.00
336	138	5 66	6.13	7 39	6.25	6.11	.....
395	160	6 56	7 10	8 67	7.25	7.12	.....
PAVING							
036P	17	$0 72	$0 78	$0.95	$0 79	$0.76	.....
053P	24	1.02	1 10	1 35	1.12	1 07	.....
072P	31	1.29	1 40	1 71	1.42	1 39	.....
097P	40	1.66	1 80	2 20	1.83	1 90	.....
049R	24	....	1 10	....	1.12	1 07	.....
067R	31	....	1.40	....	1 42	1 39	.....
089R	40	....	1.80	....	1.83	1 90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27 Dia.	2.3	$22 00	$21 25	$20 72	$21 43	$25.50
26 "	2.5	22 00	22 50	22 39	20.78	27 58
25 "	3.0	22 00	25 25	24 93	......	30 71
24 "	3 4	24 00	27 25	27 10	24 88	33 16
22 "	4.33	27 00	31 75	32 27	.....	35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
¾ and larger..	$2 40	$2 65	$3 54	$3 32½	$3.35	$3 80	$3 65
⅝...........	2 45	2 75	3 59	3 37½	3.40	3 85	3 70
½...........	2 50	2 85	3 64	3 42½	3 45	3 90	3 75
⅜...........	2 65	2 90	3 69	3 57½	3 60	4 05	3 90
¼...........	2 90	2 95	4 04	3 82½	3 85	4.30	4.15

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¾ and larger	$2 30	$3.05	$3 50	⅜........	$2 55	$3 30	$3 75
⅝ in........	2 35	3.10	3 55	¼........	2 80	3.50	4.00
½..........	2.40	3.15	3.60	....	.....	.....	....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: July 5	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)......	$23.50	$23.50	$24.60	$46 50	$54.00
New York (at dock)...	20.00	20.00	21.00	......	......
Chicago..............	11 00	11.00	11 00	34.00	42.00
St. Louis, salmon......	16@18½	16@18	14 00	38@40	40@44.50
Denver, salmon.......	12 00	12 00	12.00	......	......
Dallas................	13 10	12 90	11.15	33.00	......
San Francisco.........	15.00	15.00	15 00	......	......
Los Angeles (del.).....	15.00	15.00	15.00	(not used)	
Boston (del.)..........	22.50	22.50	16.00	48.25	56.00
Minneapolis (del.).....	17@19	17@19	17@18	......	......
Kansas City..........	14.50	14.50	14.50	......	......
Seattle...............	13.00	13.00	14.00	50.00	.....
Cincinnati............	17@20	20 00	15.00	45.00	50.00
Montreal	16.50	16.50	16 00	100.00‡	68.00
Detroit (del.).........	20.00	19.50	16 50	38 50	41.50
Baltimore (del.).......	21.00	21.00	20.00	40.00	45.00
Atlanta	14.00	14 00	11 00	40.00	45.00
New Orleans..........	18.75	18 75	12.50	......	......
Birmingham	13@16	12 50	12.00	......	......
Philadelphia..........	.....	19@25	17@18	40.00	48.00
Pittsburgh (del.)......	16.00	16.00	16@18	......	......
Cleveland	16.00	16.00	14 00	......	......

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: July 5 on Trucks*	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12...	$0.1573	$0.1112	$0.0724	......	$ 092	$0 108	....
6x12x12...	2097	.1667	.0996	......	.126	156	....
8x12x12...	.2621	.2084	.1358	......	.170	244	$0.2691
10x12x12...	....	.....	.1695	......	.20	......	3505
12x12x12...	....	.....	.1937	......	.24	......	4206

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston..........................	$0.115	$0 22	.....
Minneapolis (f.o.b. cars)........	0736	.12125	$0.214
Minneapolis (delivered)..........	.0816	.13375	.234
Cincinnati.......................	.0815	.153	....
Kansas City.....................	.083	.1455	....
Denver..........................	.065	.123	.188
Seattle (delivered).............	.11	.25	.36
Los Angeles factory............	.10	.175	....
New Orleans....................	.12	.23	....
Detroit (delivered)............	.1145	.2147	.27
Montreal.......................	.115	.225	.30
Baltimore......................	.125	.27	......
Atlanta........................	.109	.1832	......
Dallas.........................	.115	....	......
Birmingham.....................	.11	.18	......
Pittsburgh (delivered)..........	.068	.128	.179
Cleveland	.09	.172	......

San Francisco and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh Mill	Birmingham Mill	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in......	$2 50	$2 75	$3 64	$4 30	$3.45	$3 40	$3.95
Channels, 3 to 15 in....	2.50	2 75	3 64	4.30	3 45	3 40	3.95
Angles, 3 to 16 in., ¼ in. thick..	2.50	2 75	3 64	4 30	3 45	3 40	3.95
Tees, 3 in. and larger...	2.50	2.75	3 64	4 30	3 50	3.40	3.95
Plates, ¼ in. thick and heavier.............	2.50	2.75	3.64	4.40	3 45	3.40	3.95

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York July 5	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
¾ in. and larger	$3.25	$4 40	$3.60	$3.75	$4 15	$5.00	$4 95
CONE HEAD BOILER							
¾ in. and larger	$3.35	$4.50	$3.70	$3 85	$4.25	$5 10	$5 05
⅝ and 11/16........	3.50	4.66	3 86	4 00	4.40	5.25	5 20
½ and 9/16........	3.75	4.90	4.10	4.25	4.60	5.50	5.45

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.........	$3.00	$3.45	$4.30	$4.25	$3.43	$4 95
Cut..........	....	5 50	5.80	5.75	3.74	5 00

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.50 per roll in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.75 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., $5.85 per square.

ROOFING MATERIALS—Prices f.o.b. New York, in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton......................	$67.50
Tar pitch (in 400-lb. bbl.), per 100 lb	1.62½
Asphalt roofing (in barrels), per ton, f.o.b. plant*....................	38.75
Asphalt felt (light), per ton, f.o.b. plant*.........................	75.00
Asphalt felt (heavy), per ton, f.o.b. plant*.........................	75.00

* Delivered in Metropolitan Dist., $3.00 additional.

WINDOW GLASS—Double strength, box list, united inches, 34, "AA" and "A" grades, at discount of 84 per cent from standard lists, f.o.b. New York; "B" grade less 85 per cent.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10...............	$3.00	$4.45	$4.15	$5.10	$4.59
No. 12...............	3.10	4.50	4.20	5.15	4.64
No. 14...............	3.20	4.55	4 25	5.20	4 69
No. 16...............	3.40	4.65	4.35	5.25	4.79
Black					
*Nos. 18 and 20.......	3 70	5 00	4.85	5.95	4 95
*Nos. 22 and 24......	3.75	5.05	4.85	6.00	5.00
*No. 26..............	3 80	5.10	4.90	6 05	5.05
*No. 28..............	3.85	5.20	5.00	6.15	5.15
Galvanized					
No. 10...............	4.00	5 35	5.10	6.50	5.15
No. 12...............	4.10	5.45	5 20	6.60	5.25
No. 14...............	4 10	5.45	5 20	6 75	5.25
Nos. 17 to 21.........	4.40	5.75	...	6 90	5.55
Nos. 22 and 24........	4 55	5 90	5 65	6.05	5.70
*Nos. 25 and 26.......	4.70	6 05	5 80	6 20	5.85
*No. 28..............	5.00	6 35	6.10	6 50	6.15

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: July 5	New York: One Year Ago	Chicago: July 5	Chicago: One Year Ago
Raw in barrels (5 bbl. lots).....	$1.13	$0.90	$1 28	$0 96

WHITE AND RED LEAD—Base price in cents per pound:

	Red				White	
	July 5		1 Year Ago		July 5	Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	14 50	16.00	12 50	14 00	14 50	12 50
25 and 50-lb. kegs.	14 75	16.25	12 75	14 25	14 75	12 75
12½-lb. keg	15 00	16.50	13.00	14.50	15.00	13 00
5-lb. cans	17 50	19.00	15.50	17 00	17 50	15 50
1-lb. cans	19.50	21.00	17.50	19 00	19.50	17.50

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional.

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$40.00	$41 00	$42 00	$45.00
3x6 and 8	40.00	41 00	42 00	45 00
4x4-6 and 8	40.00	41.00	42 00	45.00
3x10 and 12	40.00	41 00	42.00	45.00
3x14	42 00	42 00	44 00	46 00
4x10 and 12	40 00	41.00	42 00	45.00
4x14	42 00	42.00	44.00	46 00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$42 00	$44.00	$46.00
6x14	47 00	49.00	51 00
8x10	42 00	44 00	46.00
8x14	47 00	49.00	51 00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22–24 Ft.	20 Ft. and Under	22-24 Ft.
3x 4 to 8x8	$51.00	$52.00	$52 50	$54 50
3x10 to 10x10	55.00	56.00	55 50	57.50
3x12 to 12x12	59.00	60 00	58.50	60 50
3x14 to 14x14	66.00	67.00	63.50	65 50
3x16 to 16x16	71.00	72.00	68.50	70.50
3x18 to 18x18	85.00	86.00	80.50	81.50
4x20 to 20x20	95.00	96.00	91.50	93.50

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under.

Other Cities

	8 x8-In. x 20 Ft. and Under				2 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$67.00	.	$62.00	$57.00	$88.00	......
Seattle	.....	$31.00	......	......	......	$31.00
New Orleans	31.00	.....	......	......	35.00	......
Baltimore	33.50	53.00	53.00	60.00	33.00	53.00
Cincinnati	40.00	75.00	75 00	90.00	44.00	80 00
Montreal	50.00	.....	......	......	......	90.00
Los Angeles	.....	53.00	....	......	......	54.00
Denver	40.75	40.75	40.75	40.75	......	41.75
Minneapolis	43.50	41.50	41.50	......	46.00	43.75
Atlanta	38.00	.....	......	......	42.00	......
Dallas	50.00	...	......	......	55.00	......
Kansas City	44.25	46.50	46.50	......	57.25	48.50
Birmingham	34@38	.....	......	......	43@50	......
Philadelphia	.....	.....	......	......	......	......
Detroit	48.75	52.25	......	......	61.75	52.25
St. Louis	44.00	.....	......	......	56.00	......

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	$50.00	$90 00	$50.00	$60.00	......
Seattle	......	28.00	.....	.....	$30.00
New Orleans	75.00	.....	.....	34.00	.....
Baltimore	60.00	44.00	44.00	34.00	50.00
Cincinnati	76.00	81.00	76.00	35.00	90.00
Montreal	.....	50 00	37.00	45.00	45.00
Los Angeles	.....	48.00	.....	.....	.....
Denver	.....	35 25	35.25	.....	34.25
Minneapolis	43.50	41.75	39 50	40.25	38.25
Atlanta	22.00	.....	.....	32.00	.....
Dallas	50.00	.	.....	53 50	.....
Kansas City	69.00	43.50	.....	44.00	45.50
Birmingham	28@32	.....	.....	42.00	.....
Philadelphia	.....	..	. .	.....	.....
Detroit	52.50	39 00	.....	45.50	43 25
St. Louis	45.00	... .	. . .	32.00	.....

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M. ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers price to contractors on large projects.

St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M. ft. additional.

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M. ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.29
Birmingham	.69	Kansas City	.735
Boston	.365	New Orleans	.515
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.34†
Cincinnati	.29	Philadelphia	.32
Cleveland	.215	St. Louis	.43
Denver	1.27*	St. Paul	.60

† Minimum carload, 40,000 lb.

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.

MISCELLANEOUS

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

July 5	One Month Ago	One Year Ago
$2.65	$2.65@2.75	$2 00

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	20%
Patent flattened strand, special steel wire rope	20%
Patent flattened strand, iron rope	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft., ¾-in., 6; ⅞-in., 4½; 1-in., 3½; 1⅛-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.16¾	New Orleans	$0 18½
New York	18½	Los Angeles	18
Chicago	18	Seattle	18
Minneapolis	20½	St. Louis	.19½
San Francisco	18	Montreal	.30
Atlanta	.22	Detroit	.19
Denver	.22	Baltimore	.18
Cincinnati	21	Kansas City	.20½
Dallas	15	Birmingham	20½
Philadelphia	.		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin	
	40%	60%
New York	$0.27	$0.295
Boston	.23	.25
Kansas City	.225	.25
Seattle	.165	.19
Chicago	.22	.25
Minneapolis	.1967	.2173
St. Louis	.22	.245
Denver	.2025	.2275
Dallas	.30	.385
Los Angeles	.17	.20
Atlanta	.23	.2575
Baltimore	.22	.23
Cincinnati	.225	.25
Montreal	.195	.235
Birmingham, *delivered*	.16	.17
New Orleans	.195	.220
San Francisco	.1625	.1925
Philadelphia	.....	.....

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.181
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$15.00	$11.50	$16 00
Stove plate	12.00	12.00	15.00
No. 1 machinery cast	18.00	16.50	20.00
Machine shop turnings	11.00	4.00	12 00
Cast borings	12.00	5.50	13.00
Railroad malleable cast	13.00	12.50	20.00
Re-rolling rails	13.00	13.00	19.00
Relaying rails	.....	30.00	28.50@36.50
Heavy melting steel	12.00	.....	......

SHIP SPIKES—Current prices per 100 lb.:

	San Francisco		Seattle
In.	Galv.	Black	Black
¼	$9.85	$7.65	$8.00
⅜	7.80	6 30	7.75
½	7.75	6 15	7.70

Pittsburgh base in lots of 200 kegs or more, $3.50@3.75.

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Public Opinion Wins

JUDGE GARY and his associates in the steel business have had their ears to the ground since their inept report of last month in which they questioned the early possibility of abolishing the 12-hr. day. The head of the Steel Corporation now finds that he is "decidedly opposed to the 12-hr. day" and that, "practically all the manufacturers of iron and steel in this country have positively agreed to the entire abolition of the 12-hr. day as soon as there is sufficient labor to permit it." This is a return to that appreciation of public sentiment that has generally characterized the Steel Corporation. Unquestionably, there are tremendous labor difficulties involved in the turn to the shorter shift, but they are far from insurmountable. In view of the interest the public is taking in this issue there is every reason to believe that the President will see that effort is made to bring about the reform at the earliest possible date.

Who Restricts Apprentices?

RESTRICTION of apprentices has been a common complaint against labor unions. The condemnation is a general one. We are told that one of the reasons for the shortage of building mechanics is that the unions restrict entrance into the trades. Whatever may be the truth in specific instances and places the facts at New York at least do not warrant the charge. There it is the contractors and not the unions who restrict apprentices. For example, in the carpenter trade union rules would permit of the employment on New York operations of 2,600 apprentices. As a matter of fact, there are only 800 in the city. The painters' and decorators' unions would allow 800, but only 125 apprentices are to be found. In general, there are at work only 40 to 50 per cent of the apprentices allowed by union rules. The only exceptions are in the bricklaying and the electrical trades where the quotas are nearly full. Where the number of apprentices is below quota the reason invariably is that the contractors are unwilling to go to the trouble of training the boys. Of course, union rules do place limitations on apprentices, but until the time comes when the contractors have employed all the apprentices that the unions allow, contractors have no reason to complain against union restrictions and the public's charge against the building industry should lie at the door of the contractors and not at that of the unions.

Building Height Uncertainties

LIMITATION of city building heights by law seems to be in an epidemic stage at the moment. Half a dozen cities have concerned themselves with the question in recent months. Their conditions are quite different, and the apparent motives of the height limitation movement are just as various. In one or two cities the protection of a particular building or street appears to be at issue, while in others the objective is more general. In still other cases no immediate motive is apparent. Except in one case, it is proposed to restrict the height of future building to a lower point than the owner's or architect's choice would fix. The exception is Boston, where existing height limits on a particular street are to be raised in order to permit better utilization of the land. Nowhere, however, has substantial reasoning been brought to bear on the problem. So far as can be judged, esthetic notions are leading factors in the discussion—a belief that high buildings are unsightly in themselves or are harmful to neighbors, or the vague notion that civic beauty lies in a uniform sky line. Such beliefs do not appeal very strongly to the general run of men, and the successful development of tall buildings in both isolated and row arrangements, and the strong demand for space in them, are practical answers to many of the claims made by those who advocate restriction. Transportation difficulties, or other real objections arising out of the intense concentration of population which high buildings produce, have almost never been made an argument in height limitation, nor have they been studied with due care to determine their bearing on the problem. In cities of large size and great concentration of business these difficulties and objections are serious—though just how serious is somewhat uncertain—while in smaller cities they are substantially non-existent. In the meantime the esthetic discussion of high buildings remains largely a matter of diverging personal views, and the skyscraper has rapidly become a feature of even the smaller country metropolis, where for many decades to come such matters as zoning and setbacks can have no meaning. Until a full and convincing study of the relation of the skyscraper to community life and to the rights of different parties has been made, it is not likely that the height restriction movement will progress beyond the condition of breaking out in an occasional epidemic, as at present.

For a New Niagara Treaty

EVENTS are shaping themselves for an early revision of the treaty provisions for the use of the water power on the Niagara and St. Lawrence Rivers. On this side of the boundary the new tunnel and power house of the Niagara Falls Power Co. is nearing completion, while in Ontario the Queenston power house has nearly its full installation in wheels. This means that there are available power units in capacity far in excess of the flowage permitted under the existing treaty and water is running to waste over the Falls, water that is in no way necessary to the scenic grandeur of that spectacle. Moreover, the recent election in Ontario brings back into power the supporters of government owned and operated power, notably Sir Adam Beck, the father of the Ontario "Hydro." This new administration is committed to the utmost development of all the border water flowing by the province. Both

political and industrial demands make imperative that some international agreement be reached whereby Canada gets more than the 36,000 sec.ft. and the United States more than the 20,000 sec.ft. now permitted. The two governments are in possession of all the necessary hydraulic data and the discussion now is in the realms of diplomacy, with the customary jockeying inherent in diplomatic discussion, but it can hardly be doubted that the pressure from both sides of the boundary for some settlement will soon bring about at least a temporary agreement from which later a new treaty will evolve.

The Penalty of Neglect

THE present water shortage in portions of northeastern New Jersey affords an example of the penalty of neglect. There is most cause of alarm in the Elizabeth-Plainfield section where it has been known for years that twenty communities served by five water companies might face a serious water shortage any day. The communities and the companies have agitated the question from time to time but with no fruitful result. The State Conservation and Development Commission obtained from Allen Hazen a comprehensive report showing that water in plenty for decades to come could be had for northeastern New Jersey by carrying out any one of several water storage possibilities (see *Engineering News-Record*, March 16, 1922, p. 430). A commission to provide a joint supply for wholesale distribution and for co-ordinating the various municipal and private water purveyors in northeastern New Jersey was proposed by Mr. Hazen. The municipalities, the water companies, and the public at large in northeastern New Jersey seem to have been indifferent to the Hazen report. The major difficulty in this New Jersey region lies in the fact that while various private water companies are trying, naturally enough, to conserve their own interests in the most readily available sources of supply, and have largely consolidated their interests, the municipalities have never worked in unison to meet their water needs. If the cities and towns could unite under able leadership, as was suggested in the Hazen report, the water companies would doubtless fall quickly into line and all northeastern New Jersey might soon be insured of a plentiful, reasonably cheap and pure water supply for a century to come.

Service Charge Unpopular

ALTHOUGH based on sound reasoning designed to distribute equitably the cost of water, gas and electric current, the service charge is unpopular. This is reflected by statute or utility commission prohibitions in some states. A statute enacted this year by the New York legislature is directed against gas companies. After providing that "every gas corporation shall charge for gas supplied a fair and reasonable price" it prohibits "an additional charge or fee for service or for the installation of apparatus or the use of apparatus installed." Neither the public or the lawmakers realize that if service charges are prohibited then the rates for gas or water or electric current must be raised and that it is difficult if not impossible to do this without overburdening some consumers and favoring others. Consumers regard the service charge as a device of the corporation to raise profits already extortionate. Unfortunately the service charge in the past has been and in some quarters even now is used as a means to this end; but not where there is sound public utility regulation. A vast amount of educational work, combined with impartial utility commission administration and whole-hearted co-operation by the utility corporations, will be required in some states before the public will cease to chafe under the service charge. Meanwhile, if legislatures or commissions forbid the service charge then its equivalent must enter into the unit consumption rates—a plan that for a long time to come will probably cause less friction than the other—if for no other reason than because it is not recognized by the consumer.

Concrete for Study

THE discussion on the behavior of concrete by the American Society for Testing Materials was distinctly worth while. Only a few hundred engineers were present and but a few of them took part but the printed record will be extensive and inclusive enough to carry emphasis where emphasis was sought. If the discussion serves to focus attention upon the characteristics of concrete as exhibited in service and not in tests, its purpose will have been achieved.

There was some misapprehension as to the effect of such a symposium and a disposition to regard it as an attack on concrete. Such could hardly be the case. With upwards of 125,000,000 bbl. of cement going into concrete this year there can be no question as to its secure position as an engineering tool. That very security is its own protection against unwarranted attack. Without portland cement and the concrete which it makes possible the civil engineer today would be thrust back a quarter-century in the solution of most of his problems. But because concrete has had a wonderful development is no reason to consider it a perfected product or even to consider that all of its specific failures to achieve perfection are due to misapplication of known methods. We are far from knowing all there is to know. The true scientific spirit of trying to learn more was behind the symposium and all concrete users will be benefited in the degree which they, too, can become possessed of that spirit.

This inquiry toward perfection, however, has two phases. One was represented by the group of men who took part in the symposium, men who are well acquainted with the extended investigations into the nature of concrete and its behavior in tests and, to some degree, in service and who therefore are disposed to consider that most deficiencies in concrete are due to the non-observance of established rules, but who at the same time recognize the gaps in present knowledge. The other, and more serious, phase is represented by the larger body of concrete users who, if the truth be told, are blandly ignorant of any but the elementary information of what concrete really is and how it should be made but who are in the end really responsible for a large part of the concrete that is placed. In this latter class are most of the concrete foremen, practically all concrete workmen and too many engineers and contractors who pride themselves on having placed thousands of yards of concrete and on their expert knowledge of its technique.

A reading of the discussion will show that the experts, with a few exceptions, lay most emphasis on an insistence on the rules of making concrete. It is acknowledged that there are examples of poor concrete which cannot be classed under any of the known

diagnoses; sea water and alkali exposure are particularly elusive. It is admitted that the optimum amount of water, not especially well defined at best, can rarely be used in real construction. There are certain peculiarities of aggregate which lead to trouble but which so far we have not been altogether successful in discovering or predicting. Density, or perhaps better impermeability of surface, the great desideratum, is easier to demand than to get. Study to supply these deficiencies is recommended but the major insistence is on observance of rules.

The one exception to that group is a smaller body of students of concrete who feel that there is great opportunity for a development in cement which will lead to a better concrete. This group was ably represented at the symposium by P. H. Bates, of the Bureau of Standards. Mr. Bates' discussion is a challenge to those who know enough about the nature of cement and the methods of its manufacture to discuss intelligently any proposals for its improvement. It must be admitted that few engineers come in that category, but engineers can appreciate the fundamental requirements for concrete laid down by Mr. Bates and the deficiencies of cement in meeting them. How to improve portland cement to make up these deficiencies or to devise a new cement which will be acceptable must be left to those in the cement industry and to the few scientists and specialists outside that industry capable of studying the problem.

It is clear, however, that the one standard for cement while a most necessary stabilizing influence in the development stage of that material need not be considered the ultimate aim. So long as concretes made from different cements all passing the standard specification react differently to the same conditions it cannot be said that we have a satisfactory specification. The only ultimate solution is either to devise a specification which does indicate similar prospective reactions or to formulate different specifications for differing material.

It is true, as Mr. Kinney pointed out, that the conditions of cement manufacture with its scattered plants so located as to serve certain territories with a minimum of haulage make a uniform product economically desirable; it is also true that a multiplication of standards would be confusing both to producer and consumer. But it is conceivable that one standard would cover the major part of concrete used and that the special types would be applicable to the concrete subject to the kind of exposure that has given the greatest trouble, such as for floors, extreme weather exposure, sea water and alkali. If cements better suited to these uses can be devised the additional cost due to special manufacture would doubtless be absorbed by the user. Meanwhile it is reassuring to hear from a representative of the cement manufacturers that that industry realizes the seriousness of this demand and is engaged in a study of the nature of cement and its methods of manufacture of greater scope and more serious intent than ever before attempted.

The other phase of this inquiry into concrete behavior is something which all concrete users may take to heart. In spite of the vast amount of publicity work that has been done there are many immediately responsible for the mixing and placing of concrete, and even of the selection of the materials which make it up, who pay no attention to what are acknowledged to be elementary rules for making concrete. This is due sometimes to ignorance but more often to poorly placed self confidence. The foreman who never saw a piece of concrete he supervised five years after he placed it goes serenely ahead putting in what he has established in his mind as "good concrete" without ever knowing whether similar "good concrete" placed in the past has stood up or is going to pieces. The disease extends sometimes higher up than the foreman. Its cure lies in publicity; in constant hammering by those who do know what can happen to bad concrete; in more attention to the actual mixing and placing of the concrete; in better supervision and better inspection.

The education of the ignorant and self-complacent and the study of the yet unsolved problems of cement and concrete will be both furthered by such discussions as took place at Atlantic City. Concrete is too valuable an asset to the constructor for him to be satisfied with its present development.

Warning the Coal Men

FAIR warning to both miner and operator is the keynote of the anthracite report of the President's Coal Commission. The public must be protected against exorbitant prices and the distress of shortage incident to strikes. The commission is evidently fair and tolerant, but it is clearly convinced of the public interest inherent in the coal business—the Supreme Court's opinion in the Kansas Labor Court case to the contrary notwithstanding—and its recommendations all look toward a protection of that interest. As was foreshadowed in the earlier report government regulation, not government ownership, is recommended. But that regulation is not to be mandatory unless the two contracting parties in coal production are unable to come to an agreement which protects the public in both price and delivery.

In such an emergency government control is recommended. At other times the governmental interference would be confined to an investigation of the degree to which the public is in need of protection, with power to act to remedy any "conspiracy of either operators or miners, or both, directed against the general welfare of the people."

There is no specific charge that anthracite coal costs the public too much, but there is intimation that reduction in freight rates, royalties and dealer profits can be brought about. The commission evidently hopes that the presentation of the facts—not all yet available—will be impressive enough to bring both operator and miner to a better appreciation of the public's point of view, under the increasing threat of ultimate government control.

The representative and yet diverse character of the commission inspires respect in its report. Everyone in the coal industry must accept that; they will do well to go about the readjustment of their business in line with the commission's recommendations with the realization that the public is in a mood to get coal when they need it and at a fair price. The commission gives the industry a chance to do this without much interference from the government. If the industry fails—and the commission wants legislation to make sure that the government will know when it does fail—there is little doubt that the public will step in to run the coal industry itself.

Flood Protection Plan Adopted by Pueblo District

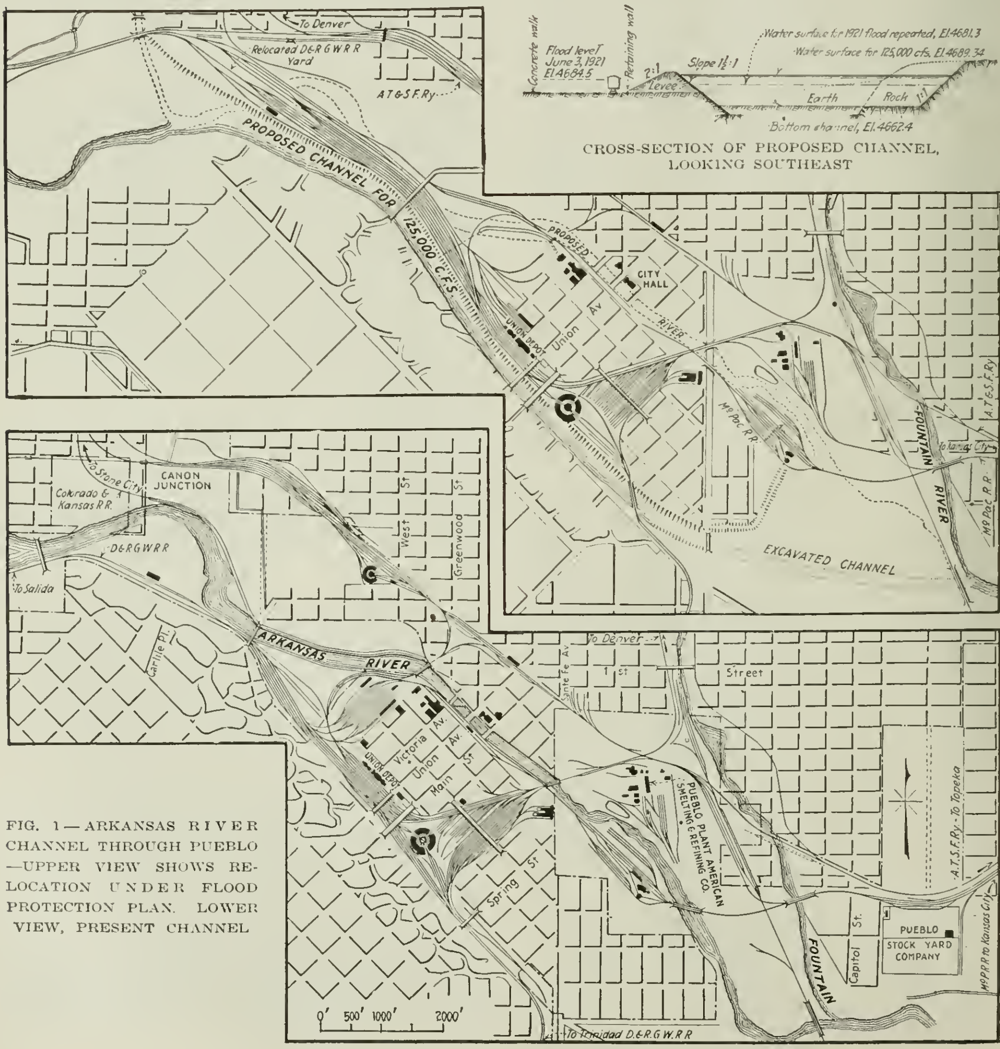
Will Provide for Flood More Than Twice as Great as That of 1921—Channel Through City to Be Relocated and Retarding Basin to Be Built Upstream—Cost Less Than Damage of Last Flood

BY C. A. BOCK
Secretary, Dayton Morgan Engineering Co., Pueblo, Colo.

On June 2 the directors of the Pueblo Conservancy District adopted a plan for controlling floods as worked out by the engineering staff of the district. The plan and its underlying conditions are outlined in the following:

Flood Conditions—Pueblo is on the Arkansas River, at the eastern edge of the foothills of the Rockies, in southeastern Colorado. With 50,000 population it is the second city in the state. Its central part occupies the river flood plain, just above Fountain Creek.

Over three-fourths of the 4,800-square mile drainage area above the city is mountainous, while 1,000 square miles are valley and mesa land lying east of Canon City, between the Wet Mountains south of the river and the Pikes Peak uplift to the north. The slope of the river through Pueblo is about 12 ft. to the mile, increasing gradually upstream to 25 ft. at Canon City. For 800 ft. through the city the channel is lined by vertical stone walls about 17 ft. high above the river bed and 150 ft. apart, but the floorbeams of Union Ave. bridge,



CROSS-SECTION OF PROPOSED CHANNEL, LOOKING SOUTHEAST

FIG. 1—ARKANSAS RIVER CHANNEL THROUGH PUEBLO—UPPER VIEW SHOWS RELOCATION UNDER FLOOD PROTECTION PLAN. LOWER VIEW, PRESENT CHANNEL

spanning this section, extend 5 ft. below the tops of the walls. The river bed is sand and gravel. Originally the river followed a winding course through its flood plain in Pueblo, but as the city grew it was slightly straightened. This straightened channel has a capacity of only 37,000 sec.-ft., while the maximum discharge of the flood of 1921 is estimated at 90,000 sec.-ft.

The 1921 Flood—The flood of June 3-5, 1921, was caused primarily by localized cloudbursts during the afternoon and night of June 3 over the mesas and in the foothills between Pueblo and Canon City, and was due to the runoff of less than 10 per cent of the drainage area above Pueblo. In the Boggs Flats district, about 15 miles southwest of Pueblo, more than 12 in. fell in 7 hr. or less; at Colorado Springs, about 45 miles north, 9.40 in. fell in 10½ hr.; and at Penrose, about 25 miles northwest, 7 in. fell in 17 hr., while the rainfall in Pueblo amounted to only 2.88 in. during 12 hr. In the Dry Creek drainage area, just northwest of Pueblo, a cloudburst possibly more intense than that of the evening of June 3 fell on June 2, but it did no appreciable damage at Pueblo. The rain continued at intervals in various parts of the valley during June 4-8, causing the failure on June 9 of the Schaeffer Dam, on Beaver Creek, about 30 miles northwest of Pueblo.

The main flood in the Arkansas River at Pueblo occurred during the night of June 3-4, the water beginning to rise at about 5 p.m. and reaching the crest of 24.7 ft. at the Main St. gage at midnight—a total rise of 20 ft. in 7 hr. Before 1 a.m. the river began to fall, and by 5 a.m. was down to about the tops of the levees. Fountain Creek, with a fall of 25 ft. per mile, had not reached appreciable flood proportions at 1 a.m., but developed a violent flood a few hours later, reaching a crest flow of 50,000 sec.-ft. at 4 a.m.

The flood runoff was confined to the territory below Canon City. No damage occurred at Canon City and practically none at Florence, 27 miles above Pueblo. Below Florence, the damage increased rapidly and was greatest at Pueblo, where the property damage is estimated at over $10,000,000. Hundreds of dwellings were swept away and many buildings were wrecked. The loss of life in the city was great; the official list of 78 bodies recovered doubtless fails to include all the deaths. Of the nine railroad bridges in the city, eight were either seriously damaged or completely destroyed; portions of the yards were badly wrecked or buried in sediment, and much equipment was washed away or seriously damaged. The intangible losses were very great.

Flood Possibilities—Indian legend tells of a flood much greater than that of 1921 which occurred prior to the settlement of the Arkansas Valley, probably in 1844. Newspaper articles together with statements of early settlers indicate that floods of considerable magnitude occurred in 1855, June 1864, May 1867, June 1869, August 1889, July 1893 and May 1894. The flood of June 11, 1864, seems to have been comparable in size with the flood of June 3, 1921. The flood of May 30, 1894, was the most destructive in the history of the valley prior to 1921; its maximum height was about 6 ft. lower than the flood of 1921, and surveys made by the city engineer at the time indicated that the maximum discharge was about 40,000 sec.-ft. Next in size was the flood of July 26, 1893, which reached a height about 10 ft. lower than that of 1921.

It is impossible to work out any very satisfactory flood-frequency relation from the brief records available for the Arkansas River. About all that can be said is that there have been three floods of 40,000 sec.-ft. or more at Pueblo in 75 years, or one in about 25 years, and that two of these may have exceeded 90,000 sec.-ft.

Far less is known about floods in Colorado than might be desired, and the determination of what constitutes a reasonable degree of protection is in the main a matter of judgment supplemented by studies and experience elsewhere. American storm rainfall records, studies of cloudburst rainfalls and of great floods in this country and in Europe, theoretical studies of the total amount of water which can be retained in the atmosphere and concentrated in any one locality under given conditions, and probabilities of various possible condi-

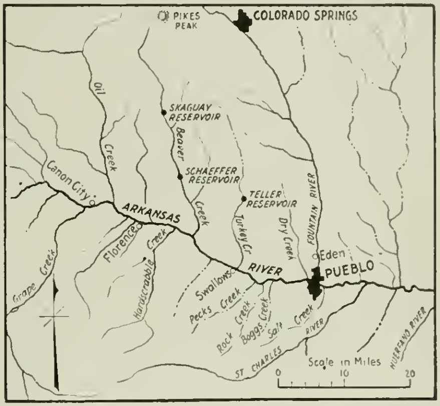


FIG. 2—PART OF DRAINAGE AREA ABOVE PUEBLO

tions and combinations of rainfall occurrence were considered in this connection. Thus, if the Boggs Creek cloudburst, which caused a discharge of over 55,000 sec.-ft. in the St. Charles River at 1 a.m. on June 4, had centered five miles farther north, this additional runoff would have been transferred into the Arkansas River and might have nearly doubled the peak discharge through Pueblo.

The conclusion reached was that the protection works should be made adequate to care for a flood two or three times as great as that of 1921, depending upon the relative duration and intensity of the rainfall causing the flood. Other requirements for a satisfactory plan were that the cost must be well within the resulting benefits; the construction should be as beneficial and of as little detriment to the city as possible; it should cause a minimum of disorganization and rearrangement; and it must be adapted to future requirements of a growing city. The railroad tracks and yards adjacent to the river were an important factor in determining the plan. The chief engineers of the various railroads held a number of meetings at Pueblo in an effort to assist in working out the problem, and further co-operated by making available maps, plans and data. All possible plans or methods of control were studied.

Adopted Plan—Fig. 1 shows the central part of Pueblo, as it is now and as the flood-control plan just adopted will change it. The business section centers roughly at the intersection of Union Ave. and Main St.

and extends southwesterly to the bluffs just beyond the Denver & Rio Grande Western Ry. yards. Fountain Creek, to the east, is separated from the business district by a prominent ridge, and joins the Arkansas River well below the city. The plan provides for moving the present Arkansas River channel in Pueblo to a new location along the bluffs at the south edge of the valley floor. It also provides a small retarding basin formed by the construction of a barrier at Rock Canyon, 6 miles above the city, for the purpose of regulating the flow of great floods before they reach Pueblo; the effect of this barrier is to cut off the peaks of extreme floods.

A disadvantage of the plan is that its first cost would be about half a million dollars more than the plan for a large retarding dam at Rock Canyon. Another possible disadvantage is that it disturbs the Denver & Rio Grande Western Ry. freight yards. Its advantages are numerous. The physical conditions inherent to the new channel location are favorable both as to cost and as to the degree of protection. The protection it affords is, with one exception, equal to that of any other feasible plan; it gives positive protection against floods from Dry Creek; it improves the streets at their crossings of the present channel; it opens Santa Fe Ave., the main thoroughfare from the south, avoiding undesirable grade crossings at the present channel; it decreases the number of bridges to be maintained by the city, county and railroads; it benefits the railroads operating in Pueblo; it greatly improves the appearance and attractiveness of the city, and makes important improvements in the general arrangements that are conducive to future development and growth; and it improves the channel alignment.

Space is available for a wide channel between important railroad structures and the bluff. There are limits to the desirable width and depth and flow velocities, which have been recognized in the design; the further control which is necessary is accomplished by the retarding barrier above Pueblo. The greatest flow through Pueblo will be limited to 125,000 sec.-ft., made up of a maximum outflow of 100,000 sec.-ft. past the barrier, and a coincident flood peak of 25,000 sec.-ft. from Dry Creek. The plan will protect Pueblo from a flood two or three times as great as that of 1921, depending upon the relative duration and intensity of the rainfall causing the flood.

The channel along the foot of the bluffs at the south side of the valley will extend from the mouth of Dry Creek, which enters the Arkansas River just above Pueblo, to Santa Fe Ave., where the Santa Fe Trail enters the city from the south, and will be constructed partly by excavation and partly by a levee along the left or north bank, the bluff serving as the other bank. The grade will be 10 per cent steeper than the average present grade, tending to a self-maintaining channel. From its lower end a small channel will be excavated through waste lands from Santa Fe Ave. to the present river channel at the Colorado & Southern Ry. bridge, for carrying the low-water flow eastward from the mouth of the deep channel.

Channel—The location, requiring a high paved levee on only one side, and involving a levee height which does not obstruct travel, has made it possible to design the channel for deep flow. The bottom grade is a continuation of the river bottom above and below the city. With maximum flow there will be a paved freeboard of 2 ft. The present value of the waste land below Santa Fe Ave. is not sufficient to warrant the cost of protecting it. A channel only large enough for low-water flow will be constructed here, with the expectation that water will overflow during times of flood. At any time in the future the protection could be continued below Santa Fe Ave.

The main levee, forming the left or north bank of the new channel, begins at the easterly end of the proposed railroad bridge over Dry Creek and runs to Santa Fe Ave. A similar levee will form the right bank of the new channel at its lower end after it turns away from the bluff. These levees will have a top width of 8 ft., a land-side slope of 2 to 1, and a water-side slope of 1½ to 1; the latter will be paved with concrete to 2 ft. above the high-water line.

The levees extending up Dry Creek are too high to be crossed by the tracks west of the Denver & Rio Grande Western freight yards without causing undesirable grades within the yard. The tracks are therefore carried across the stream at a level 8 ft. below the levee tops on a heavy watertight concrete bridge having

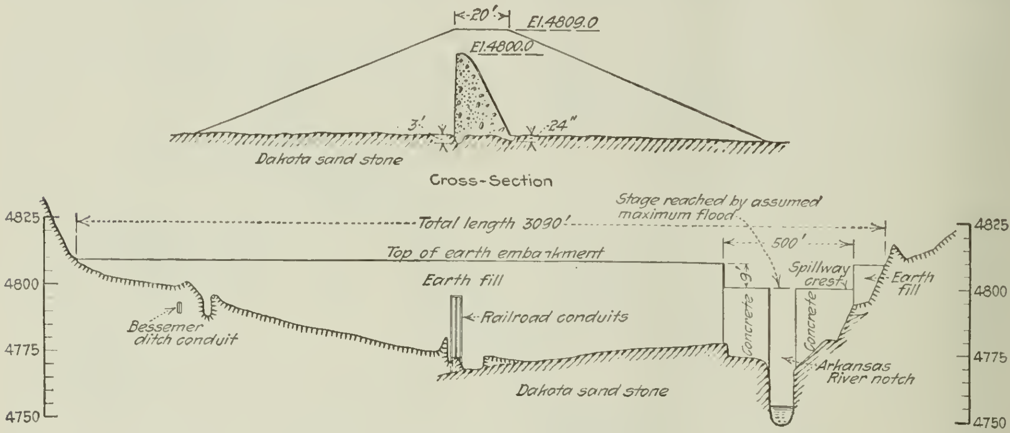


FIG. 3—ROCK CANYON RETARDING DAM

sides built up to the levee grade and at the ends connected to the levees.

Railroad Changes—The plans for railroad work aim to give the railroads every advantage of rearrangement possible at a cost to the district not to exceed the damage to the railroads by reason of the property taken. Yards and tracks of the Denver & Rio Grande Western Ry. which must be moved from their present location along the foot of the bluff are replaced by a new yard north of the new channel, extending from the westerly end of the Union Depot tracks to Dry Creek. The north unit, or that comprising all but the southerly seven tracks of the new yard, together with connecting tracks and new ice-house tracks, are to be completed ready for operation before any existing tracks are disturbed. This change will also include the construction of a new 15,000-ton ice house, freight house, coaling plant and several new roundhouse stalls. The Union Depot tracks are slightly altered but the building is not disturbed. Five single-track railroad bridges across the present river channel become unnecessary under the changes effected by the plan.

Abandonment of the present river channel makes possible the replacement of the former Santa Fe Ave. highway bridge and grade crossings by a modern subway under the four railroad tracks. Four highway or street bridges are provided across the new channel, and one double-track railroad bridge.

Retarding Basin—At the site of the retarding barrier, the river runs through a gorge 60 ft. wide and 20 ft. deep in solid Dakota sandstone formation. The barrier will consist of a concrete spillway 500 ft. long between two concrete wingwall abutments, cortaining an open notch outlet at the gorge, and earth fill extending from the abutments to high ground at the sides of the valley. The outlet notch will be proportioned to discharge about 84,000 sec.-ft. under assumed extreme flood conditions. In addition, two conduits for the Denver & Rio Grande Western double-track railroad and one for the Bessemer irrigation ditch will discharge water during large floods; these openings are so designed that the combined outflow under the assumed extreme flood conditions will not exceed 100,000 sec.-ft. The spillway, provided as a precaution to insure absolute safety to the structure in case of a flood beyond the limits of probability, will be built on the solid sandstone formation.

Other Possible Plans—Other plans of flood control included relocations of the channel, complete diversion, combinations of channel improvement and a reservoir control, a single large retarding dam at Rock Canyon, a system of small reservoirs on tributaries, a 500-ft. channel along the bluffs with extensive improvement to railroad facilities, and a large parked floodway south of the river with a high levee along the north bank of the present channel. Excessive cost, physical difficulties of construction, and inability of the railroads to co-operate in financing extensive improvements to their present facilities, eliminated these plans in favor of the one adopted.

The adopted plan is ample for the conditions of any storm rainfall on record in Colorado or any adjoining state. If during the next hundred years a storm should occur anywhere within 500 miles of Pueblo which would indicate that a greater storm might occur than is provided for, the protection works could readily be enlarged to meet such conditions. The works will handle a comparatively long-drawn-out flood, such as might result from sudden melting of snow under rare conditions, by the capacity of the improved channel, and a very sharp, sudden flood, such as might be caused by the breaking of a dam at some irrigation reservoir, by the barrier. Any existing or probable future dam above Pueblo could break suddenly without harm to the City.

Present Status—Preliminary investigations and surveys for the project were begun by the Dayton Morgan Engineering Co. in September, 1921. The Colorado Conservancy Act, which provides the necessary legal machinery for carrying out the undertaking, was passed by a special session of the legislature in April, 1922. The Pueblo Conservancy District was established under this act in September of the same year.

The Pueblo project is the second large flood-control undertaking to be carried out under a conservancy law in this country, the Miami system of Ohio being the first. The successful organization and prosecution of these projects thoroughly demonstrates the workability of this type of legal procedure for handling such undertakings. The first conservancy law was the Ohio Act, passed in 1914. It was originally drafted by Arthur E. Morgan and combines the results of practical engineering experience with legal conformity in such a degree as to make it more generally useful for conservation and flood-control projects than many of the state drainage laws or similar previous legislation. The Colorado Conservancy Act is modeled after the Ohio Act.

Quantities and Cost—The project involved the following physical quantities:

Channel excavation	999,000 cu.yd.
River levee	489,000 cu.yd.
Miscellaneous embankment	134,000 cu.yd.
Earth in barrier	217,700 cu.yd.
Earth in r.r. yards	516,000 cu.yd.
Concrete in barrier	7,200 cu.yd.
Concrete in bridges, walls and revetment	42,850 cu.yd.
Bridge steel	2,915 tons
New tracks and yards	35 miles

Its cost is estimated at $4,000,000. It will be paid for by assessments on the benefited properties and interests, distributed over a term of years. Funds for construction will be available at once, however, through bonds of the district, issued on the credit of the appraisal roll when approved by the Conservancy Court.

Motor Car Service on B. & M. R.R.

Possibilities of motor-car service on branch lines are mentioned in the annual report of the Boston & Maine R.R. as follows:

The management has been in touch with the experiments made on various roads with gasoline motor cars adapted for branch line service. It has also conducted experiments on local branch lines with a steam unit car. These trials, although generally successful from a mechanical standpoint, have been interrupted for operating reasons and have not yet been conclusive. They have demonstrated that the field for such a type of car may be overestimated, as many branch-line runs are so involved with main-line runs or with freight, express and milk traffic that it is not possible to substitute single unit cars. It is evident, however, that as soon as a satisfactory car has been developed, it can be used to advantage at a number of points on the Boston & Maine, and this development is receiving the careful consideration of the management.

A Discussion on the Behavior of Concrete

Observations on the Service Record of Concrete Structures Under Varying Conditions With Suggestions As To the Lines For Future Study

At the annual meeting of the American Society for Testing Materials, the evening of June 29 was devoted to a discussion entitled "What Properties of and Methods of Making Concrete Require Further Investigation," with a subtitle note to the effect that it was intended to be a "discussion of the requirements of concrete to meet the many varieties of service conditions;—what can be learned from behavior of actual structures?" There is given here an abstract of the printed papers and some notes, not necessarily quotations from the oral discussion.

Introduction

By Frank C. Wight
Managing Editor, *Engineering News-Record*

This is a stock-taking discussion. It is an attempt to get away from the view of concrete as a combination of cement, sand, stone and water which possesses certain physical properties to be studied and to look at it in detached fashion as a material to perform a service.

This behavior of actual concrete structures has seemed to the Society's Committee on Papers to be of exceptional interest in the study of concrete as a material. Inductive tests and studies have led to a number of theories and principles of the manufacture and placing of concrete, the best of which are embodied in modern practice. It is believed that adherence to these principles will result in a stronger and more lasting concrete, but unfortunately only time can tell whether this is a fact, always assuming that there is no readily discoverable dead line in quality, above which concrete will be everlasting and below which it will be of the most temporary nature. Five years from now possibly, better ten or fifteen years from now, we can observe concrete structures placed under recorded conditions and check up on the principles that governed their manufacture. One purpose of the present discussion is to move the clock back ten or fifteen years, to attempt to discover from the behavior of existing structures of that or greater age what were the properties and methods of making that affected their present known condition, be it good or bad.

It is recognized that this will not lead to a complete answer to the question "How can we make the perfect concrete?" It is recognized that conditions ten or fifteen years back are hard to discover, and that the elements entering into both manufacture and wear are many and diverse and that deductions made from the discoverable data are not incontrovertible. But it is hoped that by building up enough data there may appear some common facts which can be related to common results and which will be useful in the development of future practice.

The scheme of the discussion is first to consider the constituents of concrete and its methods of making, in the light of the service requirements, to discover if possible wherein lie future possibilities in cement, aggregates and proportioning and mixing. This is to be followed by a study of service conditions in roads, in sea water, in alkali water, and under the normal attacks of weather, tying up the behavior in so far as possible to the kind of concrete actually placed.

* * *

Future Requirements of Cement

By P. H. Bates
U. S. Bureau of Standards

Portland cement must have certain properties to meet certain service conditions. We are going to condense these to three conditions under which resulting cement products will be used: namely,

Class I.—Those atmospheric conditions in which the product will not be subjected to actual contact with water after making, but be subjected to only the water vapor present in the air. In this class of products we have reinforced-concrete buildings and mortars used on the interior of structures, especially as the top coat of floors.

Class II.—Those conditions in which the product is subjected continuously or intermittently to contact with water of a fair purity or low in solids composed largely of sulfates. In this class we find the greater use of cement, for it comprises such uses as in roads, mass concrete, stuccos, sewers, drain tile, etc.

Class III.—Those conditions in which the product is subjected to the action of a solution of salts, especially sulfates. In this class appear concrete used in sea water and concrete used in those arid regions where the soils contain considerable amounts of sulfate salts, as our "white alkali" regions of the West.

Stone is not permanent. Any geologist will tell us that our kaolins are disintegrated granites and that water in certain places is very "hard" because of dissolved limestone. Hence, in cement and its products we are only properly concerned with a relatively permanent material—but a material which will give such adequate service, be it months or years, as coupled with its cost of installation and superiority of resulting product will justify its use.

Atmospheric Exposure—The uses indicated in our Class I may seem to be the least severe of those to which cement may be placed. But even if such is the case, it is quite evident that we are in need of much research before we have the ideal cement for such purposes. Flexibility in the use of cement entails the use of more water than we should use and consequently in certain ways—strength and shrinkage—produces an inferior product, although in other ways it is superior. But what has been done so far as the cement is concerned, to develop a cement which would possess a minimum strength reduction and a minimum increase in shrinkage with the use of increased amounts of water? We have not made any thorough or even preliminary investigation to see how the different brands of cement vary in these respects. It is now time to investigate the quality of brands exhaustively, as a preliminary step in a research tending toward developing a cement affected in the least by the use of large quantities of water.

Very closely connected with the question of excess water used to produce readily flowing concrete is that of a more "workable" one obtained without the use of water in excess or admixtures of any kind. But how many researches have we in which it has been attempted to find if we have any cements more strikingly "plastic" than the others?

All floor finishers will say that with all cements there are occasions when a non-dusting, non-cracking floor is obtained and that with certain brands the likelihood of obtaining a good floor is far greater than with others. But they are seldom sure when the desired result will be obtained, and no one has developed a test or tests that will predict this quality. A research that would show just what constituent or combination of constituents in the cement, or what phenomena in the reaction of water on these, or what physical properties of the cement, as hardness of particles or fineness of grain, produce the expected and hoped-for result, would not only enable cement to

regain a favor that it has lost in this use but would also reduce the cost of floors and materially increase the use of portland cement for such purposes.

It is believed also that this same research would solve the problem confronting road builders where or when a very low atmospheric humidity exists. A number of instances of trouble have been reported of roads cracking under these conditions before final set has been obtained—and the trouble has not been due to excess water or poor choice of aggregate or poor grading of aggregate. *The difficulty has been with the cement.* Here again our tests are at fault. We store all test pieces of cement under close to saturated humidity conditions before and during the time of set. But much cement has to set in an atmossphere under considerably less than 50 per cent relative humidity and cannot be protected from evaporation during this period.

It has been our duty to examine the veneering of a large number of steel and concrete frame structures and we have been surprised at the relatively larger numbers of failures of the veneer on the concrete than on the steel structures. Architectural terra cotta, stone, and brick veneer show failures of a type that lead almost conclusively to the deduction that the concrete by contracting has induced strains in the veneer that have crushed it, especially when setting of the latter has been faulty due to the lack of fully embedding the individual units in the mortar.

Our present "soundness" tests are supposed to determine "constancy of volume," but this is only very relative and not near to the degree of accuracy that we must have and will ultimately have for certain types of work.

Moist Exposure—A road saturated with water may freeze and in this condition be subjected to the action of a warm sun on one side while the other remains well below freezing. A sewer is subjected to the action of water at practically all times and yet somewhat more than 50 per cent of the cement is soluble in water. A thoroughly dry stucco may suddenly be subjected to a heavy or long rain and while saturated be frozen.

Note that the conditions here are somewhat different from those existing in the first class. It is assuming rather much to infer that a cement which will be successful under the first condition will necessarily be just as successful under the second. That we do need studies for making cement still more adaptable is realized when we examine roads or massive retaining walls or foundations or stuccos. We are confronted often with a large number of shrinkage cracks which furnish a very unsightly appearance and would seem to mark a condition which may be conducive to ultimate failure. This condition occurs even under the most careful cases of application so frequently that it must be considered as produced by some inherent quality of the cement.

Our "standard" tests for cement will not tell the whole story. The character of the grading of the aggregates and strength tests of the concrete are also insufficient. Our present methods only very roughly approximately enable us to predict the suitability of a concrete for any particular use.

Concrete through which water *constantly* percolates is doomed, but only locally at that point where the percolation takes place. Hydrated cement, the matrix of concrete, is just as soluble as limestone, in fact it is more soluble. It has been found by sad experience that water must be kept out of concrete and it is being done on all large jobs. With the prevention of the water percolating through the concrete, the latter is giving adequate service. But cement in itself can not be so changed as to make the concrete impermeable. Here is a condition which requires the joint proper use of all the ingredients of concrete, cement, aggregate and water, and when so used an impermeable concrete can be obtained.

Saline Exposure—Concrete when subjected to the action of the solution of certain salts, especially sulfates, has been found to give a service which has been adversely criticised. Yet it gives a far greater service and return on the investment of installation than any other material that might be substituted for it at less, equal or greater cost.

Again we feel that the major part of such studies must be confined to the cement. If we have a matrix unaffected or but very slightly affected by these solutions, then we must of necessity assume that we would have reached the ideal condition or at least have it in sight. For we now know enough about the quality and the grading of aggregates needed for such work to be able to make the proper choice in this respect without further study. But we have such a meager amount of information in regard to the resisting qualities of cement to such salt action that this field of study may be considered a virgin one. However, we must start not with the cement as it reaches the market, but go to the plant and still further to the quarry. We must know its entire history just as much as we must know the entire history of the concrete—assuming as is generally but erroneously done that the history of concrete starts with the delivery of the cement and aggregates to the job. We must know not only that it is a certain brand made at a certain plant but we must also know from actual observation how and from what it was made and this detailed knowledge must be obtained by some keen observer more skilled in making such observations than in making cement.

We must have tests of the cement which will give us values which are indicative of the different behaviors which cement reveals in service. However, when we have all these data we are only in the position to make concrete and feel assured that we have on file some observations which have in other cases been overlooked but which are essential. In the meantime investigations must be under way which will have for their purpose the determination of the course and the products of the reaction which takes place between the constituents of cement and water, how these are affected by the various solutions with which cement may come in contact and how the reaction may be affected by various proportions of the constituents or by the different physical characteristics under which they may exist.

There is no question but that a deductive study of concrete forces us eventually to conclude that we are grossly ignorant of cement; what it is as produced on a plant scale; what variations in ultimate quality we must expect in any plant's production from day to day; what is the nature of the reaction with water and how this reaction will deport itself in a variety of atmospheres and solutions. Some intensive work must be done that will solve these questions and enable us to produce the exact kind of cement we want at any time after having found out the kind of cement we must have for the case in question.

Those but casually acquainted with the industry are surprised that a product made to meet our present standards can be produced under such a set of widely varying plant procedures and equipment as now used. Though the product may be "standardized" it is quite evident that its methods of production are not. While it is generally believed that this wide latitude in methods does produce the same character of product, we are not convinced that such is the case, especially in view of the incompleteness of the methods used in examining the marketed product. At the present time the only incentive for study is the matter of needed economies in production, and the limited studies already made have shown the economic value of certain changes in methods—as the waste heat boiler. Furthermore, in this case it seems reasonable to believe that the required care demanded of the kiln operator, in order to insure a uniform delivery of heat to the boiler, has produced a change in the cement, more marked than is generally realized. Studies of the efficiency of the grinding apparatus, not only as to the relative operating costs of the several types of machines available, but extended, as they should be, to the efficiency of the resulting cements, would be of extreme value to both consumer and producer. How interesting would be an investigation on the properties of the resulting

cements in which the sole variable in the methods of production would be the use of wet or dry raw mixes! Fuel economy demands a thorough study of all available types of kilns and furnaces and of necessity such a study must include the question of the quality of the cement produced. May not such studies result in our specifying what methods of production are desired in addition to the physical properties, just as we now specify steel of certain physical properties made by open-hearth or bessemer process?

* * *

Proportioning and Mixing

By R. B. Young
Hydro-Electric Power Commission of Ontario

Under certain conditions, concrete mixtures can be designed by new methods of determining proportions to give the strengths sought. Under other conditions equally likely to be met with on the job, the methods will not give the results required.

More exact methods for measuring the raw materials of concrete on the job can be studied to advantage. Under average conditions, our present methods of measuring concrete materials, particularly in the case of fine aggregate, result in lack of uniformity in the concrete mixtures, and their inherent errors tend to produce undersanded and permeable concrete more susceptible to the action of destructive agencies such as frost, alkali or sea water. Present methods are also responsible for a great many cases where contractors have overrun their estimates for cement. A 10 to 15 per cent increase in cement requirements brought about by improper measurement of fine aggregate is not unusual.

Nor do we know all there is to be known about the laws governing mixing. The relationship between the time during which a concrete is mixed and its strength at a given period is fairly well established, but little is known as to the relative effectiveness of different mechanical mixers.

What do we know about the influence of plant layout and construction on proportioning and mixing concrete? For example, the arrangement of bin gates in stationary plants influences the absolute volume of aggregate in a measured volume, and this in turn influences the cement content and water requirements and thus the quality of the concrete. Again, with the proper consistency there seems to be a remixing action during the transfer of concrete through chutes. How much do we know about this? Are our methods of charging a mixer altogether satisfactory? They are, probably, when we consider only our present equipment; but equipment could be modified if experiments demonstrated that other methods gave better concrete or were more economical in materials and power.

* * *

Concrete Exposed to Atmosphere

By P. J. Freeman
Consulting Engineer, Pittsburgh

A careful study of many concrete structures which have deteriorated under atmospheric conditions has led the writer to believe that most of the trouble could have been avoided if the engineers and contractors had drawn their specifications and handled the construction so that the concrete produced had the qualities necessary to meet the demands of that particular service. Instead of doing this, the required strength was used as the principal guide and little or no thought was given to other requirements, particularly impermeability, but it was assumed that any concrete having sufficient strength for the purpose would also be durable, regardless of the conditions to which the concrete was exposed.

Numerous examples could be cited, but one or two will serve to illustrate the point which the writer wishes to make.

A concrete dry-dock on one of our northern lakes was constructed at a cost of about a million dollars, using a mixture of one part of portland cement, three parts of sand and five parts of limestone. At the end of five years the inside or exposed surface began to disintegrate so badly that at the end of about six years at least thirty per cent of the entire inside surface had crumbled and spalled away to depths varying from one to six or eight inches. Horizontal cores were drilled from the walls, which were thirteen feet thick. An examination of these cores showed that, extending in for several inches from the exposed surface, the concrete was mostly sand and cement. In placing the concrete, care had not been exercised to make an impermeable surface, although the compressive strength of the concrete was entirely adequate for the load requirements. The alternate filling and emptying of the dock caused water to percolate into the porous or permeable concrete and the action of the weather, particularly freezing and thawing, produced the disintegration which continued to eat away the walls until extensive repairs were made. The outside of the dock had been back-filled with loose material, principally cinders, which permitted water to come in contact with the wall within a few feet of the top. Excavations to remove this back-fill were made and in no instance was any disintegration found, as the wall had been protected from freezing by the fill.

A similar example shows quite clearly the results of neglecting to consider impermeability as an important factor in the design of a large hydro-electric plant. The project was started about 1912 and after building part of the dam the project was abandoned until recently. The mixtures used were 1 : 2 : 4 and 1 : 3 : 6 of portland cement, river sand, and river gravel. The 1 : 2 : 4 mix does not show signs of serious disintegration, but the concrete of the leaner mixture is in very bad condition. The investigation has not been completed, but it seems to be another case of not having the concrete made to suit the particular class of service but designed only to furnish the required strength on the assumption that such concrete would be durable.

It is not necessary to discuss the effects of placing concrete in cold weather, except to observe that many jobs are spoiled because those in charge neglect to consider that concrete must be warm to set and that they have not satisfied this requirement by merely keeping the materials from freezing while being mixed and placed and for a short time afterward. A $300,000 reinforced-concrete building was built last winter under these conditions and when the first warm day came the concrete began to go to pieces, and it is doubtful if satisfactory repairs can be made to save the structure.

An entirely different kind of trouble was experienced in connection with the base of a concrete highway. The mixture used was one part of portland cement, three parts of river sand, and six parts of river gravel, which were tested and passed by the State Highway Department. The concrete was placed during the summer months and allowed to harden before the asphalt top was applied. After about two years it was necessary to make some repairs and it was found that the concrete was not firm and hard but could be easily broken up, and that the gravel was covered with a white deposit of calcium sulfate. After exposure to the air the concrete had a tendency to become hard. Inasmuch as all of the materials had been found to comply with the best modern specifications and chemical analyses of the concrete showed that the mixture was 1 : 3 : 6 as specified, it was not possible to draw definite conclusions and a more thorough study should be made of similar conditions with particular reference to the specifications covering the richness of the mix.

In every case the concrete disintegration mentioned, the cement was all tested and complied with the specifications of the American Society for Testing Materials.

Designers of concrete should realize that they must consider the atmospheric conditions to which the concrete will be subjected and eliminate from their design any features which would tend to cause or permit water to percolate into the concrete.

At the present time it is almost impossible to obtain the facts necessary to make a satisfactory investigation of any concrete structure that was built a few years ago.

If concrete producers will make more careful records and tests and exchange ideas concerning their troubles, the writer feels that it will take only a few years to eliminate most of the unsatisfactory conditions which now exist.

* * *

Concrete in Roads

By A. T. Goldbeck
U. S. Bureau of Public Roads

It is difficult to conceive of any type of concrete structure which is subjected to a more complex set of influences than is a concrete road surfacing. Investigations of the past few years are just beginning to show us something of the stresses to which concrete roads are subjected by the many kinds of forces acting upon them.

The concrete is "cured" by the use of some means for keeping the surface wet, such as frequent sprinkling and with the use of a wet earth covering by ponding, by straw covering, and in the last few years by a sprinkling of calcium chloride which acts as a hygroscopic material. After a short period of curing, the moisture is allowed to dry out from the concrete, and, as has been well established, shrinkage now takes place and the concrete slab by contraction slowly moves over the subgrade. The forces of friction thus developed between the subgrade and the slab produce tensile stress in the concrete, and when this stress exceeds the tensile strength, transverse cracks form at frequent intervals. Changes in temperature of the slab also expand and contract it and cause it to slide over the subgrade, again producing compressive or tensile stress in the slab. During the day, the top surface is heated by the sun to a higher temperature than the bottom surface and naturally the slab is warped downward at the edges and corners. During the night the reverse is true; the corners warp upward. In many cases they actually leave the subgrade. During periods of dry weather, the top surface becomes quite dry, while the bottom surface is in contact with the more or less moist subgrade. Under such conditions the concrete might be warped and bent upward at the sides and ends. In the meantime the varying moisture conditions in the subgrade are swelling and shrinking the soil in a most non-uniform manner and the road is offered non-uniform support. When cold weather comes, the ground freezes. Very naturally the entire road is raised due to the expanding action of the frost, and if it happens that snow is cleared from the center of the road and is heaped up along the sides, the insulating blanket of snow prevents as deep a penetration of frost at the sides as at the center. The center of the road is then heaved more than the sides which then overhang their center support like two cantilever beams, and through overstress thus created, the slab is cracked down the center. Frost action within the concrete itself also must be resisted, and this requires a dense, strong concrete of low absorption. A number of natural influences then have been at work even before traffic is turned onto the road.

The heavy fast-moving loads of the present day produce high stress in concrete slabs under certain conditions. This is especially so with heavy fast-moving vehicles having well-worn solid rubber tires. Impact stresses are apt to be high and this is especially true in the vicinity of joints and on roughly finished spots in the road. Not only does this heavy impact produce high bending stress, but the local pressure on the immediate surface is considerable. There are concrete roads in which exceptionally poor coarse aggregates have been used largely as a matter of expediency, which are now showing signs of distress from the action of traffic.

When we add to all of these influences the troubles which are apt to occur due to the use of unsuitable materials, too much water, or greatly inferior workmanship, coupled with a design ill-adapted to the conditions of subgrade and traffic, the wonder is that concrete roads are capable of giving the most excellent service which, in general, they are giving under our present-day rubber-tired traffic.

Defective Design—The concrete road has had its share of failures due to the use of a design which has been ill-fitted for the traffic and subgrade conditions. There have been reasons for poor design in the past, for many principles are only now beginning to be recognized and understood, and moreover, our oldest concrete roads have witnessed an increase in variety and intensity of traffic such as has never been recorded in a similar period in history. Again, the phenomena in connection with the movement and accumulation of moisture in the subgrade and the action of moisture on various kinds of subgrade materials have never been given thorough study.

Defects Other Than Design—There are other defects occurring in concrete roads, some of which are of no particular importance, and others of which are quite serious. These defects as observed by the District Engineers of the U. S. Bureau of Public Roads, by their assistants and by the author are listed as follows:

1. Cracking:
   - (a) Transverse;
   - (b) Longitudinal;
   - (c) Diagonal cracking;
   - (d) Corner cracking.
2. Hair Checking of the Concrete Surface.
3. Surface Irregularities in the Pavement as Constructed:
   - (a) Due to lack of uniform consistency of the mix;
   - (b) High joints;
   - (c) Slumping of concrete on grades;
   - (d) Unevenness of side forms.
4. Settlement of the Pavement.
5. "Blow-ups" of the Pavement.
6. Slipping of Joints.
7. Spalling at Concealed Joints.
8. Surface Scaling:
   - (a) Due to fine aggregate;
   - (b) Too wet a mixture or excessive finishing;
   - (c) Calcium chloride curing;
   - (d) Freezing.
9. Surface Raveling.
10. Surface Wear.
11. Concrete Disintegration:
    - (a) Due to alkali;
    - (b) Defective materials.
12. Surface Pockets:
    - (a) Due to dirty aggregate, balls of clay, coal, wood chips, soft material.

Summary—With the possible exception of cracking, there is hardly a defect listed and described above which cannot be almost entirely eliminated from concrete roads through the use of proper design and construction methods, satisfactory materials and their intelligent combination.

Concrete for pavements must have high flexural and tensile strength in order to minimize the frequency of cracking, it must have high density to better enable it to exclude moisture; the aggregates must be well bonded together to resist the disintegrating action of traffic, and the mixture must be homogeneous in proportions and consistency.

Perfect concrete road building is an intricate operation which too often is entirely under the control of inspectors who are not well versed in the technique of materials or construction. They do not understand the great importance of careful attention to details. By all means, concrete road inspectors and, in fact, inspectors on other types of concrete construction should be schooled in the causes and effects in connection with the various operations under their control. It is absurd that millions of dollars worth of materials and expensive construction should be left at the mercy of any but the most competent of inspectors.

* * *

Exposure to Sea Water

By S. C. Hollister
Engineer, Philadelphia, Pa.

Of the many structures of plain or reinforced concrete exposed directly to sea water for the past ten years, few are free from some degree of deterioration.

The nature of the deterioration of plain and reinforced concrete by exposure to sea water is distinctly divided into two classes: (1) The deterioration resulting from the corrosion of the reinforcement, and (2) the disintegration under certain conditions of the concrete itself. Both forms are found only above the level of complete immersion. Attack is found regardless of whether sea or fresh water was used for gaging; whether the structure was cast in place or formed of precast units; or whether construction proceeded in the open air or under water. The deterioration seems to bear little relation to the variety of mixtures usually employed in construction work. Faulty placing or excessively wet mixture, however, hastens the attack.

The attack on reinforced concrete begins with the corrosion of the reinforcement. No corrosion is found where

there is complete immersion. It begins just above the mean water level, in from two to five years after construction. A two-inch covering of 1 : 2½ : 5 mixture or richer will protect the reinforcement from corrosion by fresh water; but no concrete mixture in this thickness will protect the steel from sea water corrosion.

Due to the expansion accompanying corrosion, the concrete covering is split in the direction of the reinforcement. These cracks permit more ready ingress of the sea water and the attack proceeds with increasing rapidity. Splitting does not extend below low tide to any great extent, because corrosion does not take place there; instead, it progresses upward, not only within the wave or spray belt, but as far as salt-laden air is found. A satisfactory permanent protective coating for the steel which does not seriously reduce the bond has not yet been found.

Once a portion of the surface of the concrete has been spalled off, the sea water attacks the concrete mass in the same manner as in plain concrete structures.

The attack on plain concrete begins at the mean water line and extends in diminishing degree upward and downward from that level. It originates wherever the sea water can gain access to that portion of the concrete mass lying within the surface skin originally formed over the exterior of the structure. Sometimes this access is provided through a honey-comb, or through a layer or pocket of laitance; at other times it is provided through the removal of the surface skin by abrasion or frost action.

Once the sea water has reached the inner concrete, chemical disintegration of the cement develops. The matrix is softened in time to such an extent that the concrete can be scooped out with the hand. Magnesium chloride, and especially magnesium sulphate, in the sea water appear to be the principal agents of attack. Calcium sulphate in considerable quantity is formed; and this compound having no setting properties under the conditions, the mass may be washed away by stream or wave action. Mechanical abrasion and frost action hasten disintegration.

Chemical disintegration begins at once after the inner concrete is reached by the sea water. Marked disintegration has been noted in two years where honey-comb or laitance forms the path of communication. Carefully made structures two years old, so situated as to be subject to abrasion by floating ice, have shown well-started attack. In some cases, the concrete has been wasted away for a depth of from eighteen inches to two feet on structures eight to ten years old.

To date, little has been learned of a constructive nature concerning the arrest or prevention of this wide-spread attack on concrete marine structures, other than to armour them with treated timber, stone or paving brick. Little is accurately known of the chemistry of the concrete disintegration. Cements other than portland are advanced for marine use; but although each may have some instances of successful use, there is no well-defined conclusion of preference over portland cement. The lack of thorough understanding of all cements is a handicap in the solution of the problem.

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Mass Concrete in Service

By Arthur P. Davis
Recently Director, U. S. Reclamation Service

The writer has had opportunity to examine many large masses of concrete such as dams and bridge abutments, either in a supervisory or consulting capacity, or as an observer during and after construction.

These observations are very convincing upon two points:

1. That where clear water can be made to glide over concrete without disturbing its velocity or abruptly changing its direction, there is no practical limit to the velocities that can be permitted without harm.

2. That concrete which is subjected to the impact of water under high velocity is rapidly eroded and that under such conditions the velocities must be very carefully limited.

Water carrying sand or grit will gradually erode good concrete if the velocity is high.

Exposure to Alkali

By G. M. Williams
University of Saskatchewan

In numerous instances, irrigation structures, foundations and other concrete works have shown signs of failure after short exposure to the salts in the soil. Various theories as to the cause of deterioration were advanced and it was first believed to be due to the crystallization of the soluble salts in the pore space of the concrete, which action was greatly accelerated by the use of poor aggregate and poor methods of preparation and curing. The problem was further complicated by the fact that not all concretes exposed to *apparently* similar conditions were attacked, tending to substantiate the theory that aggregates and workmanship were to blame. The possibility that the deterioration was primarily due to reaction between the salts in solution and constituents of the cement was also advanced but was not generally accepted owing to lack of experimental verification and the knowledge that materials and workmanship were of inferior quality in some cases.

Deterioration due to alkali has generally occurred in the arid or semi-arid sections of the Western states. The weathering and breaking down of rocks by long exposure to the elements has resulted in the formation of soil, and the salts of sodium, calcium and magnesium which were once among the constituents of the rocks are now found distributed throughout the soil, usually in greatest amount in the clays and shales. While most ground waters carry in solution appreciable quantities of one or more of these salts, it is in the arid regions that concentrations are sufficiently high to result in such waters being classed as alkali waters. In the humid region, heavy rainfall for many years has washed most of these salts from the soil, but in the arid and semi-arid districts, a smaller rainfall together with soils less easily drained have resulted in the conditions as now found. The excessive application of irrigation water, together with poor drainage facilities, has resulted in a gradual raising of the soil-water level which has brought about a high concentration of salts at the ground surface and a few feet below.

Investigations to study the cause of deterioration were started in those localities where the trouble was first encountered.

All of the investigations may be considered as establishing the first phase of the investigation—definitely fixing the problem—and demonstrating the fact that disintegration is primarily a chemical action, rather than a physical disruption, and indicating the variable factors and conditions which must be met in practical work. The second phase of the work involves the discovery of means, materials and methods for eliminating the possibility of disintegration in future work.

1. In many districts of the Western states and Canada there are areas where the salt content of the soil is high and concrete cannot be used with assurance of success.

2. Study of field conditions indicates that deterioration of concrete structures is almost entirely confined to regions where the sulphate type predominates. Good quality concrete is apparently being successfully used in chloride and carbonate soils.

3. Rapidity of disintegration varies directly as the sulphate concentration.

4. Where concentrations are permanently low, good quality concrete appears to have a life which fully justifies its use.

5. Concentration of salt in ground water may be extremely variable at points short distances apart. There also appear to be seasonal or yearly variations in some districts.

6. Concrete of high quality is most resistant to action. High quality for exposure to alkaline conditions is measured by impermeability or resistance to passage of water through the mass under pressure. The one big factor necessary to secure low permeability is high cement content, so that high compressive strength can generally be

used as a criterion of low permeability. Consistency, within practical working limits, and gradation of aggregate are secondary factors in obtaining a concrete of low permeability.

7. Where alkali conditions are bad, the factor of safety against failure can be greatly increased by employing proper drainage precautions.

8. The employment of a membrane waterproofing may prevent action for a time at least, but such a method is not practicable under all conditions.

9. Portland cement, as now constituted, is inherently subject to attack by sulphates in the soil and ground water and the practical and final settlement of the alkali-concrete problem is dependent upon modification of, or the discovery of some material which may be added to, portland cement to make it immune to such action.

* * *

Oral Discussion

Duff A. Abrams, Structural Materials Testing Laboratory—The strength and resistance of concrete depends mainly on the water-cement ratio and not on the aggregate. Aggregate must be well graded, clean and structurally sound. Given that a strong and durable concrete can be made provided methods of manufacture are correct.

H. S. Spackman, Philadelphia—No encouragement is given to the manufacturer of cement to strike out on new lines so long as the user does not call for other than standardized cement. The user must be educated to his own needs in this respect. Portland cement is far from perfect. The durability of concrete depends largely on the binder cement because the aggregate when properly selected is quite permanent.

Robert W. Lesley, Philadelphia—From long experience in the manufacture of cement, particularly in the early days when more than fifty-seven varieties were made, it seems strange to hear suggested a reversal of the one standard toward the getting of which so much effort was expended.

W. F. Purington, New Hampshire State Highway Department—Study must be made of aggregate. In New England particularly there is danger from felspathic sands which are in process of decomposition. Much of this type of sand, however, is used in concrete. It is initially weak and there may be progressive disintegration. Furthermore, shape of sand is a factor of strength. Slaty or ferruginous schists are stronger than granular sands. This may be because the fibrous material interlocks. Microscopic study of sand is most necessary in determining strength.

R. W. Crum, Purdue University—The methods of manufacturing concrete should be studied. There is need for extensive research into fabricating methods. The art of placing is far behind the science of design. Unquestionably with this, too, should go more study of cement.

T. G. Campbell, J. N. Chester Engineers, Pittsburgh—Cited several cases of disintegrated concrete in bridge floors, filtration plants, etc. His firm feels it cannot prophesy that concrete will not deteriorate.

W. C. Hart, Portland Cement Association—Principal difficulty with outdoor concrete is the excessive use of water. There is evidence in study of existing structures that those built before the water transportation method of placing concrete was developed are in good condition. Numerous structures have been examined, particularly the Illinois Central bridges built in 1902 and the Illinois-Mississippi Canal structures built in 1893. All of these show excellent present condition. Danger today is the use of too much water and lack of proper curing. Most careful inspection is necessary.

R. S. Greenman, New York State Engineer Department—What is needed is production of a non-absorbent concrete. Concrete which will best resist frost action is the most permanent. Density of concrete will not always keep out water, because dense concrete may contain aggregate which is porous. Copings are the weak points in most concrete buildings. Why do they disintegrate? Because practice allows the poorest concrete to flow to the top or sides with no compactness.

J. J. Payne, City Testing Laboratory, Pittsburgh—Many bad cases of concrete street base failures in Pittsburgh. Investigations have not fully revealed the trouble. The practice of concreting is far ahead of the theory. It will not hurt to study it.

W. G. Atwood, Marine Piling Investigation—If we can make a stable cement and make a good concrete later from the cement the problem of concrete in sea water is solved. Portland cement of today does not meet Vicat's hydraulic index for sea water written a hundred years ago.

E. E. Butterfield, Chemist, Borough of Queens, New York—Described special attention given to concrete in sea water now being placed in Jamaica Bay Boulevard. This concrete, due to special precautions, has the remarkable density of 0.875 and tests 4,200 to 6,000 lb. Hopes that it will resist sea-water attack, but is not altogether confident. There are two examples in the Borough of Queens of concrete in sea water, one carefully made, which is resisting the attack, and one poorly made, which has quite disintegrated.

H. S. Mattimore, Pennsylvania State Highway Department—We can get the most education from failures, but we make a mistake in giving brief rules for making concrete. The concrete placer himself must be educated. Materials are not being tested the way they should be in most work. We must study something besides strength. Aggregates must be studied for more than their strength.

W. M. Kinney, Portland Cement Association—The greatest trouble with concrete today is the water content. Sooner or later proportioning will be on the basis of a fourth ingredient, water added to the cement, sand, and stone which are now noted in ingredients. Failures of concrete observed are mostly in surfaces and in appearance. The structures are still quite capable of sustaining the loads for which they were designed and for which they are used. A suggestion for various standards of cement would bring back the old days of the cement business which were economically unsatisfactory. With the great number of cement plants designed so as to reduce as low as possible the freight distribution of cement, there would be the greatest difficulty in manufacturing different kinds of cement, certainly not justified if the present cement will serve. So far nothing has been developed to show that the present method is not satisfactory. In construction the placing in the forms is the detail most neglected and the actual fabrication must be perfected in a wide degree.

R. L. Bertin, White Construction Co., New York—There are plenty of good rules for making concrete. The trouble is they are not observed. If the studies on concrete and the methods of making it could be enforced we would have less trouble.

R. J. Wig, Los Angeles, Calif.—There is little danger of plain concrete in sea water so long as full attention is paid to its constituents and manufacture. Reinforced concrete in sea water is a different matter, though with proper design the deterioration in the slender type of members even may be reduced, if not eliminated.

Ernest Ashton, Lehigh Portland Cement Co.—Attention should be called to the fact that the present activity in the study of concrete has been brought about most by the activities of the manufacturers who went far beyond the manufacture of the cement itself into a study of the concrete in order to perfect the material which the cement is used in. So far the manufacturers have been anxious to establish a standard for cement so they might know what they are making and devote their attention to making the one thing. This standard having been established and the methods of testing it having been established, they are now ready to enter into a more detailed investigation of the nature of cement and the method of improving it. Such studies are going on and it is hoped will result in some material benefit to cement users. These users should bear with the manufacturers during this study period. The problem is not simple and the solution is being honestly sought.

Building Intercepting Sewers and Siphon at Hammond, Ind.

Large Concrete Pipe in Deep Trench—Well-Points Drain Sand—Traveling Trestle Handles Excavation and Backfill

By J. B. Murphy
Engineer of Construction, Sewer Department, Hammond, Ind.

In constructing a system of intercepting sewers at Hammond, Ind., features of special interest were the use of concrete pipe up to 9 ft. in diameter, well-points and pumps to drain the deep bed of water-bearing sand in which the sewers are laid, a trestle and cable-haulage system for handling the excavated material and backfilling, and the construction of a double-barrel siphon under the river. The construction plant and methods are shown in Figs. 1 and 3.

In the summer of 1922 contracts were awarded for the construction of the main intercepting sewers and pumping station of the new sewerage system, which

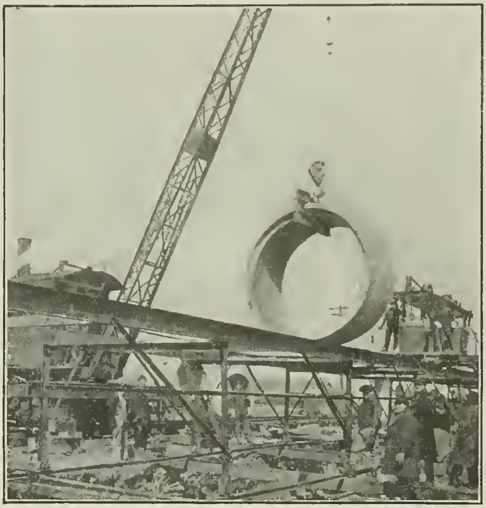


FIG. 1—CRANE PLACING 84-IN. CONCRETE PIPE

is of the combined type and will provide drainage for 4,680 acres or for all of the city except a portion recently annexed on the south side and that part near Lake Michigan called Robertsdale. The city is divided by the Grand Calumet River, necessitating the construction of two general sewer systems, each with an intercepting sewer and both interceptors delivering to one pumping station, from which the sewage is discharged into the Calumet River. There are about 6½ miles of intercepting sewer ranging from 24 to 108 in.

On the south side, the intercepting sewer varies from 54 to 108 in. internal diameter, and is connected to the pumping station on the north side by an inverted siphon consisting of two 60-in. reinforced-concrete conduits with a total length of 300 ft. and placed 56 ft. below the surface of the river. The north side intercepting sewer varies from 24 to 84 in., internal diameter and also discharges into the wet well of the pumping sta-

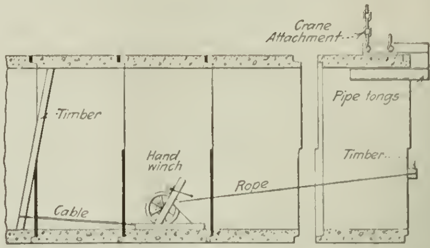


FIG. 2—HEELING PIPE INTO POSITION

tion, the bottom of which is 17.95 ft. below the surface of the river. A brick and steel building 52x148 ft. houses four centrifugal pumps and has space for two additional pumps when required. Two 20-in. electrically driven pumps, each of 20 c.f.s. capacity, take care of dry-weather flow; two 48-in. gas-driven pumps, each of 100 c.f.s. capacity, provide for storm-water flow.

The average depth of the sewers is 18 ft., in fine, water-bearing sand, the elevation of the water table being approximately 4 ft. below the surface of the ground and 14 ft. above the invert of the sewers. In the north portion of the city the water table is slightly above the surface of the ground. Under these conditions and since the discharge of the entire system has to be pumped into the river, at an estimated cost of $33 per million gallons per twenty-four hours, the question of infiltration became very important. Monolithic reinforced-concrete construction was considered in the original design for the interceptors, but it was later decided to use reinforced-concrete pipe for the following principal reasons: (1) In many sections of the country such pipe has been used successfully for conveying water under 10 to 50 lb. internal hydrostatic pressure, thus convincing the designers that its use was particularly adaptable for preventing infiltration; (2) the units can be fabricated on or near the site of the work several weeks in advance, allowing sufficient time for seasoning and affording adequate inspection before and after the units are installed.

The 108-in. pipe are 5 ft. long, with a 9-in. shell and weigh 8.6 tons each. They are installed by a 20-ton crane, as shown in Fig. 1, and the methods used in drawing them together are illustrated in Fig. 2. The units are laid to exact grade and levels taken on portions of the finished lines show that the elevation of the invert does not vary more than ¼ in., from the correct grade. Record runs of 100 ft. in eight hours were made during the extremely cold months of January, February and March, 80 to 90 ft. of 96-in. and 60 ft. of 108-in., pipe are average runs in eight hours. The lines are immediately backfilled as shown in Fig. 3. The joints are made tight by filling with neat Utica natural cement and oakum.

Rapid progress under the unfavorable conditions of soil and water have been made possible by the use of special construction methods. In order to remove the ground water from the trench, two 4-in. cast-iron pipe lines each 300 ft. in length are installed, one on each side of the trench (see Fig. 3), with gate valves 20 ft. apart on each line. At 4-ft. intervals on each line are located double hose-connections which are connected by means of 1½-in. hose, 3 ft. long, to 16 ft. lengths of

2-in. steel pipe driven vertically into the ground parallel to and outside the sheeting at 2-ft. intervals.

These drive pipes are provided with ordinary well-points 3 ft. long, which are jetted down to about 2 ft. below the invert of the sewer. The 4-in. main lines are connected across the trench by means of a 4-in. rubber hose. The ground water is removed through this system by the use of 7x8-in. triplex pumps, each fitted with vacuum gages and operating continuously, day and night. Experience has shown that it is necessary to keep the pumping system in operation for a length of trench representing a two-days' run and for 24 hours after the joints have been made so as to let the grout set. With the sand bed thus drained the working conditions at the bottom of the trench are very satisfactory.

Excavation to a depth of about 4 ft. is done by a dragline excavator and the trench is sheeted for this depth. Below this level the work is done by hand, the material being removed by a Potter plant consisting of ½-yd. buckets handled by a cable-operated car on a traveling steel trestle 352 ft. long, built over the trench. At the rear end of this trestle the material is dumped for backfilling.

This sewerage system was designed by W. F. Bridge, city engineer of Hammond, and by the writer, who is also in general charge of construction. The contract for the south side system and inverted siphon was let to the Proudfoot Construction Co., Chicago, which sublet the siphon work to the Subway Engineering Co., Chicago. The north side system is being built by the United Construction Co., Hammond, Ind., and the pumping station by Bates & Ahlborn, also of Hammond. The concrete pipe was made by the Independent Concrete Pipe Co., Indianapolis, Ind. The total estimated cost is $1,497,704, divided as follows: North Side system, $846,596; South Side system, $345,784; inverted siphon and gates, $78,000; pumping station, $227,324.

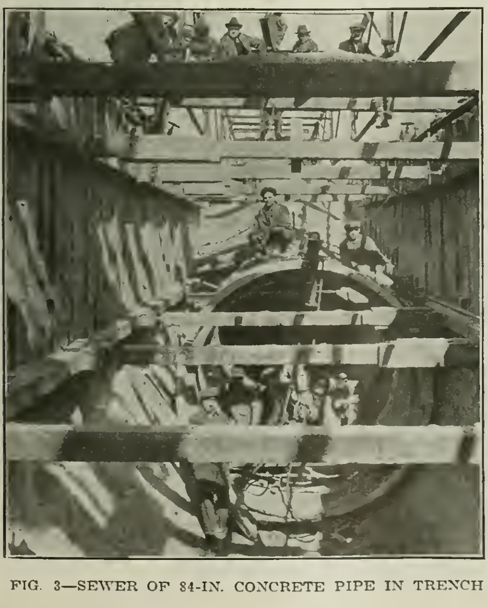


FIG. 3—SEWER OF 84-IN. CONCRETE PIPE IN TRENCH

Twin Tunnels for Sewer Siphon Under Calumet River

Shaft Lining Sinks with Cutting Edge—Pneumatic Tools for Heavy Clay in 6-Ft. Tunnels Steel and Wood Forms

An INVERTED siphon under the Grand Calumet River at Hammond, Ind., is required to connect the new south side intercepting sewer with the pumping station on the north side, as described in the preceding article. This siphon, shown in Fig. 2, is composed of

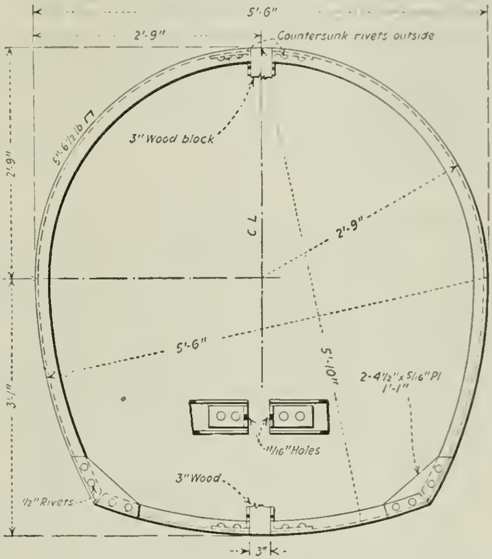


FIG. 1—STEEL FORMS FOR SEWER TUNNEL

two horseshoe tunnels 5 ft. 8 in. x 6 ft., two 11½-ft. shafts concreted to form two 5-ft. tubes in each shaft, an intake and an outlet chamber and two 72-in. and two 60-in. sluice gates with operating machinery. All the excavated material was used by the city for covering the sand formation in the public park, thus forming a good base for a soil top dressing.

Shafts—The shafts were 14 ft. in outside diameter and 11½ ft. inside the concrete shell. After about 8 ft. of sand and gravel the shafts were in soft clay which soon changed to hard dry clay of a shaly character; this latter disintegrated into thin horizontal layers or flakes when brought up and exposed to the air. Several seams of water-bearing sand were encountered, but only a little pumping was required since the shafts were not pumped out until the cutting edges of the forms had penetrated about 6 ft. into the clay. The depth from grade to tunnel invert was about 60 ft.

Steel forms in 5-ft. lengths were used for the south shaft and wood sectional forms in 8-ft. lengths for the north shaft. The cutting edge in each case was an angle 4x4x½ in. and a ½-in. plate 18 in. deep with 3-ft. anchor bolts spaced 24 in. c. to c. At each shaft was a traveling derrick with double-drum hoist and 40-ft. boom handling a ½-yd. clamshell bucket. The shafts were sunk by open dredging to the top of the tunnel

and were underpinned from that level to the bottom. Several small cavings or wash-ins occurred in the south shaft, owing to old bed springs and other obstructions being caught under the cutting edge and carried down with it, thus forming a path on the outside of the shell for sand and muck to follow and wash under the cutting edge. In the north shaft there was little trouble. As each 5-ft. or 8-ft. length was sunk the shell spades or chisels were used. Muck was handled in ½-yd. steel dump-cars on tracks of 14-in. gage with 12-lb. rails on 4x4x30-in. ties spaced 3 ft. c. to c. These cars were handled on an elevator 5x4½ ft. in the south shaft, both tunnels being driven from this shaft to within 10 ft. of the north shaft and then completed from the latter. Gravel concrete was used, of 1:2:4 mix. In cold weather, the water and sand were heated, and for the

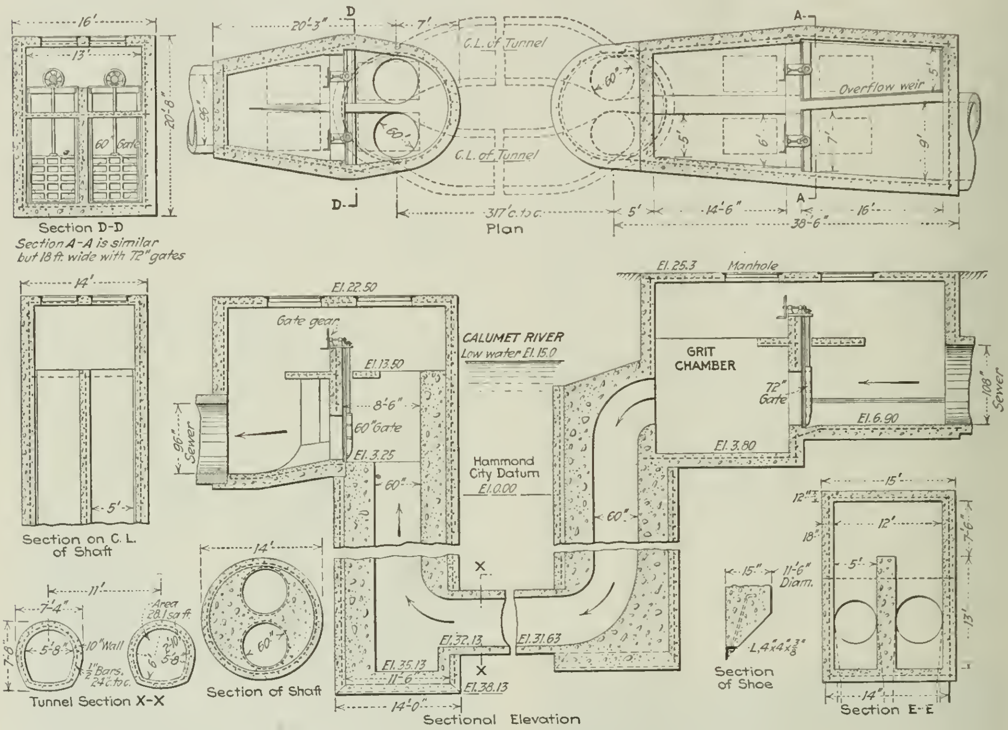


FIG. 2—SEWER SIPHON, TWIN SHAFTS AND TUNNELS

was concreted and the concrete was allowed to set for 48 hours before the excavation was continued, the shell going down with the cutting edge.

Tunneling—Tunnel excavation was mainly in the hard blue clay, which was dry but contained some boulders and numerous pieces of shale and slate. In this material the ordinary method was to mine 6 ft. and place the concrete lining. This operation was completed in nine hours, so that with two shifts the daily progress for each tunnel was 12 ft. Several sand pockets were encountered and some of these contained water. At these points the tunnels were timbered and the mining and concreting was done in 3-ft. sections. Steel forms were used, as shown in Fig. 1, each rib consisting of two 5-in. channels for the ribs with angle-iron lugs at top and bottom. The lagging was 2x6 in. with beveled edges, and was in 6-ft. and 3-ft. lengths. Each rib was set up by means of a 3-in. wood block at the crown and another in the invert.

Grub hoes and knives were used in driving the first 30 ft. of each tunnel, after which compressed-air shaft lining about 2 lb. of calcium chloride per bag of cement was added to hasten the setting. Cofferdams were built for the intake and outlet chambers, the water being taken care of by use of well-points and electric pumps.

Lines for the tunnels were furnished by the contractor, being transferred to the headings by means of piano wires and heavy plumb-bobs suspended in the shaft. Grades were given by the city engineer. The south shaft was begun Dec. 16, 1922, and completed Jan. 16, 1923. The intake chamber and 60 ft. of tunnel were excavated in February. In March, both tunnels were driven and concreted for 450 ft. In April, the tunnels, north shaft and outlet chamber were completed. The Subway Engineering Co., Chicago, had the subcontract for the siphon, the general contractor for the sewer work being the Proudfoot Construction Co., Chicago. Its price was about $77,000, including the gates.

Ernest A. Clark, member of the Subway Engineering Co., was in direct charge of the work.

To Increase Safety of Traffic on Highways

H. E. Breed Submits Recommendations in Committee Report to National Highway Traffic Association

RECOMMENDED practice to increase the safety of highway traffic, particularly at curves, was embodied in the following report submitted May 10 to the annual meeting of the National Highway Traffic Association by a committee consisting of H. Eltinge Breed, consulting highway engineer, New York City, chairman, W. G. Thompson and W. M. Acheson.

Safety on the highway is a matter of national concern. During this last year 14,000 lives have been sacrificed in automobile accidents. There are now registered in the United States 12,000,000 motor vehicles. This year's increase to that number is estimated by manufacturers at 3,000,000 The risk to safety lies in the congestion of 90 per cent of these vehicles upon 10 per cent of our roads. This risk we must minimize. That it is at present fraught with appalling loss of human life is evidenced by the casualties from automotive vehicle accidents—a loss yearly greater than by all other means of transportation combined.

The majority of these accidents of congestion occur under five conditions, all of which road builders may help to eliminate.

1. Sight distance on curves, both horizontal and vertical, which is insufficient to permit precaution against the other man's reckless driving. Lack of sight distance also increases accidents at intersecting roads and railroad crossings.

2. Insufficient width of pavement, especially in congested districts, which increases the number of cars that turn over on soft shoulders and roll down unprotected slopes. Narrow, or single-track bridges are a constant menace. In the design of roads 10 ft. should be allowed as a minimum width for each single line of traffic each way and 9 ft. more for each additional line each way.

3. The inadequate, irregular and improper spacing of danger signs which encourages a general carelessness of their import. Judged by the number of accidents in their vicinity, they are a spur to the recklessness of the joy-rider and a consequent risk to his sober brethren.

4. The tendency of detours under traffic to become almost impassable. On heavy-traveled routes traffic going in different directions should be routed over different detours, or, if detours are inadvisable on account of dangerous or impassable conditions, the road should be built horizontally a half at a time.

5. Railroad grade crossings.

Four Methods of Attack—To help prevent accidents to which these and other highway conditions are conducive, we may proceed at four points: First, to secure good design for new roads; second, to promote adequate improvement of old roads; third, to insist upon reconstruction of existing roads at places that have proven especially dangerous such as grade crossings, approaches to bridges, etc.; fourth, to improve the location of the center line on dangerous curves and elevations. Under these headings the following recommendations are made. They aim to promote the safety of the traveling public as far as impersonal factors can do it, and they aim to diminish as far as possible the personal menace projected by the reckless driver. Safety for the careful with protection from the careless.

Under the consideration of general safety for traffic comes the necessity of standard practice throughout the country in respect to placement of danger signals, elevation and banking of curves, widening and regulation of traffic on curves. Standardization in these matters is imperative because with the completion of transcontinental routes there is increasing interstate traffic. Drivers traveling to remote sections cannot be expected to apprehend distinctions in practice now existing between different highway departments, yet departure in one state from what they have become accustomed to expect in others is a frequent cause of disaster. There is no real obstacle in the way of this standardization; it is merely a matter of agreement among state highway officials and motor organizations.

Recommendations—Your committee has amplified the resolutions that you passed last year. They now stand:

1. On all curves of more than 3 deg. the pavement and inner half of the earth shoulder should be banked. This superelevation should vary from 0 for a 3-deg. curve to 1 in. per foot of width for curves of 20 deg. or sharper.

2. On all curves of more than 4 deg. the pavement should be widened on the inside ½ ft. for each 1 deg. increase in curvature. The widening and banking on a 4-deg. curve should start at a minimum of 50 ft. before reaching the P. C. and come to the fully widened and banked section at or very soon after reaching the P. C. Inversely, the regular section should be reached at a minimum of 50 ft. beyond the P. T.; for a 20-deg. curve, this varying or transitional width should be about 150 ft. long, with proportional lengths for intermediate curvatures.

3. A line about 4 in. in width and of an appropriate color should be painted on the center line of pavement on all curves, both vertical and horizontal, this painted line to be renewed as necessary in order to keep it conspicuous so that it may indicate to traffic in each direction the limit of its half width of pavement.

4. All sharp or dangerous curves, either simple or reverse, horizontal or vertical, should be posted about 500 ft. from each end with a sign indicating that danger exists. Railroad crossings at grade should be posted in a similar manner.

5. The National Highway Traffic Association recommends to all legislative committees preparing motor traffic laws that the attempt to pass a motor vehicle while going in the same direction on a curve, either horizontal or vertical, where the unobstructed line of vision is less than 500 ft., be made a misdemeanor; all damages resulting from an accident under these circumstances to be placed upon the passer.

6. The minimum radius of curves should be 1,000 ft. unless prevented by an approach to a bridge not practicable to change or an improvement being made on village or city street, even to the end that new right-of-way should be procured in order to increase the radius, bearing in mind that the improvement is being made for a long time, and that land values may increase to an extent that might prohibit procuring more right-of-way.

7. Providing there is sufficient space within the right-of-way, earth slopes should be carried out with a 4 on 1 slope. If this is not possible a guard rail should be placed on the inner edge of all curves of more than 8 deg. This rail should be kept painted white and be about 4 ft. in height.

8. In order to prevent the shoulders adjacent to hard-surfaced pavements from being gouged out, gravel or crushed stone, 1½ in. and 2½ in. size, mixed and filled with screenings, should be placed 2 ft. in width and 4 in. in depth on each side, maintained at the level of the pavement. An application of hot tar or asphalt on this gravel or stone will be found beneficial.

9. For public safety all advertising signs and obstructions along highway routes should be eliminated *except those erected by direction or permission of officials having jurisdiction over the highways and for public benefit.*

10. A definite sum should be set aside annually by each highway department, and a comprehensive plan devised on which annual progress is made, for the elimination of the most dangerous grade crossings.

11. Everyone who drives a car should be instructed by some competent person in the common courtesy usage and legal road rules.

12. There should be cleared away wherever possible all stone walls, brush, trees, banks, etc., on the inside of curves where it is impossible to obtain a sight distance of 500 ft.

13. All single-track bridges should be widened to double-track, and every community, through surveys by proper officials, should ascertain the conditions of and on its bridges to carry safely loads up to the legal limit.

14. Where conditions warrant proper sidewalk provisions should be made and where sidewalks are provided it should be a misdemeanor for pedestrians to encumber the roads.

Allocating Concrete, Cast Iron and Wood Stave in a Pipe Line

All Three Kinds Used in 18½-Mile Conduit Bringing Water to Norfolk, Va., From a New Storage Reservoir

CONNECTING the new 4-billion-gallon Lake Prince storage reservoir of the Norfolk water-works with the filtration plant of the city, is an 18½-mile conduit of 30- and 36-in. pipe line made up of 2½ miles of cast-iron pipe, 10 miles of wood-stave pipe and 6 miles of concrete pipe. Protests against the use of anything but cast-iron by citizens led the engineers to study the route of the line carefully to obtain comparative figures bearing on the financial outlay, carrying capacity, leakage and desirability. The result was that all three were used—wood-stave wherever the local conditions were entirely favorable to its durability; cast-iron where conditions were not favorable to use of wood-stave or concrete, such as a summit approaching the hydraulic grade line and at river crossings; concrete, where conditions permitted and the working head would not exceed 150 ft. In a paper presented recently before the Virginia Engineering Society, William H. Taylor, III., city engineer, gave the following analysis:

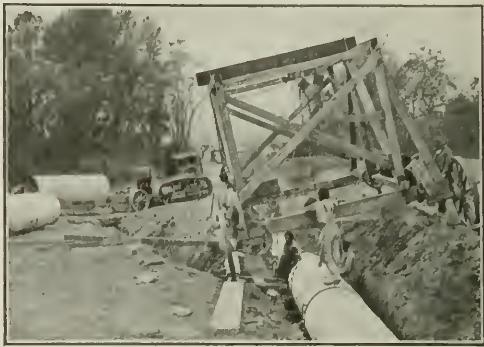
WOOD-STAVE PIPE ON CONCRETE BRIDGE OVER CREEK

Assuming the first cost of the wood-stave pipe of the required diameter and designed for a certain pressure to be unity, then the relative cost of the reinforced-concrete and cast-iron pipe of the same diameter and designed for like pressure would be represented by about 1.7 and 2.4, respectively. Corrected for carrying capacity, leakage and durability, based to some extent on experience with a local wood-pipe line, the relative costs of 1, 1.7 and 2.4 were corrected to 1.6, 1.7 and 3.4, respectively, considering every known or estimated advantage or disadvantage possessed by any one of the three pipes over the other two. It was therefore decided to use cast-iron pipe only where it was impracticable to use either the wood-stave or concrete pipe.

On the summit referred to, and less than two miles from the dam, a surge tank 10 ft. in diameter and 125 ft. high has been built, as a vent for entrained air, a pressure regulator, and a safety device against vacuum troubles.

The supply line has comparatively few curves of any magnitude, either vertical or horizontal, but the country varies from cultivated fields to swamp land, forest and rivers. Four major streams extensively navigated were crossed by submerging the pipe, and fourteen minor waterways were crossed by exposing the pipe and supporting it upon concrete piers on piles above the stream or bog. A right-of-way 30 ft. wide has been purchased throughout the length of the line, providing the means for future development. The submerged river crossings were described in *Engineering News-Record* of Sept. 7, 1922, page 393.

Venturi meters will measure the delivery of water into the line at the dam, and out of the line at the filtration plant. Near the ends of each section of concrete pipe brass rings 24 in. long were inserted (precast in a section of the pipe) for use as permanent pitometer stations. These rings were machined smooth and accurately calibrated. By means of pitometer readings at these points, together with accurate pressures ascertained, reliable determinations of the value of C in the Chezy formula are expected, as well as information as to leakage in the different kinds of pipe under service conditions. Static pressure tests indicate a leakage of 83 gal. per inch of diameter of pipe per mile per day for the concrete pipe and 310 gal. for the wood pipe.

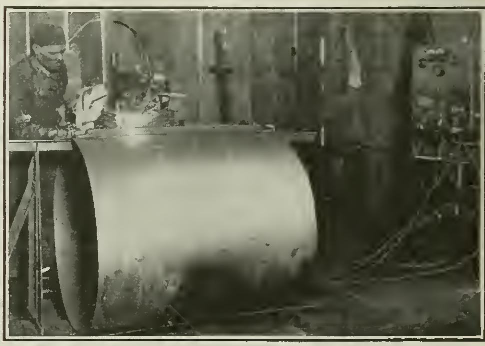


LAYING CONCRETE PIPE WITH A PORTABLE GANTRY

Pipes were handled on the job by caterpillar tractor and special low-hung trailers with plenty of clearance between front and back axles to permit rolling the pipe off sidewise.

The concrete pipe has 4-in. walls and was cast in 12-ft. lengths. Midway of the wall is a steel cylinder with electrically welded seams, riveted and lead-calked to cast-iron bell and spigot end rings. The rings were turned, a groove was provided in the bell and a taper was given to the spigot ring. A special lead ring gasket inserted in the groove was tightly compressed when the spigot end was drawn "home" beyond and over the tapered section of the spigot ring. The 2 in. of concrete outside of the steel cylinder was reinforced with woven-mesh wire.

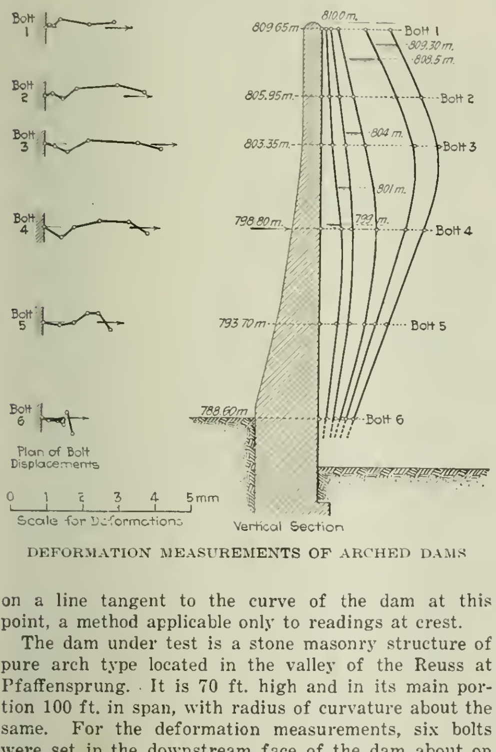
The Redwood Manufacturing Co. of San Francisco manufactured and laid all of the wood-stave pipe. The Lock Joint Pipe Co. did likewise with the concrete pipe, and the Lynchburg Foundry Co. made the flexible joint cast-iron pipe. Col. Dabney H. Maury was consulting engineer on this work, which was designed and carried out under the general direction of the writer with Norman Z. Ball as designing engineer and David A. Decker as assistant engineer in charge of construction of the dam and pipe line. W. R. Galt, John O. Miller and John N. Vaughan were resident engineers.



ELECTRICALLY WELDING A LONGITUDINAL SEAM

Deformations of Arched Dam Measured by Triangulation

LAST year the geodetic department of the federal survey bureau of Switzerland undertook to measure by triangulation the deformations of a small arched forebay dam. The work was done at the request of the electric traction division of the federal railways and had the main purpose of determining whether accurate and consistent results in such measurement could be obtained by survey methods. According to a report of the work in the *Schweizerische Bauzeitung* of Jan. 20, the results showed the method to be wholly successful. In fact, triangulation proved somewhat more satisfactory than direct sighting on a scale attached to the crest of the dam and read from an instrument set up



DEFORMATION MEASUREMENTS OF ARCHED DAMS

on a line tangent to the curve of the dam at this point, a method applicable only to readings at crest.

The dam under test is a stone masonry structure of pure arch type located in the valley of the Reuss at Pfaffensprung. It is 70 ft. high and in its main portion 100 ft. in span, with radius of curvature about the same. For the deformation measurements, six bolts were set in the downstream face of the dam about on the line of the crown of the arch, one at the crest, one at base, and four at intermediate levels. Instrument piers were erected on either bank, on rock, close to the abutments of the dam, and a third pier was provided on one bank 40 or 50 ft. upstream of the abutment, to give a sighting line nearly tangent to the curve of the dam at its crown; the latter pier was used for direct reading on a scale attached to the dam crest, while the two other piers, from which the bolts in the face of the dam were visible, were used for the measurements by triangulation. The measurements were carried out at five different water stages, ranging from half the height of the dam to full height. Atmospheric conditions were favorable (sky overcast) and the small size of the reservoir permitted the entire series of measurements to be carried out in a single day. The results are sketched in figure herewith.

At the left the triangulated displacements of the six bolts are shown in plan. At the right are plotted the deformation profiles of the wall in vertical section. The maximum displacement, it will be seen, was 3.3 mm., which occurred about 6½ m. below the crest. The crest displacement at full reservoir was 2 mm. The direct-reading measurement of this displacement was 2.2 mm., but the report credits this reading with a possible variation of ± 0.5 mm. The work as a whole is considered by the geodetic bureau to establish the suitability of the triangulation method for such measurements. As the bolts in the face of the dam and the instrument piers will remain in place, future measurements can be made at any time to give a check on the permanence of position and form of the dam.

A 12.76-In. Rainfall in 4½ Hours at Beaumont, Texas

A RAINFALL of 12.76 in. in 4½ hr. was recorded at Beaumont, Tex., on May 18. Through the courtesy of P. C. Day, meteorologist in charge of the Climatological Division of the Weather Bureau, Washington, D. C., the following details of the precipitation for the 12 hr. that included the period of excessive rainfall already noted are made available.

The total rainfall at Beaumont, Tex., from midnight, May 17-18, to noon, May 18, 1923, as measured by John Bender, river observer, Weather Bureau, was 13.54 in. The rainfall measurements are made at Beaumont in an ordinary 8-in. gage at 7 a.m., daily. The amount measured up to 7 a.m. of May 18 was 0.78 in., falling between the preceding midnight and the hour of observation. It is believed that practically all of this amount was gaged between 6 and 7 a.m.

A special reading of the gage was called for from this office (Houston) and made at 11:30 a.m., showing a catch of 12.76 in. during the preceding 4½ hr., the heaviest of which occurred between 7 a.m. and 9 a.m. It is believed that practically all of the amount measured on the 18th, 13.54 in., occurred between 6 a.m. and 11:30 a.m., and most of it between 6:30 a.m. and 9 a.m.

The first estimates of damage done by the excessive rainfall in the city of Beaumont were placed at $100,000. "Downtown streets were flooded, trees were struck by lightning, an oil tank caught fire, and the city government suffered serious losses as a result of the Beaumont downpour . . . Water was more than a foot deep in Pearl St. stores, and business was badly handicapped. The rain began falling (heavily) about 6 o'clock and continued in a terrific downpour until shortly before noon. Automobiles were stranded on many of the downtown streets. Hail accompanied the storm. . . ."

Considerable wood-block street paving was floated off during the storm and the storm sewers were inadequate to carry off the water. No lives were lost and the damage seems to have been extremely light in view of the phenomenal rainfall in so brief a time. The excessive rainfall was confined to a small area, with Beaumont as its center, near the mouth of the Neches River. This fact prevented any appreciable rise in the Neches, the stage on the gage being 3.8 ft. at Beaumont on the 17th and reaching a crest of only 4.8 ft. on the 20th.

Railway Trestle in Hawaii Fails

By B. F. Rush
Inspector of Construction,
Board of Harbor Commissioners, Hawaii

In March of this year ten bents of a trestle of the Hawaii Consolidated Ry. at Hilo, Hawaii, one by one upset and disappeared into the Wailuku River, each bent falling against and upsetting the adjoining one. The trestle was constructed in 1910. The bents consisted of two cylindrical reinforced-concrete posts 3 ft. in diameter, and a reinforced-concrete cap. In all there were 23 separate bents at 16 ft. centers. Each bent was a unit within itself, no cross bracing to adjacent

FIG. 1—CONDITION OF BRIDGE JUST AFTER COLLAPSE

bents having been provided. The total length of the bridge is 352 ft.

The type of construction is well illustrated in Fig. 2. On each cap was bolted a 12x12-in. timber. Resting on these were six 6x12-in. deck stringers, three under each side of the track.

The posts were constructed by sinking wooden forms to bedrock, excavating the interior, placing steel dowels in the solid rock and then filling the casing with reinforced concrete. At the time of construction there were from 8 to 10 ft. of sand above the solid rock on which the posts rest. This sand was expected to act in place of cross bracing.

From an examination after the failure it was found that most of this sand had washed away; under the section of the trestle which failed there remained only from 2 to 4 ft.

The first bent to fall was on the Wainaku side of the river which is opposite the piledriver shown in Fig. 2. This pier no doubt had been undermined. When it gave way it fell toward the center of the stream striking the adjacent pier and knocking it over. This continued

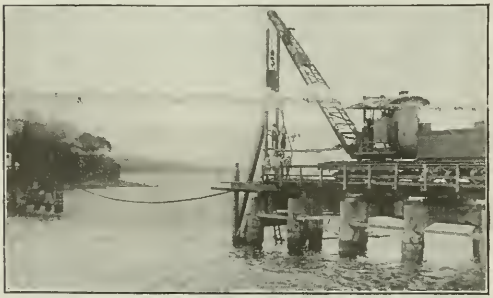


FIG. 2—DRIVING PILES FOR THE TEMPORARY BRIDGE
One of the overturned bents is resting against the bent under the leads of the driver.. The bracing between the caps was put in after the failure.

until in all ten piers were overturned before a bent was reached which was sufficiently embedded in the sand to withstand the force of the blow from the adjacent falling bent.

The failure emphasized two precautions that might have been taken when the original construction was done. Bracing from bent to bent should have been provided and the posts should have been set into the bedrock instead of on top of it.

It is thought that the recent tidal wave which visited Hawaii a short time before the failure had a great deal to do with washing out the sand from the bed of the river.

High Yield From Small Watershed With Large Water Area

By Frederic I. Winslow
Consulting Engineer, Framingham, Mass.

A considerably larger yield than appears to be normal from watersheds in Eastern Massachusetts is found at Framingham, in Farm Pond, which is an adjunct (now practically discarded) of the Metropolitan water-works for Boston and adjacent cities. This unusual yield may be due to underground flow from a slightly higher watershed, as explained further on.

TABLE I—HIGH YIELD FROM FARM POND WATERSHED*
Per Cent of Rainfall Appearing as Yield

	From Farm Pond		
Year	Published Figures	After Correction†	From Entire Sudbury Watershed
1916	95.9	85 0	47.6
1917	108 2	99.1	38.0
1918	98.5	88.2	38.2
1919	69.4	62.1	45.5
1920	83.8	74.7	53.6
1921	76.3	67.3	39.8
922	66.7	57 6	45.1

* Area of watershed, including water surface, 0.54 sq.mi.; water surface, 0 25 sq.mi.; Storage capacity, 216 m.g † Correction made for amount drawn from Pond.

Table I compares the Farm Pond yield for the last seven years, expressed in percentages of rainfall, with that of the entire Sudbury watershed, (including Farm Pond). For the last forty-eight years the average yield of the Sudbury has been 46 per cent of the rainfall, compared with which the Farm Pond yield for the past seven years has been from 25 to 115 per cent higher.

TABLE II—YIELD IN SECOND-FEET PER SQUARE MILE OF FARM POND, SUDBURY, WACHUSETT AND COCHITUATE WATERSHEDS

	From Farm Pond					
Year	Using Annual Reports	Corrected as in Table 1	Entire Sudbury Watershed	Wachusett Watershed	Cochituate Watershed	Rainfall by Gage on Sudbury Watershed
1916	2.775	2.459	1.398	1.880	1.588	2.894
1917	3.253	2.902	1.161	1.290	1.216	3.005
1918	2.886	2.583	1.139	1.395	1.173	2.930
1919	2.341	2.094	1.529	1.945	1.634	3.372
1920	3.105	2.769	1.917	2.521	2.171	3 708
1921	2.474	2.183	1.276	1.690	1.518	3.244
1922*	2.211	1.908	1.516	2.045	1.701	3.312

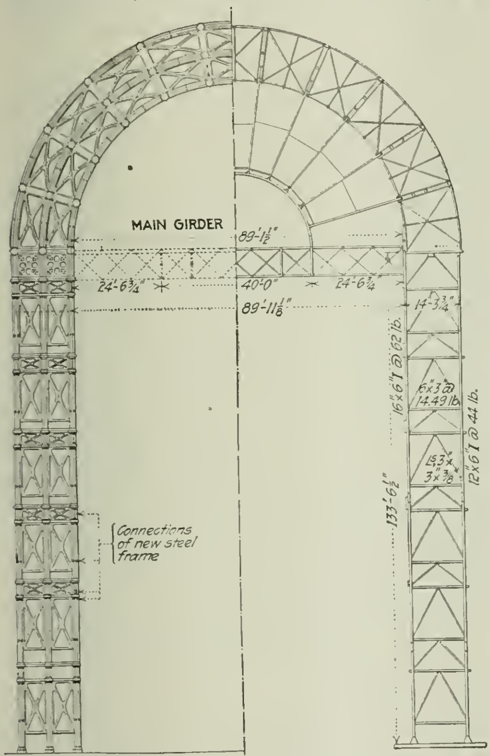
* The figures for 1922 are subject to possible slight correction after being issued in final form.

Table II compares the yield of Farm Pond in second-feet per square mile with that of the Sudbury, Wachusett and Cochituate watersheds.

Observations on the southerly side of Farm Pond show very little water when excavations are made; but on the north side, about 1,650 ft. away, is a pond—Larned's Pond—covering about 42 acres of possibly 100-m.g. capacity. This pond is about 7.85 ft. above Farm Pond, and has no visible outlet; but as the soil between the two ponds is largely gravel it may be that enough water passes through to account for the high yield on a different watershed from the last pond.

Old Cast-Iron Frame of Crystal Palace Strengthened by Steel Framing

AFTER seventy years, the well-known Crystal Palace in London was recently repaired in interesting manner. The building is a high, arch-roof structure with cast-iron framing, covering nearly 11 acres of ground surface, and has its entire exterior glazed. It is 384 ft. wide in its main portion and 1,392 ft. long with a clear height above ground of about 192 ft.; the height of the frame above footings is about 195 ft. It was built in 1851 and was expected to last only about 25 years, but is still in excellent condition. The repairs concerned chiefly the east face of the central aisle, which



FRAMING OF EAST FACE OF CRYSTAL PALACE

projects about 25 ft. from the main portion of the building, and they appear chargeable in the main to a weakness in the original construction, consisting of the use of timber plates between the cast-iron segments of the arch.

In the sketch herewith the cast-iron frame of the east face is shown at the left. Each of the two towers consists of three cast-iron posts, which are connected by horizontal girders and diagonal members, also of cast iron. On these towers is seated the arch, whose three ribs continue the lines of the posts of the towers. In the arch, however, radial members connected to a small central half ring (not shown) are inserted, and these radials are 5 x 10-in. timbers which pass between the contact faces of the successive segments and are subject to full arch pressure. Cast fascia members cover the outside of these members. The material of the radials is untreated soft wood, and decay has been extensive in the course of years, especially near the bolt holes. The result was serious settlement and distortion of the frame, many members being as much as 3 to 7 in. out of true. The method of repair was to erect an independent steel structure back of the cast-iron frame, and bolt all members of the cast-iron frame to the steel frame. The steel frame is shown at the right; its connections to the old frame are partly by direct bolting and partly by brackets carrying steel girders bolted to the cast-iron columns. The main verticals of the steel frame are I-beams, the outer one being 12 x 6 in. and the inner one 16 x 6 in.; they are connected by struts of 6 x 3-in. channels and diagonals of 3 x 3 x ⅜-in. angles. The old frame being not vertical and out of true, the connections between it and the new frame had to be such as to suit the varying horizontal distance between them, for which reason bracket connections were largely used. The work was planned by W. Wright, engineer for the Crystal Palace.

Concrete Road Maintenance Costs in Ohio, 1917-1922

BY E. C. BLOSSER
State Highway Engineer, Columbus, Ohio

OCCURRENCES recently demanded that we make a determination of the relative maintenance costs of plain and reinforced concrete pavements in Ohio, and a careful analysis was made from the maintenance records for the years 1917 to 1922 inclusive. The results are given in the accompanying table.

The widths and depths of the pavements are variable in both cases, the depths ranging from 6 to 9 in. and the costs are for surface only. The reinforced-concrete pavements include those with only circumferential reinforcement and light mesh reinforcement. The average cost of the reinforcement probably did not exceed $0.12 per square yard.

Using the average costs per square yard, the maintenance cost per mile per year for a plain concrete road

MAINTENANCE COSTS OF PLAIN AND REINFORCED-CONCRETE PAVEMENTS

Year	Sq.Yd. Completed	Accumulated Yardage	Total Maintenance Cost	Maintenance Cost per Sq.Yd.
1917	2,556,005*	2,556,005	$23,317	$0.00990
1918	175,303	2,731,308	29,477	0 01079
1919	321,299	3,052,607	34,892	0 01143
1920	677,758	3,730,365	85,214	0 02284
1921	516,091	4,246,456	145,690	0.03431
1922	520,910	4,767,366	106,986	0.02244
Average				$0.0223
		Reinforced Concrete		
1917	628,067*	628,067	$1,208	0.00192
1918	103,686	731,753	1,793	0.00245
1919	379,817	1,111,570	2,785	0.00250
1920	563,252	1,674,822	7,960	0.00475
1921	315,507	1,990,329	10,610	0.00533
1922	930,673	2,921,002	14,209	0.00487
Average				$0.0043

* These figures include all pavement built prior to 1918.

16 ft. wide is $209.33 and for a reinforced-concrete road 16 ft. wide is $40.36. The difference is $168.97, which capitalized at 5½ per cent equals $3,072. Considering maintenance costs alone, we are in general justified in expanding this amount for reinforcement. The advantage as to life of pavement probably favors reinforced concrete over plain concrete in the ratio of at least 5 to 4, i.e., if the average life of plain concrete is 20 years, for reinforced concrete it will be at least 25 years.

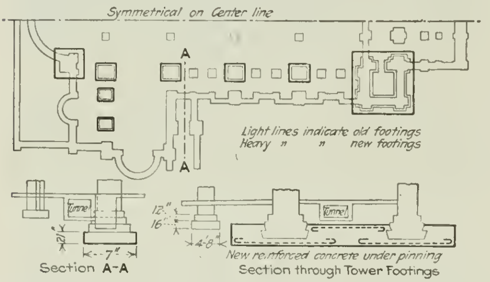
Underpinning a Church Foundation With Slab Footings

Soil Loading Reduced From 5 to 3½ Tons Per Square Foot by Spread Footings—Temporary Support by Pretest Piles

By Lazarus White
Spencer, White & Prentis, Engineers and Contractors, New York

IN ORDER to reduce the soil loading which would be imposed by the completed structure, a church in course of construction in Brooklyn has just been underpinned with spread footings of increased area. The operation was carried out by undermining the old footings, supporting the structure on "pretest piles" and temporary supports, and constructing the new reinforced-concrete footing slabs in the excavation. The work was rendered difficult and delicate by the fact that services in the church continued throughout the work.

Existing Conditions — The foundations and superstructure to the level of the main floor of the Church



ORIGINAL AND UNDERPINNED FOUNDATIONS OF CHURCH

of Our Lady of Perpetual Help were originally built in 1907 and 1908; a temporary roof was installed and services were conducted in the roomy basement. The structure is spacious, its extreme length being about 250 ft. and its breadth at the altar about 180 ft.

The original foundations were of the spread-footing type, and had been designed for an ultimate load of about 5 tons per square foot on the soil. When building operations were about to be resumed in 1922, the Bureau of Buildings of the borough of Brooklyn, after a reconsideration of the building plans and designs, ruled that the former allowable loading was too high and reduced the loading to 3½ tons per square foot. This placed a very serious problem before the architect, particularly at the tower foundations, whose estimated loads were over 3,000 tons for each tower. It was necessary almost to double the bearing area of each foundation.

The architect, F. Joseph Untersee, of Boston, with J. R. Worcester as consulting engineer, solved the problem of design by providing new and larger reinforced-concrete footings below the old footings, the reinforcement being so placed as to allow the placing of the large tower foundations in sections. To carry out this design it was necessary to underpin the old structure and transfer its load to the new footings. The construction was undertaken by Spencer, White & Prentis, Inc., of New York.

Underpinning Operations—Beginning with the tower foundations, the contractor took up the old floor and excavated to the bottom of the footings at one side of the church entrance, leaving the entrance clear. Excavation was then carried forward under the old foundations, the corners being first undermined and diagonal reinforced-concrete blocks placed under them for preliminary support. Then the entire area beneath the old footings was excavated, by tunneling methods, and pretest cylinders were driven in the soil below as temporary supports for the tower foundation. These cylinders were 14-in. steel pipes filled with concrete, each loaded by a hydraulic jack to 60 tons and then wedged up against the old footing by short lengths of I-beam set vertically on the cylinder as a strut, with steel wedges driven between the I-beams and the bottom of the footing.

With the tower foundation so prepared, a block of reinforced concrete 34 ft. square and 3 ft. thick was poured under the old footing. This operation was difficult chiefly because it had to be carried out in a very cramped space, and necessarily in one run to secure full benefit of the reinforcing. It was carried out in about 12 hr. time for each tower, with the use of an electrically driven mixer set up in the tower. Material was conveyed to the mixer from the sidewalk by wheelbarrows. The new concrete was carried up to within a few inches of the bottom of the old footing, and no attempt was made to obtain a tight contact in the first operation. A liberal number of 3-in. grout pipes were placed around the perimeter of the old footing, some of them being driven from the adjoining yard. Around the inside of the old footing, a sand dam a few inches high was built on the top of the new concrete, to hold the grout and permit its flow and spread from the grout pipes to be checked up. The grout was mixed in a large mortar box and run directly through the pipe. By this method perfect contact was secured between the old and the new concrete.

The small interior footings, each about 10 x 10 ft., were placed by similar methods, the work being carried on from an adjoining pipe tunnel under the church floor. Each of the old footings was supported on four pretest piles, the new concrete footing was then placed, and the contact grouted through holes drilled in the floor. Very little disturbance of the church floor was required in the entire work.

The contract was carried out in a few weeks, with little interference with the services in the church, and was wholly successful in its structural results. The success of the work was due, in the writer's opinion, largely to the skill of the men engaged upon it and to the combination of tunneling and underpinning methods in the operation.

New York State Aid to Health Laboratories

State aid to enable city and county health laboratories to provide laboratory service for local medical practitioners and for health officers is authorized by an act of the New York legislature of 1923 which carries an appropriation of $25,000 for the expenses of the State Department of Health to put the act in effect. The department may grant $2,500 towards the initial cost of installing and equipping such laboratories and may pay one-half the maintenance cost but not to exceed $7,500 a year for any one laboratory.

Building a 50-Kilometer Railroad Through Tropical Swamps

Log Cribs Substituted for Dirt Fills—Rude Barge Transports Materials—Pony Bents on Falsework Support Steel Span

By Francis R. Molther
Former Office Engineer, D. E. Wright Construction and Engineering Co., Inc., Panama

THE ECONOMIC desirability of putting a 50-km. stretch of railway in Honduras, C. A., into operating condition at the earliest date possible urged the employment of certain unusual devices to expedite construction. The use of these devices, while not generally commendable from the point of view of engineering practice, was justified by the existing conditions which made the expense of the construction a secondary consideration, and is explained here with that understanding.

The urgency of this work was complicated by the fact that the weather was most unseasonable for such extraordinary effort, heavy and continuous rains causing floods over much of the low territory in which the line was located. It was determined, therefore, to form log cribs or grillages, through the shallow fills from three to ten feet in height, for the purpose of carrying the ties and rails until the dry season might make the manipulation of the adjacent material more convenient. It was planned to make much of the actual fill by train, thus reducing the cost of handling the earth over cost of placing it by hand, beside making execution possible under less urgent conditions. The absorption of the logs due to decomposition obviously indicated that bringing the line to grade with earth would be a question of several years.

The first course was laid so as to provide longitudinal members, parallel to the rails, in the top course of the crib, alternating longitudinal and transverse systems between them. The material was hauled into place with oxen, owing to the great capacity of these animals for work in soft ground. The ties were shimmed to grade as much as possible, but the use of thin shims was generally avoided. In dry weather this flooded territory bakes as dry and hard as pottery, making the timber fills look strangely out of place.

The route of this line crossed a river with a 200-ft. through-riveted span about three kilometers from a switch to the main line. This stream cut off the laying of track during the time required for the erection of a temporary trestle, although grading was complete for some distance on the far side of the stream.

For the purpose of laying steel on the distant graded section, which not only assured the use of that portion as soon as the trestle might be completed, but also furthered the progress of more remote grading, a barge or ferry was rigged up to convey ties, rails and accessories to the other side.

The barge was swung from two pulleys traveling on a steel cable spliced around stout trees on the opposite banks. The lines to the pulleys were adjusted at different lengths, so that the upstream side of the barge was presented to the current at an angle that furnished some assistance from the flow in crossing with the barge loaded. A manila rope swung from the same trees, and connected to the barge with a hand-line running on the rope by means of an eye, furnished the means to haul the barge back when unloaded.

One or two fills between 500 and 1,000 ft. long which delayed the laying of rail on completed grading beyond them required the use of a detour to get material to the completed dump ahead.

As soon as steel was laid to the end of the completed grade, 20-lb. rail was laid from this point down into the gully where grading was incomplete, but outside the toe of the proposed fill. This light rail was continued up to the completed work ahead, where ties, rail and accessories were received from hand cars loaded alongside the regular flat-cars that were run to the end of rail and the beginning of the detour. Oxen and men hauled the hand cars over the light rail.

In the figure are shown pony bents built on top of regular falsework for a through-riveted steel truss bridge, to facilitate the removal of the falsework after the truss was erected. The falsework was of four-pile double-braced construction cut off to place the main

DETAIL OF PONY BENTS

caps 5 ft. under the bottom chord of the bridge. Through pile pony bents were built of 12 x 12-in. material, also double braced, to 6 in. below the level of the bottom chord, which proved sufficiently sturdy to carry the steel.

State Bureau of Housing and Regional Planning for New York

A STATE Bureau of Housing and Regional Planning within the Department of Architecture was created by the legislature of 1923 and $10,000 appropriated for its expenses. The bureau will be in charge of a commission of eight members, consisting of the state architect, the state highway commissioner (now a bureau head in the Department of Public Works) and the state industrial commissioner, ex-officio, and five "lay members" appointed by the state architect. All the members serve without salary but are to receive traveling expenses. Besides being required to make a special report on the present housing shortage and a yearly general report the duties of the new bureau are:

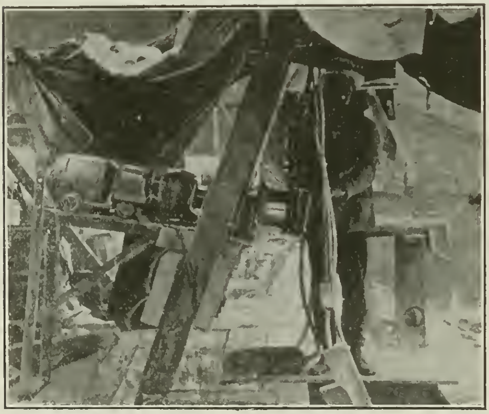
1. Study housing needs and conditions in the State and prepare plans adapted to meet such needs and conditions.
2. Collect and distribute information relating to housing and community planning and study means of lowering rents on dwellings by securing economy in the construction and the arrangement of the buildings.
3. Assist in the preparation of legislation and regulations in relation to housing, zoning and planning throughout the State.
4. Co-operate with local housing boards or similar bodies in cities and localities and with State and Federal authorities.

From Job and Office

Hints That Cut Cost and Time *For the Contractor and the Engineer*

Small Motor-Driven Foundation Hoists

INDIVIDUAL electric hoists with 2-hp. motors are being used in sinking the 160 foundation wells for the Illinois Merchants' Bank Building, Chicago, instead of the more usual arrangement of having the hoists for a row of wells operated by an endless running rope driven by an engine or motor. This new arrangement is shown in the accompanying view. At each well there is the usual tripod carrying a sheave over the well and having a canvas cover for weather protection. Ordinarily, a short shaft mounted on one post of the tripod carries a niggerhead or drum at the inner or well side and has at the outer end a grooved sheave around which the driving cable is looped.



SHAFT HOIST WITH 2-HP. MOTOR

With the new equipment, the drum, shaft, motor and transmission or reducing gear form a self-contained unit mounted in tandem on a bed plate, one end of which is supported by a steel leg while the other end rests on a timber placed across two posts of the tripod. In the view the well is partly covered with planks. From the drum the rope passes up over the head sheave and down to the bucket. The drum runs continually and the rope makes two or three turns around it, the hoist man drawing the rope tightly upon it to get the friction necessary for hoisting, or letting the rope run loose for the bucket to overhaul in lowering.

Flexibility and convenience of operation are among the advantages claimed for the individual motor-driven hoist system. Each well is independent of the others and as soon as it is completed the hoist can be shifted to another site. But with the cable system the rig for a set of wells must remain in place until the last one is completed, although it may be operating only one or two of the wells; and time is also consumed in making the set-up for another row of wells. Furthermore, the individual hoists avoid the trouble of long running cables across the site and are both convenient and economical where wells cannot be operated in rows but must be handled singly.

These new electric hoists, which have been used also in trench excavation, are built by Louis Falzer & Co., Chicago. At the Illinois Merchants' Bank Building, eighteen hoists are in use for sinking the 160 wells by the Henry Ericsson Co., Chicago, contractors for the building.

Ice as a Protection Against Ice in Exposed Penstocks

By J. LeRoy Underhill
Inspector, Vermont Department of Highways

AFTER several winters in which the half mile of 6-ft. penstock at power house No. 4 of the Montpelier & Barre Light & Power Co. had been a continued source of trouble and expense due to ice forming on the inside, Mr. Lawrence, the chief engineer of the company, resorted to an unusual method of protecting the penstock against further frost action. On the first 1,500 ft. below the dam he had ⅛-in. holes drilled in the top of the penstock at 12 ft. centers. For the remainder of the distance the same spacing was used, but due to increased head, the diameter of the holes was reduced to $\frac{3}{32}$ in.

The accompanying photograph shows the results that were obtained, and after having been used for four winters, the method is endorsed by Mr. Lawrence as being a very satisfactory means of preventing interior ice formation. It is usually necessary to keep the ice chopped down until sufficient water has escaped to form the required thickness of covering after which the jets may be allowed to flow until frozen.

Contrary to belief, it is not necessary to plug the holes in the Spring. Owing to their small diameter, they are effectively closed by the large amount of suspended matter carried in the water at that period of the year. They can be easily cleared with a sharp-pointed tool when it is desired to prepare the penstock for Winter again.

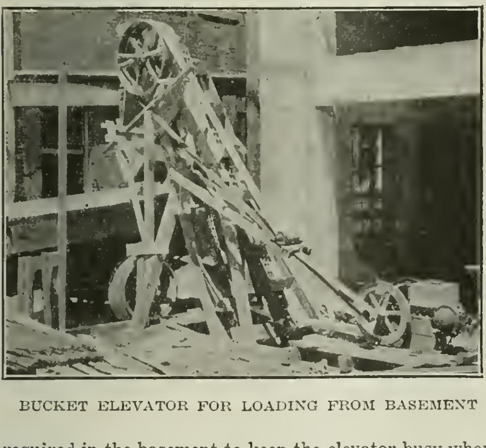
ICE JACKET AROUND THE EXPOSED PENSTOCK

Bucket Elevator Useful in Excavating Basement

THE CONSTRUCTION program on an office building in Fresno, Calif., being built for the San Joaquin Light & Power Corp., was such that it was necessary to remove several hundred cubic yards of earth after the foundation walls and part of the superstructure had been built. An old bucket elevator of suitable size was available and the contractor set this up in one corner of the basement and operated it at low cost with a 4-hp. gasoline engine.

The elevator was set so that with its lower end below the basement floor level its upper end would deliver through a short chute directly into trucks standing in an alley. A belt drive was used between engine and elevator and the use of a 30-in. pulley at the upper or elevator end of the belt gave the desired speed. Alongside the driving pulley was an idler pulley onto which the belt could be slipped by pushing a lever. Thus the gasoline engine was allowed to run continuously but by shifting to and from the idler pulley the bucket elevator proper was operated only when a truck was in position to receive the material. This did away with the necessity of bunkers. The shaft driven by the belt carried a smooth-face double-flanged wheel over which the links of the bucket elevator passed, the friction being sufficient to drive the elevator without the use of sprocket teeth.

No bin or other receptacle was provided at the lower end of the elevator, the material being merely piled up by shoveling or dumping from wheelbarrows. A shovel man was kept in attendance at the lower end when the elevator was working to shovel spillage from the buckets back onto the feed pile. As many as 12 men were



BUCKET ELEVATOR FOR LOADING FROM BASEMENT

required in the basement to keep the elevator busy when the material had to be moved by wheelbarrows the maximum distance of 60 to 75 ft.

One man was required at the top to start and stop the elevator and generally superintend its operation and the loading of trucks. Trucks handling 5 cu.yd. were loaded in about twelve minutes.

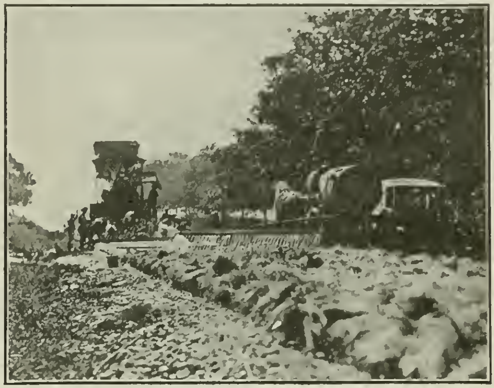
The contract is being carried out by the R. F. Felchin Co. of Fresno for whom E. M. Lewis is superintendent of construction.

Street Sprinkler Used in Curing Concrete Pavement

By J. G. Bragg

Senior Testing Engineer, New Jersey Highway Department, Trenton, N. J.

THE New Jersey state highway specifications require that concrete pavements be covered with salt hay or straw as soon as possible after placing the concrete, and this covering kept damp for a period of at least ten days. The usual procedure is to take the water from a pipe line supplying the mixer, hose connections having been provided at frequent intervals for



SPRINKLER WITH SPECIALLY MADE DISTRIBUTOR

that purpose. In cases where the road is constructed full width in one operation, from one-half to one mile of road is being cured at all times. If the covering is kept sufficiently moist, this is by no means a small undertaking, but it becomes still more difficult when the pavement is constructed one-half width because of the greater length to be cured.

The accompanying photograph shows portions of half-width construction being efficiently sprinkled with a horse-drawn street sprinkler, equipped with a special distributor consisting of a length of galvanized leader pipe in which holes have been bored about 5 in. apart. The distributor is hung on a pivot so that it may be swung to either side of the sprinkler.

The road under construction is known as Section 8 of State Highway Route 9, between Somerville and North Branch, N. J., and was built by Ralph Sangiovanni, of Newark, N. J.

Excavation Costs by Draglines

AVERAGE unit costs of comparable dragline excavation of drains for the 1922 season on some of the U. S. Reclamation Service projects are given in the following table. Costs are for machine operation only with no overhead:

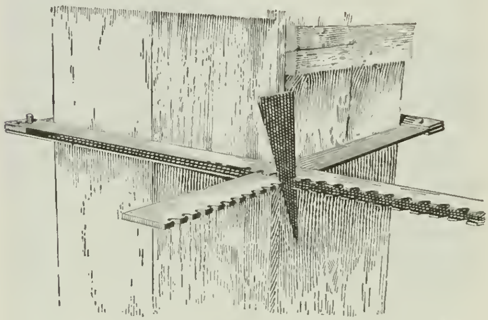
Project	Cu.Yd.	Unit Cost	Dragline Machines Used
Shoshone	836,800	$0.110	3 Bucyrus 9½ elec.; 1 Bucyrus 9½ gas; 1 Bucyrus 14 gas; 2 Pawling & Harnischfeger 206 gas.
No. Platte	522,085	.121	2 Monighan 1T gas; 1 Bucyrus 9½ elec.; 1 Bucyrus 14 gas; 1 Pawling & Harnischfeger 206 gas.
Newlands	1,706,816	.091	2 Bucyrus 14 gas; 1 Pawling & Harnischfeger 208 gas; 1 Austin 4 gas; 3 Monighan 1 T gas.
Rio Grande	1,770,605	.072	5 Bucyrus 9½ gas; 1 Monighan 2T gas; 3 Pawling & Harnischfeger 206 gas; 1 Bucyrus 30B gas.

In the table below is shown the average cost of canal excavation by draglines this season. As for the drains these costs are for machine operation only. Drilling and blasting and engineering and overhead are not included in costs.

Project	Cu.Yd.	Unit Cost	Dragline Machines Used
Klamath	442,737	$0.120	1 Monighan 1T gas; 1 Bucyrus 30 gas; 1 Bucyrus 14 gas; 1 Pawling & Harnischfeger 206 gas.
N. Platte	1,149,782	.107	1 Monighan 1T gas; 1 Bucyrus 14 gas; 2 Bucyrus 9½ elec.

Metal Clamp for Concrete Column Forms Saves Cost and Time

CONCRETE column forms on the sixteen-story Matson Building, just completed in San Francisco, were held in place by a new type of clamp which, according



CLOSE VIEW OF CLAMP IN POSITION ON FORM

to the Lindgren Co., general contractors, saved $1,500 on this job over the cost of accomplishing the same purpose with the ordinary wooden clamps. A further economy resulted from being able to fill the column forms to the top in one continuous operation as fast as the concrete could be dumped from the buggies. The surrounding slab was poured as soon as the column form was full, the runway for the buggies being moved back as the pour advanced and each succeeding column being filled as it was reached. This reduced the number of runways required to make the pour and also the labor of shifting them around. Since its success on this job the device has been patented as the "Wedge Notch Form Clamp."

As used on the Matson Building the clamps consisted of two pairs of intersecting arms, 3 ft. long, and two wedges. Each pair of arms consisted of one double bar (two 2½x$\frac{5}{16}$-in. pieces) and one single bar (one 2½x$\frac{5}{16}$-in. piece). The single bar was held between the double bars by a ½-in. loose rivet which was secured with a cotter pin. The double bar was held together at the other end and at the center by countersunk rivets with ⅜-in. washers as spacers between the bars.

The ends of the bars were notched, the notches being on the outside of the arms and set at an angle of 45 deg. with the longitudinal axis. The wedges were 8 in. long, ¼ in. thick and tapered from a 2-in. width at the top to a ½-in. bottom width. The complete clamp weighed 37 lb. or about the same as the wooden clamp which it replaced. In the size used on this building the clamps were adjustable to any rectangular column from 6 in. to 30 in. square. This range was made possible by a hole in each arm half way from hinge to

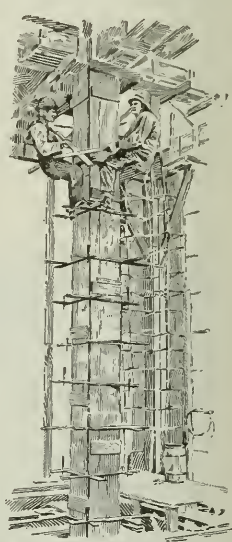
From Job and Office

Hints that Cut Cost and Time

notch into which the loose rivet hinge could be transferred when clamping smaller sized forms. The loose rivet was used in place of a bolt to avoid delay in making shifts that might otherwise be due to rust or concrete in the bolt threads.

The column forms were made on a bench, placed in the usual way and held temporarily by nailing the edges of the panels together at bottom, center and top. The first steel clamp was then placed 9 in. above the floor and each succeeding clamp 18 in. above the one last placed. In setting the clamps the single bar in each pair of arms was slid through the double bar in the opposing pair until all four arms rested against the form. The wedges were then inserted so as to engage opposed notches and driven home with a hammer. It was found that the wedges exerted sufficient pressure to draw the form boards tightly together and prevent any leakage of water and cement.

As the forms were set higher up the column the men soon found that they could climb up on the clamps, hooking one knee over the projecting arm of the top clamp and resting the other foot on the next clamp below. In this way, and taking the average for the job, the seven clamps on a column were placed by two men in twelve minutes and one man stripped the seven clamps and piled them at the base of the column in four minutes. These figures, which give an average for clamping and stripping of one man's time for four minutes on each clamp, were used in estimating the comparative saving of the metal clamps over wooden clamps. The cost of using wooden clamps was estimated on the basis of lumber costing $35 per M. or 35 cents per clamp, framing 40 cents and removal 5 cents, or a total of 80 cents per wooden clamp.



WORKMEN CLIMB ON THE CLAMPS AS THEY ARE PLACED

The first story columns on the street fronts of this building are T-shaped. To use the steel clamps on these columns 2-in. filler blocks were cut to fit between the stem of the T and the clamps.

Prize for Street-Railway Crossing Design

One of the members of the Contractors' Association of Philadelphia has offered a $50 prize for an expression of the best idea or experience in connection with paving a street intersection containing a railway crossing. The contest is open to anyone connected with public construction work.

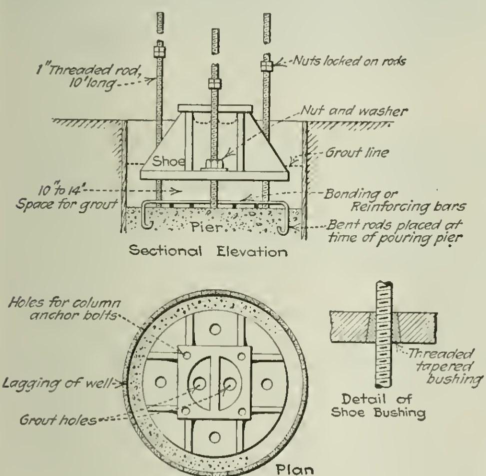
From Job and Office

For Contractor and Engineer

New Method of Placing Column Shoes for Steel Frame Buildings

A CONVENIENT method of setting column shoes and grillage on the foundation piers of large buildings is being employed in the construction of the new Union Station at Chicago. It permits of more rapid erection and insures stable support for shoe and column.

In common practice, after the head of the pier has been cleaned of laitance and foreign material, the shoe is placed on brick or concrete blocking on top of the pier and, after it is adjusted to level, grout is poured in through holes in the base to fill the 3- to 6-in. space between the shoe and the pier. This grout is usually required to be left for 70 to 90 hours before any load is placed on the shoe. When a girder is to be fitted against the web of the column, it is customary for the erector to push the column laterally so that the girder will clear the flanges. This movement of the column frequently results in a tipping of the shoe and crushing of the grout under its edges, especially as the grouting is often more or less incomplete or defective. Tilting of the shoe in this way may result in considerable expense and delay by making it necessary to remove the column, readjust the shoe and then start the steelwork again.



SCREW SUPPORTS FOR COLUMN SHOES

The new method of carrying the shoe consists of providing an adjustable support which will hold the shoe in place until the grouting has been completed, and which will take care of erection stresses until the grout has hardened sufficiently to take the required stress. Four taper holes are cored in the shoe base, and threaded taper bushings of soft steel are set in them, as shown by the sketch. Four 1-in. steel rods 10 ft. long, threaded for their entire length, are used for raising or lowering the shoe.

When the shoe is to be placed, the four rods are screwed into the threaded bushings, so as to project 12 or 14 in. below the base. A nut and washer on top of the base are screwed up when the shoe has been adjusted so as to prevent the shoe from tipping. Two square nuts are locked on the upper part of each rod, above the shoe. The shoe is brought to exact level by gripping each threaded bar with a wrench applied to the locked nuts, thus turning the bars like screw jacks until the shoe is raised or lowered to proper level. Wedges driven between the shoe and the wood lagging of the pier prevent lateral displacement of the shoe. Then 1:1 grout is pumped in to fill the space under the shoe. To bond this grout cap to the pier, two hook-end bars have their vertical ends set in the concrete at the time the pier is being completed.

When the grouting is completed, the projecting ends of the threaded rods are broken off above the nuts and washers with a cold chisel, and are used in another shoe.

The usual cost of setting one shoe by the old method ranges between $50 and $300, and sometimes reaches $400 with a large shoe or grillage lowered to a considerable depth in the casing or well above the top of the pier. With the rod method, the labor cost of setting a shoe averages about $12, and the total cost $22.

This new method of securing column shoes to concrete piers for support of steel structural work was invented by G. W. Allen, superintendent of construction for Graham, Anderson, Probst & White, of Chicago, who are the architects for the Union Station.

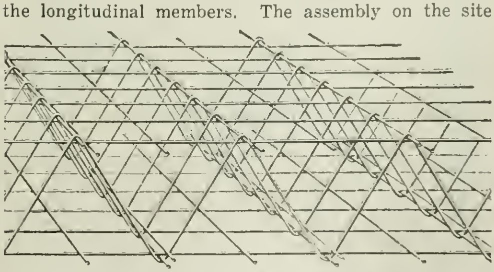
Double Layer Reinforcement for Roads

BY R. JOHNSTONE-TAYLOR
Shrewsbury, England

WITH the idea of developing the most effective type of reinforcement for reinforced-concrete roads a number of British engineers have devised a system of double layer reinforcing, the theories upon which it is used being explained below.

The nature of the effective loading is always indefinite and there cannot be exact knowledge regarding the action of the ground in supporting the slab. The advantage generally assigned to a double layer fabric is that it will take up tensile stress occurring along the upper part of the slab under certain conditions and will also provide for shear stress due to heavily-loaded axles supporting machines traveling at high speed.

The type of double layer reinforcement used consists of a bottom layer, a top layer, and a connecting fabric. The first and second consist of hard drawn steel mesh, the transverse members being electrically welded to the longitudinal members. The assembly on the site is perfectly simple and the method of doing the work is evident from the illustration.



DOUBLE LAYER ROAD REINFORCING

From Job and Office

Hints that Cut Cost and Time

Simulating Summer Conditions for Mid-Winter Construction

TO CARRY ON a large building operation in the midst of Adirondack winter conditions without the loss of a single day's work due to the cold, or storm, was the unique record made at Lake Placid last winter. The operation included the construction of the first three units of the new Lake Placid club house, a reinforced-concrete structure, faced with a local rubble stone up to the second story level and with rough texture chocolate-brown brick above. The three units are: Unit A, 44 x 105 ft., five and six stories and basement; Unit B, 35 x 38 ft., four stories and basement; and Unit C, 17 x 32 ft., five stories and basement. The frame is of reinforced concrete in bays 18 x 21 ft. with a 6-ft. corridor between them, running lengthwise of buildings A and B. The floors are structural slabs, 2 in. thick, reinforced with mesh for temperature stresses only, carried on reinforced-concrete ribs 25 in. on centers. Over this slab is placed 2 in. of cinder concrete with wooden sleepers on 12-in. centers laid flush with the surface. The maple floor is nailed direct to the sleepers without the use of underflooring. The corridors are floored with cork tile laid on cinder concrete with a troweled cement finish. Partitions, except at stair and elevator shafts, are of gypsum.

FIG. 1—INTERIOR OF THE ENCLOSURE SHOWING THE METHOD OF FRAMING AND SUPPORTING FORMS

In order to carry out the work during the winter a wooden inclosure was built around the space to be occupied by the completed building and made larger than the building to allow for a working space of about 5 ft. between the finished walls of the new building and the sides of the inclosure. The roof of the inclosure was supported on wooden bents to the full height of the temporary structure. These bents were placed 10 ft. on centers and they were made up of 3 x 4 verticals, braced transversely and longitudinally.

The exterior walls were of 2 x 6 material, 30 in. on centers, sheeted on the outside with ⅞-in. matched boards, and faced on the inside with tar paper.

Fig. 1 well illustrates the type of framing and the method of supporting the forms for concrete. All forms were of wood. The posts were built into the floor slabs and later cut off flush. 150,000 ft. b.m. of lumber were required for the inclosure.

After the inclosure was roofed over, it was heated by a B. F. Sturtevant Vento system, with a capacity of 15,000 cu.ft. per min. at a temperature of 150 degrees. Steam was supplied from the boilers serving the present buildings of the Lake Placid Club. The coal consumption averaged 3½ tons a day. The heated air was distributed throughout the inclosure in wooden ducts. Artificial lighting was necessary inside the building after the outside walls and interior partitions were up, only a few small windows having been placed in the sides of the inclosure.

FIG. 2—THE ENCLOSURE IN MID-WINTER

Excavation for the foundations was begun on Nov. 23, 1922, by the owners of the property, the Lake Placid Club Co. Even at that early date the ground was frozen enough to require blasting. The footings were started on Nov. 29, and completed on Dec. 7. They were carried to a depth of 5½ ft. below the finished external grade. Their depth was dictated by frost penetration rather than by the class of material on which they were built. Measurements of the depth of frost penetration this spring showed 62 in.

The work on the foundation walls and the first floor was carried on before the inclosure was completed, all exposed work being protected by canvas covers and heated with coke salamanders. The inclosure was completed to the fifth floor level and roofed over on Jan. 11. The heat was then turned into it and thereafter the men could work inside without heavy coats and gloves, the temperature averaging above 55 degrees, except on some

FIG. 3—REMOVING THE ENCLOSURE IN THE SPRING

From Job and Office

For Contractor and Engineer

extremely cold days. Only once did a thermometer register down to freezing inside the inclosure and then only along the ground below the level of the heating ducts. At the time the outside temperature was 32 degrees below zero. Specimen temperatures on days of low temperature were as follows: Outside, 36 below zero, inside 40 to 58 above; outside 24 below, inside 42 to 46 above.

As much of the building material as could be obtained in the early winter was brought to the site while the roads were good and was stored outside the inclosure, under canvas covers. Some of the reinforcing steel was later stored in one of the clear spaces within the inclosure. Materials for the concrete were heated with steam, since it was necessary to store these materials outside of the inclosure.

When the building was started a progress schedule was prepared, and except for the first and second floors, was followed so closely that the high roof was completed on the schedule date, March 1. The progress was as follows:

1st floor concreting completed A—Jan. 12; B—Jan. 18; C—Jan. 23.
2nd floor concreting completed A—Jan. 27; B—Jan. 28; C—Jan. 29.
3rd floor concreting completed A—Feb. 2; B—Feb. 3; C—Feb. 5.
4th floor concreting completed A—Feb. 8; B—Feb. 9; C—Feb. 10.
5th floor concreting completed A—Feb. 14; B—Feb. 15; C—Feb. 16.
6th floor concreting completed A—March 1.

The plastering was all done before the inclosure was removed, flood lighting being used to provide proper illumination. The building was substantially completed on May 15, and the inclosure was completely dismantled by April 28.

This work was done by the Turner Construction Co., New York. The architect was William G. Distin, Saranac Lake, N. Y. Information for this article was furnished by H. H. Alger.

"Duckboards" Handy for Building Concrete Buggy Runways

WHERE concrete buggies have to be wheeled over runways or ramps supported on trestles, the R. F. Felchin Co. of Fresno builds up the runways quickly and at low cost by the use of sections called "duckboards." These are 4x14 ft. in size and consist of 1x6-in. boards cut in 4-ft. lengths and nailed as a flooring onto three 14-ft. 3x4's that serve as joists. One of the 3x4's is placed in the center section and the others are placed 1½ in. inside each edge of the 4-ft. flooring, thus the sections are light and easy to handle, and, since they can be quickly made from old form lumber, do not cost much.

The duckboards are used repeatedly and as they pile up in small space can be readily stored or taken from job to job. When supporting these sections on trestles they are held in place by short lengths of scantling nailed to the support and to the outer joists. When this is done the result is much stronger and safer construction than loose planks and can be put in place almost as quickly. Outer joists are not set more than 1½ in. from the ends of the board because a greater overhang is likely to be broken off under the wheels of the loaded buggies.

Cement Protected From Weather by Tent Placed With Derrick

IN RAISING the height of the Copco Dam, which is near the California-Oregon line, a canvas tent stretched over a light wooden framework was found to be a convenient and economical means of protecting cement from sudden rainstorms or from heavy dew during the night. Cement storage warehouses were permanently roofed over, of course, but the comparatively small quantity of cement kept piled on the platform alongside the concrete mixer could not be kept under a permanent roof without rehandling because delivery was made from directly above by means of a derrick.

LOWERING THE TENT TO THE CEMENT PLATFORM

Tent is lowered by derrick at the end of each night's run over cement remaining on the mixer platform.

The tent on its wooden frame was therefore built up and set at a convenient spot where the derrick boom could reach it, and at the close of the day's work or whenever operations were stopped on account of rainfall, this tent was picked up bodily by the derrick and lowered into place over the cement that remained on the platform at the mixer. The same tent was used through the two winter seasons over which the work was in progress.

The raising of the Copco Dam was done under the supervision of P. O. Crawford, chief engineer, California Oregon Power Co.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Selling Cement by Sack

Sir—I have observed with interest your reference, under the caption "A Rational Change," to the adoption of the sack unit for selling and invoicing cement, in *Engineering News-Record* of June 21, 1923.

In this connection I may state that this company adopted the sack unit quite a while before either of the companies mentioned, and it may be interesting for you to know that the sack unit is now observed by nearly all of the cement manufacturers in this section including mills in the Rocky Mountain district.

We believed it to be a desirable change, and it is pleasing to note the commendatory attitude of the trade.

L. T. SUNDERLAND,
President, Ash Grove Lime & Portland Cement Co.

Kansas City, Mo.,
June 28, 1923.

Safe Roadway Widths

Sir—In the letter by L. R. Ash on roadway widths in May 17 issue, p. 894, with reference to Mr. Kipp's article in *Engineering News-Record*, April 19, p. 699, it is evident that the term roadway is confused with that of pavement. I believe it is general practice to consider the width of roadway to include the shoulders on either side of the pavement, or traveled road metal. Of course, with earth roads and, in some cases, gravel surfaces the two terms are identical.

Assuming that Mr. Ash's comments apply to widths of pavements the question arises as to what width is logical to provide for two lines of traffic, or, in other words, for a double track road. The average truck body is not greater than 8 ft. wide and the maximum width over all of a passenger automobile is 5.5 ft. Of course there are trucks operating on our highways with bodies greater than 8 ft. in width, but widths are restricted by statute in most states now, and doubtless will be by all in time. The speed of trucks, especially those loaded to the legal limit, is also limited by state laws. To construct a pavement for the exceptional case of excessive truck body width or for truck speeds exceeding legal limits cannot be justified economically. With trucks, 8 ft. wide, passing on an 18-ft. pavement and with the outside wheels 18 in. from the edges, there is a clearance of 2 ft. between bodies. This clearance is too little for high speed operation or even for comfort, but it indicates that trucks can pass with the wheels remaining well on the pavement. However, the writer believes that the correct criterion for determining the proper width of pavement is obtained when a passenger automobile passes a truck. This case would apply to at least 90 per cent of the highway mileage. By this criterion center clearance on 18-ft. pavement is $3\frac{1}{2}$ ft., which is believed to be ample for high speed traffic. The general practice on all modern road improvements is to widen the pavement on curves, which eliminates that complication. It is not believed that the additional cost of pavement width greater than 18 ft. for a double track road can be justified from an economical standpoint, and there is a practical objection to a width of 20 ft. This objection is based on the observation that a 20-ft. width invites a third line of traffic with the attendant risk of accident because of the small clearances provided. In other words there is danger in increasing the width beyond what is ample for the great preponderance of traffic and still does not encourage the passing of slow-moving by high-speed vehicles, forcing a third traffic lane for which the pavement was not designed.

For two lines of high-speed passenger automobile traffic and one line of slow-moving truck traffic an analysis similar to this indicates a required pavement width of 27 ft.

With reference to types of construction it is a well known fact that macadam with a bituminous top course breaks off in "scallops" at the edges, thus decreasing the effective width. On the other hand, in the case of rigid pavements the occurrence of dangerous ruts in the shoulder adjacent to the pavement is more frequent and pronounced than in the flexible type and the traffic will consequently not venture so near to the edges of the pavement, the practical effect of which is to decrease the effective width.

Columbus, Ohio,
May 29, 1923.

G. F. SCHLESINGER,
Consulting Engineer.

Interpretation of New York Timber Tests

Sir—Your brief analysis of the timber tests conducted under the auspices of the New York Lumber Trade Association, in the issue of June 21, contains one or two erroneous statements to which I would beg to call your attention. The purpose of these tests was not the comparative study of the two species of wood tested, but an attempt to secure some practical data upon which to base a proposed revision of the New York Building Code. It was the consensus of opinion of those engaged in the lumber industry in this section that the recommendations of the U. S. Forest Products Laboratory were at least not applicable to the character and quality of timber available in the New York market.

The test specimens of both Southern pine and Douglas fir were selected from commercial stocks of local yards, except that during the progress of the tests a shipment of 15 especially selected Douglas fir specimens was received from the West Coast via the Baltimore yards of the Weyerhaeuser company, of which 13 were tested and gave the excellent results noted. These specimens were not included in the original test program nor do they represent a grade available in this market either at the time of tests or at present. The results of the tests on the special timbers were not considered by the New York Lumber Trade Association.

The tests proved that the ordinary run of Southern longleaf yellow pine available in the New York market could safely be used at the working stresses in bending specified by the existing building code (of Mar. 30, 1915), but that the stresses for ordinary run Douglas fir as proposed for amendment of the code of Mar. 1, 1921, through the recommendation of the Board of Standards and Appeals were excessive. The tests also indicated the character and quality of defects that are commonly encountered in both species and gave valuable data as to their influence on the strength of structural size members. It was also clearly demonstrated that to equal the ordinary run Southern longleaf yellow pine, which consisted in large part of S_3 and S_4 specimens under the proposed rules of the U. S. Forest Products Laboratory, it would be necessary to specify the higher S_2 grade of Douglas fir.

The proposed standardization of grades of structural timbers, as contemplated by the recommendations of the U. S. Forest Products Laboratory, loses sight of the desired goal of this process, that is, economical manufacture and use. The rules recommended, besides being too complicated, exacting and unpractical in application, do not secure results that warrant the greater expenditure of time and waste of raw material required by them.

The National Lumber Manufacturers' Association has compiled the recommendations of the Southern Pine Association and the West Coast Forest Products Bureau governing standardized grades which have been presented to the timber committees of the several technical societies whose activities involve the study and use of structural timbers. These recommendations provide for three structural grades, standard, select structural and common, and are adaptable to practical methods of manufacture as developed by the lumberman after years of experience with his product.

GEORGE E. STREHAN.
Consulting Engineer,
Southern Pine Association.

New York, June 25.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Fire Caused by an Explosion destroyed the municipally-owned garbage-reduction works of New Bedford, Mass., on June 22.

A Net Income of $20,635,186 for the year 1922 is reported by the New York Central. This amounts to 7.20 per cent on the common stock as compared with 8.93 per cent in 1921, and a deficit in 1920.

The Bill Providing For the construction of branch lines to the Canadian National Railways during a period of three years at a cost of approximately $28,000,000, which was passed by the House of Commons, was rejected by the Senate on June 29, by a vote of 47 to 10.

Four Hundred Pullman Cars were used for the accommodation of the Shriners at Washington during the recent convention. To keep the storage batteries of these cars charged while they were standing still the Pennsylvania R.R. used 130 lighting plants with a capacity of 1½ kw. and supplying current at 32 volts, mounted on skids and distributed among the cars.

Appointment of "a Professional Engineer of broad experience" as a member of the Milwaukee Sewerage Commission, to fill a vacancy caused by resignation, has been urged upon the mayor by the Engineers Society of Milwaukee. It is pointed out that results previously achieved by the commission when an engineer was a member are recommendation for the appointment of another engineer to that body.

As Soon As the Detailed plans and specifications for the improvement of Montreal Harbor, at an estimated cost of $10,000,000, have been approved by the Dominion government the work will begin. The program includes the extension of the grain storage and handling capacity at Windmill Point and deepening of the basin there; reconstruction and heightening of wharves; construction of new wharves and railway connections for the grain elevator at Tarte pier now under construction; and extensions of piers in the central harbor.

The Harbor Car Service Bureau, organized for centralizing the handling, tracing and checking of railroad cars on the San Francisco waterfront, is now operating with offices at 110 Market street, San Francisco. It was formed by fourteen of the largest steamship and stevedoring companies. A complete record of movements of all steamer lines will be kept for the benefit of shippers and correct information on car loadings, toll, wharfage, switching, demurrage, etc., supplied. The bureau's services are free of charge to shippers and consignees. Anthony W. Frost is superintendent of the bureau.

President's Coal Commission Reports on the Anthracite Mines

Document Contains 30,000 Words—Strict Regulation Rather Than Government Ownership Recommended—Analysis of Cost

The preliminary report of the United States Coal Commission made public on July 8 is a unanimous report and was signed by the following members of the commission: John Hays Hammond, a mining engineer, chairman; Thomas R. Marshall, former vice-president of the United States; Clark Howell, editor of the Atlanta *Constitution;* George Otis Smith, director of the Geological Survey; Edward T. Devine, an authority on social relations, and Charles P. Neill, former commissioner of labor.

In the beginning the report points out that the fundamental fact in the anthracite coal problem is that heretofore the limited and exhaustible natural deposits have been in the absolute private possession of their legal owners, to be developed or withheld at will, to be released for such royalties as could be exacted, to be transported and distributed at such rates and in such manner as a doubleheaded railroad and coal combination might find most advantageous, and to be sold at such prices as could be maintained by the restriction of output and the elimination of independent competitors. The commission does not recommend the abolition of existing property rights nor does it recommend government ownership either by purchase at present value or by expropriation. It does, however, hold the view that a limited natural monopoly like anthracite held by a relatively small number of individuals and supplying a necessity for millions of people cannot continue to be treated as if it were not affected by a public interest.

Considered Public Necessity

Coal is quite as much a public necessity as gas, street railway service, railroads, and like them should be required to report to a public authority and be subject to regulation in the public interest and should have no secrets from the public in regard to mining costs, profits, salaries, wages, or corporate relations. The commission believes that the principal of individual and corporate responsibility should be maintained as most likely to insure economical and efficient management of the industry, and that the public interest may be adequately safeguarded by the creation of a governmental authority with power to require financial and operating reports, to prescribe uniform methods of cost accounting, and to determine the conditions on which coal may be shipped in interstate commerce.

It is recommended that the president of the United States be authorized by act of Congress to declare that a national emergency exists whenever, through failure of operators and miners in the anthracite industry to agree or for any other reason, there is a suspension of mining operations; and to take over the operation of the mines and transportation and distribution of the product with full power to determine wages and price at which coal shall be sold; and subject to court review, the compensation to be paid to land and mine owners.

Am. Soc. C. E. Board of Direction Protests Ousting of Davis

Engineering News-Record Staff Report

Preparation of a strong statement decrying the removal of A. P. Davis from the directorship of the Reclamation Service, and approval of the Executive Commitee's action in starting an investigation into Secretary Work's summary dismissal of Mr. Davis, were features of the session Monday and Tuesday of the Board of Direction of the American Society of Civil Engineers, previous to the summer convention being held in Chicago this week. The statement will be read at the business meeting of the society, July 11.

The Board also approved the report of the secretaries of the four founder societies favoring a joint engineering employment service, final approval of the plan to rest with the membership of the four societies. The present employment service is to be discontinued and the joint plan made effective Sept. 1. Branches of the service will be installed in various centers of engineering activity later on.

The Committee on Registration of Engineers was instructed by the Board to present a model law to the Board 30 days in advance of the fall meeting, to be held in Richmond, Va., Oct. 15. Because of his activity in connection with work on the Illinois engineers' license law, T. L. Condron was added to the Committee on Registration of Engineers.

Other action taken by the Board included approval of resolutions expressing regret for the death of Rudolph Hering and John Shoemaker, the latter killed June of last year in the clash between union miners and strikebreakers at Herrin, Ill.; and approval of a petition seeking the establishment of a city planning division of the society. Five technical divisions have now been organized or authorized. Four of these, dealing with the sanitary, highway, irrigation and power fields, were organized at the annual meeting of the society held in New York City Jan. 17-19.

The Board voted to hold the 1924 spring meeting at Birmingham, the summer convention at Pasadena, Calif., and the fall meeting at Detroit.

An analysis of the consumer's dollar, based on November, 1922, prices, shows that in New York every dollar paid for 145 lb. of coal; 56c. of the dollar went to the mine operator, 18c. to the railroads, and 26c. to the dealer. In Washington, the consumer's dollar paid for 141 lb. of coal and was distributed as 58c. as the mine price, 20c. as freight, and 22c. to the dealer. In Chicago, the dollar paid for only 120 lb. and was distributed as 49c. as mine price, 30c. as freight, and 21c. to the dealer.

As so large a part of the consumer's dollar goes to freight charges, the commission recommends that the Interstate Commerce Commission make further investigation of the reasonableness of the present anthracite rate. In view of the three successive jumps of approximately a dollar in the mine price of coal in the past three years, which is largely charged to labor, the commission has undertaken an extensive inquiry into the cost of living, the earnings, and other conditions surrounding the mine workers. The income of a family of five ranges in general from $1,500 to $2,000 for those who avail themselves of the opportunity to work the year round.

Basis of Income

The commission has found itself confronted with conflicting claims as to the basis upon which the rate of income should be reckoned. Cost of reproduction might well be reported as a fact with reference to the plant and equipment, but as the greater part of the investment claimed by the company is in coal-bearing land, reproduction cannot apply to these lands, because the lands cannot be reproduced. Nor is present market value a satisfactory basis, as there is no market for such lands in the accepted sense of the word.

In discussing the relation of production to the increase in population, the commission points out that the most significant fact is the progress made in twenty years in decreasing the wide gap between mine capacity and actual output; with approximately the same number of mine workers, the production was 50 per cent greater in 1920 than in 1900.

On the matter of the miner's rights, the commission says that the principle that a man has a legal right to work free and unimpeded and for whomsoever he choose; that another man has a legal right to employ and discharge as he pleases, and that men have a right to bind themselves together for collective bargaining are freely admitted by every one. These principles, honestly lived up to, would keep the open shop and at the same time permit the existence of the unions. But, as a matter of fact, the closed shop in a unionized mine is open to the union miner and closed to the non-union miner, while the open shop in the non-union mine is open to everybody save a United Mine worker. Neither side can show absolutely clean hands in keeping and helping to enforce the civil rights of American citizens.

The commission makes the following recommendations for the prevention of strikes:

"1. The commission recommends that in the next agreement there should be a provision for a continuing umpire and that he or an assistant named by him should sit with the Conciliation Board at all its meetings, but without a vote.

"2. That alternates should be selected with authority to act in the absence of the original member.

"3. The operators' group should appoint a full-time representative and all necessary assistants to consider jointly with the district officers of the union each case before it is appealed to the Conciliation Board in the hope of securing a local agreement, thus producing a mutual feeling of respect for the other's opinion and each obtaining the outlook of the other upon the problems.

"4. So many changes have taken place since 1903 that the agreement should provide for a joint committee to work out a restatement of the whole agreement in the terms of today, and this agreement should be specific enough to be the code by which all persons having anything to do with the settlement of grievances shall be bound.

"5. If the Board of Conciliation does not clearly understand the facts involved in any case, it should appoint an examiner from each side immediately to investigate and furnish it with all the facts.

"6. The agreement should provide for penalties for the breach thereof by either party, and the method by which such penalties are to be enforced.

"7. The renewed agreements have too rigidly retained the practices and conditions of 1902 and have not had adequate flexibility. A second joint committee should be provided for in the next agreement and directed to make an engineering study of the elements of the job of mining anthracite coal, for the purpose of building up a scientific and more equitable basis for rate making.

"8. The expiration of the contract in the anthracite region should not coincide with the expiration of that in the bituminous region. The contract should run for a definite period of time with the proviso that it shall be deemed to be renewed for a like period of time except as to such provisions thereof in which notice of a desired change shall have been given by either party to the other at least ninety days before the renewal date. Upon these proposed changes the parties shall immediately confer and if, sixty days before the date fixed for the renewal of the contract, they have been unable to agree, they shall report such fact to the President of the United States, specifying clearly the controverted points. The President shall thereupon appoint a person or persons to inquire into and make public a report upon all the relevant facts in controversy before the date of such renewal shall have arrived."

Conclusion

In conclusion the commission recommends at this time no punitive legislation. It awaits with interest whether the next agreement entered into shall show a co-operative spirit, a clear idea of partnership on the part of all concerned, and a proper conception of the rights of the American people. It points out that both the operators and the United Mine Workers are giving out information which apparently is intended to inflame the public mind for or against one of the parties, instead of informing the public as to what will be justice to both operator and miner.

Random Lines

Naval Engineering

In commenting on the sabotage of the "Vaterland," now the "Leviathan," former Secretary of the Navy Daniels explains as follows:

"On examination, the complete report by Captain Jessop will show other acts of sabotage, such as the removal of the propeller shafts, which would have permitted the seepage of tons of water into the hull of the ship and thereby cracked in the high pressure cylinder."

The mystery is how the binnacle, the foretopmizz'nm'st and the bos'n all escaped injury.

* * *

This Week's Grist

"Read what Henry F. Woods, Secretary of the Forgery Prevention Bureau of New York, has to say as to what the Todd Protectograph Co. has accomplished for Business America. Then call a Todd Forgery Prevention Engineer at Seneca 0571. He will gladly give you a visible demonstration of the story."—From a Buffalo newspaper.

Lauterbach,

1826 W. Pratt St.

Paint Engineer

A hand bill from Baltimore.

At a recent meeting of the Buffalo City Council the gentlemen who remove the garbage cans from the back doors were referred to as "sanitary engineers."

Sir—"Having noted, in my weekly quota of reading, the advertisements of Smart, Clever, and Sharks as "clothing engineers," I felt thoroughly vindicated, as an "ornery" civil, when I saw the spirit of retaliation manifested in an ad. of the products of a steel works, who emphasized their "hand-tailored boilers." E. F.

* * *

Warning Mr. Ashburner

The new city manager of Stockton, Calif., has good cause for action against the make-up man on the Washington *Star* who perpetrated the following sequence of news and philosophy:

NORFOLK, Va., June 23.—Charles E. Ashburner, city manager of Norfolk, and the first man to hold that position in the United States, resigned today to accept the place as city manager of Stockton, Calif., at a salary of $20,000 a year.

Fortune, when she caresses a man too much, makes him a fool.

Philadelphia Resumes Construction of Delivery-Loop Subway

Bids have been called by the Department of City Transit, Philadelphia, for construction of part of the delivery-loop subway, authorized in 1916 and begun shortly after. The portion to be put under contract includes 1,529 lin.ft. of the Arch St. leg of the loop. It is double-track structure of box section. About 300 lin.ft. of sewer besides intercepting sewers along the sides of the subway are included. Two short sections at each end of this one were constructed in 1917. It is planned to complete subway construction on this side of the loop eastward to a point near Eighth St., where the line is subject to change under revision of the plans now being considered.

As contemplated before the war, Philadelphia subway construction was to include the delivery loop in conjunction with a main trunk line north and south in Broad St., of which, however, only the section under the city hall, all of which forms a station, was built. Recently the administration, after the Frankford elevated line was placed in operation last November, proposed to place under contract a 13,000-ft. section of the Broad St. subway, beginning at a point 7,000 ft. north of the city hall and extending to Venango St. Changes in routing that have been suggested since the work was originally planned would not affect this portion. However, the city council repealed the ordinance appropriating funds for the Broad St. section. The appropriation for the delivery loop through Arch, Eighth, and Locust Sts. was not affected by this repealer. A commission of the council, including representatives of business organizations, is now considering the question of revising the authorized lines. It is working in conference with engineers of the Department of City Transit and of the Philadelphia Rapid Transit Co. The report of this commission is expected to be a necessary preliminary for further subway construction.

Marx Becomes Emeritus Professor at Leland Stanford

Charles D. Marx, professor of civil engineering at Leland Stanford Jr. University (Palo Alto, Calif.), retired at the end of the recent term and became professor emeritus. He went to Stanford in the opening year, has served the institution with great credit, and leaves under the university regulation that retires faculty members at the age of 65. For many years he has been prominent in activities of the Am. Soc. C. E. of which he has served successively as director, vice-president and president. When the San Francisco Engineering Council was organized some years ago to represent all technical societies having branches at San Francisco, Professor Marx was selected as president and each year has been re-elected to that office. A review of his professional record was published in *Engineering Record*, Jan. 23, 1913, p. 124.

C. B. Wing, professor of structural engineering at Leland Stanford Jr. University, becomes head of the civil engineering department. The faculty in this department is to be strengthened by the addition of L. B. Reynolds of the Burns & McDonnell Engineering Co., Kansas City, Mo.

Pennsylvania Soon to Organize State Traffic Police

The vanguard of Pennsylvania's traffic inspection force, authorized in a bill recently signed by Governor Pinchot, will be on the roads within a month, according to word emanating from the State Department of Highways last week. The legislation authorizes the highway commissioner of the state to employ such men as he deems necessary to enforce the penal provisions of the motor laws. Particular attention will be paid to the correction of the following evils, says Paul D. Wright, highway commissioner: Overloading of trucks, excess speed of all motor vehicles, and misuse of headlamps.

It is the intention of the commissioner to drive from the road the five per cent of road users who endanger the lives of all those who travel the highways. As an indication of the problem Pennsylvania faces in the correction of the headlamp evil, it is said that there are 150 different headlamps and devices approved by the department, many of which are declared to be obsolete. Also, there is almost as wide a divergence in the lenses used, so that the combination makes night traveling one of the most difficult of the problems concerned with road traffic in Pennsylvania.

The traffic inspection force is to be uniformed. Those police who will supervise speed of vehicles will use motorcycles, while automobiles will be used by those in the inspection force who are on the lookout for violations of the laws governing truck weights. Scales will be carried by these machines and whenever overloading is suspected, trucks will be weighed.

Kansas Contractor Goes to Work

DURING a recent flood in Kansas, caused by continued excessive rains, several cities were inundated by flood waters from the Arkansas River. Herewith is a photograph of the principal street of Wichita, Kansas, Douglas Ave. Irwin Hale, a general contractor of that city, is en route to his work. The current of the flood waters is considerable, as the picture indicates.

Wisconsin Bill Proposes State Acquisition of Water Power

The Wisconsin Legislature in session at Madison, has before it for consideration a bill which will amend the state constitution so as to permit the state to go into debt, by issuing securities, in order to buy hydro-electric power plants and water-power sites. The bill has passed the lower house and is expected to pass the Senate shortly.

Illinois Central R.R. Completing Chicago Yard

Work is being pushed on the large terminal freight yard of the Illinois Central R.R. at Chicago and it is expected to have the greater part of the yard in service before the end of the year. This Markham yard, just south of Harvey, Ill., 18½ miles from the Chicago passenger terminal, will be the main-line freight terminal for the Chicago district, where inbound trains will be broken up and outbound trains made up. All movements north of this yard will be switching and transfer service. This freight terminal was begun in 1918 (see *Engineering News-Record*, Aug. 15, 1918, p. 313) but work has been delayed by various causes. About $2,500,000 has been spent, mainly on the filling to raise the site to grade, but $6,000,000 will be required for completion. For northbound and southbound traffic there will be two separate units, each consisting (for the present construction) of a 10-track receiving yard, a 10-track departure yard and a classification yard with hump for gravity switching. The northbound classification yard will have sixty tracks for 2,400 cars and the southbound yard will have forty tracks for 2,000 cars. Double the number of tracks in each yard is provided for by the general plans. In addition there will be an engine terminal and a transfer station for rehandling l.c.l. freight.

The design and construction of the terminal yard are under the direction of F. L. Thompson, chief engineer, Illinois Central R.R.

Let First Contract on Moffat Main and Pilot Tunnels

The letting of a contract July 5 for electric power (3,000 hp.) for driving the 6-mile Moffat Tunnel under James Peak, just west of Denver, marks the initial step in the expenditure of a bond issue of $6,720,000 by the Moffat Tunnel Commission. A pole line 29 miles long from the Colorado Power Company's plant 5 miles west of Boulder is to be completed within 90 days and ready to deliver power at both east and west portals. The cost is approximately $65,000 and the contract price for current will average about 1c. per kw.-hr. When completed traffic through the tunnel will be operated electrically with current over the same pol line.

Successful sale of the 5½ per cent bonds late in June at a premium of $215,000 followed the action of the U. S. Supreme Court in validating the bonds by decision handed down June 11.

W. P. Robinson, president of the commission, states that he hopes to have the work under contract by Aug. 10 and actual construction started by Sept. 1. A chief engineer and staff will probably have been appointed by the time this is printed. Tunnel contractors have been notified of the work and the public advertisement will be made the latter part of July, a minimum of 10 days only being required.

The commission of five members, who serve without pay, was appointed by the governor immediately after the law went into effect. Their successors were voted upon July 10 but the only nominees were the appointees. D. W Brunton, J. Vipond Davies and J. Waldo Smith are the consulting engineers.

Missouri Highway Department Loses Freight Rate Suit

The Missouri Public Service Commission July 3 dismissed the complaint filed by the State Highway Commission against all the railroads of the state, demanding a reduction in intra-state freight rates on road building materials. The dismissal was without prejudice to the right of the Highway Commission to apply to the Public Service Commission for specific rates on road building materials between given points within the state.

The commission held that to grant the highway body's request and lower rates for general application between all points in the state upon all shipments of road building materials would result in undue discrimination against interstate commerce in the same commodities, which is prohibited by the interstate commerce act.

A ruling of the Missouri Supreme Court in a similar case against the Missouri, Kansas and Texas Ry. Co., was cited to support this view.

Pinchot Gets Bill Seeking Repeal of Engineers' License Law

Both legislative and judicial opposition to the engineers' license law has been raised in Pennsylvania. Governor Pinchot has now before him a measure seeking the repeal of the registration law, upon which action must be taken by July 13. There is little exact knowledge concerning Governor Pinchot's attitude on the bill, though it is the personal view of a number of engineers of high repute in the state that he will veto the repealer.

Judicial opposition to the bill is embodied in a decision handed down July 2 in a lower court by Judge Samuel E. Shull, of Stroudsburg, who decreed that the 1921 law creating the registration board is unconstitutional. The decision was the result of a test case wherein George D. Stevenson, a civil engineer of Scranton, was arrested about a year ago for practising his profession without first obtaining a license.

Forty-Year-Old Bridge Destroyed by Colliding Automobile

An old iron truss highway bridge crossing Pushta Creek near Wapakoneta, Ohio, was wrecked on the night of June 2 by an automobile which struck the end post while traveling at high speed. Chalmers S. Brown, of Lima, reports the accident as follows:

"The bridge, built in 1883, was a pin-connected through Pratt truss structure of 88 ft. span, with a clear roadway of 16 ft. The trusses were 15 ft. high and comprised eight panels of 11 ft. The floor was a 2 in. bituminous mat laid on a subfloor of 3 in. oak plank over 3 x 12 in. oak joists spaced 18 in. between centers.

"A large touring car carrying six people approached the bridge from the west at a speed of about fifty miles per hour. The approach to the bridge is on a down grade of 2.3 per cent, and has a curve to the right of 500 ft. radius and 19 deg. central angle which ends 40 or 50 ft. before the bridge is reached. The driver managed to pilot the car into the bridge entrance but in such a manner that the left running board was crushed against the left batter post and the left rear wheel struck the face of this post squarely, knocking the post off the abutment and causing the entire bridge to collapse.

"The speed of the car was such that it reached the last panel of the bridge before the superstructure fell upon it. The line of travel of the car was close to the left-hand guard rail. The top chord of the right-hand truss fell diagonally across the car, crushing the windshield and top and killing one passenger in the front seat and fatally injuring one in the back seat. The damage done to the car by the falling superstructure indicated that the car had come almost to a stop before being struck from above.

"It is interesting to note the heavy floor construction, the estimated weight of which is 42 lb. per square foot or about equal to the total original dead load. The bridge had withstood heavy traffic and was pronounced by engineers safe for ordinary service."

EAST PORTION OF WRECKED BRIDGE

West end post of north truss knocked off abutment and both trusses overturned toward north. Photographs taken from electric railway bridge near.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

The San Francisco Section, Am. Soc. C. E. at the bi-monthly meeting on June 19 had as guest of honor Professor C. D. Marx, recently retired from thirty years of active service as head of the civil engineering department, Stanford University. As a token of esteem and in appreciation of his long service, members of the section presented Professor Marx with a pipe banded with gold and suitably engraved. The topic for the evening's discussion was "The Investigation of California's Water Resources."

Personal Notes

DR. GEORGE A. SOPER, consulting engineer, New York City, has been appointed managing director of the American Society for the Control of Cancer. Besides his notable investigations of water treatment and sewage disposal, the latter including years of study while member and president of the Metropolitan Sewerage Commission of New York, Dr. Soper has conducted much epidemiological work, particularly during typhoid outbreaks and while in the office of the Surgeon General, U. S. A., during the World War.

F. D. MARQUEZ has resigned as superintendent of public works in Porto Rico, under the United States Department of the Interior, to become commissioner of public works of the city of San Juan.

FREDERICK L. RANSOME, formerly assistant in geology at Harvard, and since 1913 in charge of sections of western work for the U. S. Geological Survey, has accepted the position of professor of economic geology at the University of Arizona. He is a graduate of the University of California.

A. L. FERVER, for two years director of public service in Long Beach, Calif., has resigned and will be associated with James F. Collins, development engineer, in that city.

JAMES OGDEN has succeeded F. S. Benson as city manager of Bakersfield, Calif.

PROF. IVAN C. CRAWFORD, associate professor of civil engineering at the University of Colorado, will become dean of the college of engineering, University of Idaho, this fall.

R. SCOTT KIFT, civil engineer, Lock Haven, Pa., was elected as borough engineer for Lock Haven to succeed W. F. Cowley, who will locate at Birmingham Ala.

W. C. KEGLER, engineer of maintenance-of-way on the Cleveland, Cincinnati, Chicago & St. Louis Ry., has been appointed engineer of track and roadway, with headquarters at Cincinnati, Ohio.

RICHARD CASE has been appointed assistant town engineer of Phillipsburg, N. Y., to succeed BERNARD P. MONOHAN, resigned. Mr. Case has been connected with the engineer's office of the town for eight years.

T. E. HUFFMAN, county engineer of Denton County, Texas, in charge of the $2,000,000 highway program for the past four years, has resigned upon completion of the major portion of the work, and H. T. BREWSTER, resident engineer, has succeeded him.

W. S. BELLOWS, Oklahoma City contractor, and W. H. MACLAY, recently of the Central Contracting Co., Dallas, have opened offices as general contractors at 1217 Kerby Bldg., Dallas, under the firm name of Bellows-Maclay Construction Co.

EDWIN F. WENDT, of Washington, D. C., has been selected as consulting engineer on valuation for the Toledo, St. Louis and Western R.R. Co.

M. M. LEIGHTON has been appointed chief of the Illinois State Geological Survey, with offices at Urbana, Ill., succeeding F. W. DeWolf who resigned.

R. T. HOYT CONSTRUCTION CO. has been organized in Colorado Springs, Colo., with the following as principal members of the firm: R. T. Hoyt, F. L. Grandon and Paul T. Barrett.

MAJOR A. B. CUTTER, former city engineer of Everett, Wash., has been appointed resident engineer for the recent $850,000 bond improvement program at Bluefield, West Virginia. The bond election carried on June 19.

W. F. COOPER, of Union Parish, assistant highway engineer of the Louisiaa Highway Commission, has been appointed by Governor John M. Parker to succeed Arthur Taylor, of New Orleans, as a member and vice-chairman of the commission.

CLYDE POTTS, consulting engineer, New York City and Morristown, N. J., has been elected vice-president of the New Jersey State Board of Health.

ROY A. KLEIN has been made chief engineer of the Oregon State Highway Commission. Mr. Klein, who succeeds Herbert Nunn, retains the position of secretary of the Highway Commission which he has held for several years. Since the resignation of Mr. Nunn, Mr. Klein has been serving as acting chief engineer of the commission.

THOMAS J. WASSER, former chief engineer of the New Jersey State Highway Department, has been engaged by the Public Service Production Co., a subsidiary of the Public Service Corporation of New Jersey. Mr. Wasser will take charge of all road work in his newest association.

R. T. REGESTER and G. E. STONE have established the firm of Stone & Regester, consulting engineers and contractors, with offices in Baltimore, Md. Mr. Regester has been construction engineer of the Loyola Construction Co., Baltimore, and Mr. Stone has been assistant highway engineer.

ORRIN E. STANLEY, for several years sewer engineer, department of public works, Portland, Ore., has been appointed chief of the bureau of maintenance in that department, following the resignation of R. S. McMullen. C. H. SMITH is the new sewer engineer.

H. L. TROTTER and C. L. CATE have formed a partnership under the firm name of Trotter & Cate, consulting engineers, with offices in Montreal. Henry Holgate will be connected with the firm as associate consulting engineer. Col. Trotter is a graduate of the Royal Military College, Kingston, and has worked with Ross & Holgate, consulting engineers, and for Morrow & Beatty in British Columbia. Mr. Cate is a graduate of McGill University and besides doing hydro-electric work with the Foundation Co., Ltd., has been a consulting electrical engineer.

H. B. VOORHEES, general manager of the New York terminal of the Baltimore & Ohio R.R., has been promoted to be general manager, western lines, with headquarters at Cincinnati.

L. S. ROSE, assistant to the general manager of the Big Four Ry., has been appointed general manager of the Peoria & Eastern, with headquarters at Indianapolis, Ind.

DR. W. R. WHITNEY, director of the research laboratory of the General Electric Co., was recently elected a member of the corporation of the Massachusetts Institute of Technology for a term of five years. CHARLES R. MAIN, consulting engineer, Boston, was also elected to the corporation. Both men are graduates of the school.

THEDORE E. VELTFORT, who for ten years has been assistant to the district construction manager in the Chicago office of Stone & Webster, Inc., has been transferred to the structural division of the company in the Boston office.

HOWARD A. HOLMES, construction engineer of the Montana state highway department, has been appointed chief engineer of the highway commission of that state, succeeding John N. Edy, who has gone to California.

JAMES ALLEN, formerly state highway supervisor of Washington under the department of public works, has now been designated state highway engineer reporting directly to the State Highway Commission.

BERNARD L. CROZIER has been appointed highway engineer for Baltimore, Md., succeeding CHARLES F. GOOB. Mr. Crozier has been connected with the engineering forces of the Baltimore & Ohio R.R., United Railways & Electric Co., Maryland State Roads Commission and the Baltimore Paving Commission.

JOHN A. MACDONALD has been appointed highway commissioner of Connecticut to succeed C. J. Bennett, who resigned July 1 to enter the construction business. E. C. WELDIN, former division engineer, has been named deputy commissioner.

The WATSON ENGINEERING CO., Cleveland, Ohio, architects and engineers, has changed its corporate name to the Watson Co., in order that the name of the organization may describe more accurately the scope of the service it gives. The change became effective June 1. For sixteen years the services of the company have consisted mainly of design and supervision of construction of both architectural and engineering structures. The reconstructed firm offers to its clients coordinated personal services of a competent staff of architects and structural, mechanical, electrical, heating and ventilating engineers, all of whom have had specialized training and experience.

Obituary

JOSEPH G. LEGRAND, bridge engineer of the Canadian National Railways, Western region, died at Winnipeg July 2. He was born in France in 1861 and went to Canada at the age of 30. In 1900 he was appointed bridge engineer of the Grand Trunk Ry. and in 1920 to the position he held at the time of his death.

JOHN A. BRITTON, first vice-president and general manager of the Pacific Gas & Electric Co., died in San Francisco June 29, aged 68 years. He had spent most of his life in California, having gone to that state from Massachusetts at the age of thirteen. His schooling was cut short by the necessity of earning his own way and he entered the employ of the Oakland Gas Co. as collector in 1870, working up through the positions of secretary and chief engineer to the office of president. When the company was absorbed by the Pacific Gas & Electric Co. he again advanced rapidly in the larger field to the position held at the time of his death. As active head of the company he directed the affairs of one of the largest hydro-electric systems west of Chicago. He was an active participant in affairs of the civil, mechanical and electrical societies, and at the time of his death was the president of the Bohemian Club and a prominent leader in business and professional circles.

JULIO FEDERICO SORZANO, consulting engineer, died in Brooklyn, New York, June 25. Educated in France and Belgium, he had been engaged in the engineering field since 1879. Although established in New York, the greater part of his work was done abroad, principally in Cuba, Mexico, Puerto Rico, Haiti and the countries of South America. He designed and built a score or more sugar mills in Cuba and Puerto Rico alone, and was an acknowledged expert in matters pertaining to the raw cane and beet root sugar industries. He constructed the first railway built in Venezuela, as well as two subsequent roads in the same country. One of the first matters on which he was consulted here was in connection with the foundations of the Brooklyn Bridge towers with which there had been considerable difficulty. He was greatly interested and very active in the Panama Canal controversy over the relative merits of the lock canal as against the sea level canal, and the water supply available for the lock canal. Mr. Sorzano was a close student of Latin-American affairs, and in 1911 organized the Pan-American Chamber of Commerce. He was president of the institution up to the recent illness which culminated in his death. He was a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Institution of Civil Engineers of Great Britain and la Société des Ingénieurs Civils de France.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Lubrication of Construction Equipment—Part II

How Contractors Can Secure the Maximum Service from Gears, Chains, Wire Rope and Concrete Mixing Machinery

(From Information Supplied by The Texas Co., New York.)

IN ORDER to preserve and maintain operation at the highest efficiency, it is essential to keep all gears, chains and wire rope well coated with a suitable compound which will serve not only as a lubricant, but also as a preservative. Wire rope in particular requires attention due to the possible hazard involved if internal strands are allowed to rust, wear and corrode. Although wire rope as constructed today contains a hempen core which is usually soaked in lubricant prior to the winding of the steel strands, the theory that this core will serve adequately to lubricate the strands and prevent wear, rust and corrosion during subsequent service should not be relied upon. Therefore, the exterior surface of the rope should be treated at frequent intervals with a suitable lubricant and preservative, which is capable of penetrating to the innermost strands during operation and not only re-lubricating the core but as well preventing wear at the points of contact of the strands.

Such a compound should be: Plastic at all temperatures; capable of being readily applied in a thin film without undue heating; free from acids and alkalis; non-evaporative; so tenacious and adhesive as not to drip or run off under abnormal pressures or temperatures; insoluble in water; non-hardening; capable of resisting the entry of dust, dirt, chemical fumes or salt water. The most suitable lubricant for this service is a pure petroleum compound having a viscosity of about 2,000 Saybolt at 210 deg. F. In some cases increased viscosity up to perhaps 5,000 may be necessary.

Gears and chains should be treated with a similar compound. There is relatively no hazard if they are neglected, but wear will develop abnormally accompanied by excessive noise and rattling, and corrosion of the wearing surfaces, especially if they are exposed to sea air, or acid fumes. Whatever the type of machine involved, the setting and aligning of gears is important, and all teeth should so mesh that there will be a uniform and constant application of power and smooth, quiet operation in order to insure against jerky action. This latter would tend to produce strains and abnormal wear, not only on the gears, but also on other driving mechanisms.

To attain best results in applying the gear lubricant the surfaces of all teeth should first be washed with kerosene or some other solvent, the lubricant being then heated and brushed or poured lightly onto the wearing surfaces while the gears are in slow rotation. Pressure between the teeth will adequately spread the lubricant, if it is applied in the proper amount, and it should not be forced over the sides of the gears unless the film is too thick. In this event the intensity of the application should be decreased.

Concrete Mixing Machinery

In construction work concrete mixers have become essential. Their rate of production is the prime factor governing the progress of the work, and possibility of break-down due to serious wearing of gears, overheated bearings or engine troubles which are traceable to faulty lubrication, should be carefully guarded against. Concrete mixers, at best, will receive the roughest kind of treatment. There is always a certain amount of dust grinding into bearings, gear teeth or other operating mechanisms, so that mixers should receive proper and sufficient lubrication throughout the job.

In general the lubrication of concrete mixers, whatever their type or design, can be effectively carried out by the use of three grades of lubricants: A gear compound; a suitable grade of grease or semi-solid lubricant for general bearing lubrication; and a power plant lubricant adaptable to the type of machinery used to drive the mixer. On gears, pinions, racks, sprocket wheels and chains, as well as wire rope, a heavy grade of petroleum compound having a viscosity of about 2000" Saybolt at 210° F. has proved to be the most dependable lubricant. Such gearing in general operates under considerable pressure and there is always a certain amount of dust, slush and water present. Therefore, a lubricant must be selected that will not only have sufficient viscosity to insure a dependable film and prevent metal to metal contact, but as well which will be so adhesive as to stick to the teeth and chains and resist the washing action of water as much as possible.

Grease or cylinder oils can be used on such gears but they are not as efficient as the heavier compound due to the presence of dust and to their tendency to absorb or accumulate fine particles of cement readily. They simply develop into an abrading paste instead of a lubricant. The heavier compound mentioned above, however, withstands such contamination to a marked extent.

Drum Roller Bearings

The bearings of drum rollers also require careful lubrication if the machine is to be kept in continuous service and breakdowns forestalled. If these bearings are not properly lubricated at all times the resultant wear, which will be brought about by the abnormally high down-thrust caused by the tumbling action of the materials within the drum, will result in flattened shafts and a certain amount of wobbling. Vibration, pounding, and distortion or misalignment of the entire mechanism will thereby follow. Certain manufacturers use roller bearings on the drum rolls, and certain other shafting, while others prefer split babbitted bearings equipped with grease cups.

Attention to Grease Cups

Where roller-bearings are used the most suitable lubricant will be a pure mineral product of the nature of petrolatum, a relatively heavy grade of liquid grease or a light compression cup grease. Grease cup service requires a heavier lubricant of about the same consistency as a medium compression cup grease. Attention to grease cups throughout the machine is very important. In daily operation they should be kept well filled with clean grease and screwed down at least twice a day in order to insure a sufficient film of lubricant in the bearings to prevent cement dust from working its way in along the shaft ends.

Roll surfaces and drum runways should never be lubricated, inasmuch as the presence of oil or grease on the frictional surfaces will reduce tractive effort. Such rolls are in general built of car-wheel metal in order to withstand the heavy duty required.

Lubrication of the power plant of a concrete mixer will, of course, depend upon its type. Where steam is used both internal (or cylinder) and external lubrication are required. Inasmuch as saturated steam is chiefly used, a compound steam cylinder oil of from 130 to 150" Saybolt viscosity at 210° F. will be suitable. This should be furnished to the cylinder at a rate of about five drops per minute by means of a dependable hydrostatic or force-feed lubricator. Care of a hydrostatic lubricator is important especially in freezing weather. During such operation whenever a shutdown is to be made for any length of time, both oil and water should be drained from the lubricator, in order to prevent freezing in the sight feed glass, and possible cracking.

External Engine Lubrication

The external lubrication of engine bearings and guides, etc., should be carried out in the manner explained heretofore, using either a high grade straight mineral oil suitable for service in ring oiling systems and drop feed oil cups, or a pure compression cup grease of light or medium grade according to the prevailing temperature involved. In general, grease lubrication is preferred by most mixer builders and their machines are therefore usually equipped with compression grease cups.

Where internal combustion engines or electric motors are used to drive the mixer lubrication is similar to that recommended for excavating machines equipped with similar power plants. All such machinery is subjected to the same severity of operation. Hence, motor bearing lubricants of from 180 to 200" Saybolt viscosity at 100° F. will be most suitable on electric drive mixers; and the usual grades of automobile and tractor engine lubricants will serve the purpose on internal combustion engines.

Messinger Becomes President of the Chain Belt Co.

C. R. Messinger, vice-president and general manager of the Chain Belt Co., Milwaukee, since 1917, has been appointed president, succeeding William C. Frye who retires from active participation in the company's affairs after a service of 28 years with the organization, including 7 years as its administrative head. Under Mr. Frye's leadership the company has maintained a steady growth, inaugurated by C. W. Levally, founder and first president, in the production of chain, concrete mixers and conveying machinery, under the trade name of Rex.

Mr. Messinger joined the Chain Belt organization in 1917 after 8 years as general manager of the Sivyer Steel Casting Co. He is also president of the Interstate Drop Forge Co., vice-president of the Sivyer Steel Casting Co., vice-president of the Federal Malleable Co., all of Milwaukee, and a director in the Nugent Steel Castings Co. of Chicago and the First Wisconsin National Bank of Milwaukee. During the term 1922-23 Mr. Messinger was president of the American Foundrymen's Association and is also prominent in the affairs of the American Malleable Castings Association.

Recommend Fewer Varieties of Structural Concrete Units

Washington Correspondence

Recommendations for the elimination of a number of sizes of structural and partition units made of concrete were endorsed by committees representing the Concrete Products Association and the American Concrete Institute at a preliminary meeting held in Washington, D. C., June 21 with the Division of Simplified Practices of the Department of Commerce. The committees expressed a desire for a general meeting of all interests concerned in the subject next October to consider adoption of the recommendations.

The tentative recommendations are the result of a survey made under the direction of Wallace R. Harris, chairman of the Committee on Standard Building Units of the American Concrete Institute. This survey showed concrete blocks made in 30 different lengths, 20 widths and 26 heights.

The tentative recommendations for foundation units are: Height, 7⅝ in., length, 15⅝ in., with wall thicknesses of 8 and 12 in. For load bearing wall units the recommendations are: Height, 7⅝ in., length 15⅝ in., and wall thicknesses of 6, 8, 10 and 12 in. For load bearing concrete structural tile the recommendations are: Height, 5 in., length, 11⅝ in., and wall thicknesses of 4, 8 and 12 in. For concrete partition tile (non-load bearing) the recommendations are: Height, 7⅝ in., length 16, 18 and 24 in., and width 3, 4, 6 and 8 in.

Attending the preliminary conference were: Herbert A. Davis, representing both the Concrete Products Association and the American Concrete Institute; C. E. Lindsley, American Concrete Institute; L. L. Wagner and John L. Miner, Concrete Products Association; P. E. Holden and E. W. McCullough, Chamber of Commerce of the United States; and R. M. Hudson, assistant chief of the Division of Simplified Practice.

George L. Buff, Instrument Maker, Dies

Head of Well Known Firm Began Work at 17 in German Shop and Established Own Business in New York in 1870

GEORGE L. BUFF, head of the Buff & Buff Manufacturing Co., which for years has supplied surveying instruments for notable engineering projects throughout the world, died July 5, at the age of 84. Such works as the Panama Canal, the Catskill Aqueduct, the Union Pacific, New York, New Haven & Hartford, and Mexican Central Railways, to say nothing of thousands of triangulation surveys and scores of long tunnels, mines, highways and waterways have depended for their location, alignment and precise control of line and grade on the transits and levels produced by the organization established by Buff in Fulton St., New York, in 1870, and later moved to Boston.

Born in Giessen, Germany, in 1839, of the family which furnished Goethe with the *Lotte* (Charlotte Buff) for "Werther's Leiden," George L. Buff left home at the age of 17 to enter the factory of Repsault & Co., Hamburg, manufacturers of scientific instruments. Two years later he went to York, England, as foreman in charge of the large astronomical instrument shops located there. For six years he devoted his efforts to the finest sort of mechanical workmanship and with this training as a foundation emigrated to New York in 1864 to associate himself with the firm of Stackpole & Sons, well known instrument makers.

Business Established in 1870

In 1870 he established his own business on Fulton St., New York, and a year later entered into a partnership with C. L. Berger under the firm name of Buff & Berger, which continued 27 years, and won a nation-wide reputation for the excellence of its products. This partnership was dissolved in 1898 when Mr. Buff took his three sons into a newly formed organization under the name of the Buff & Buff Manufacturing Co., with a manufacturing plant in Boston.

Speaking of his work, one of his friends has said: "Buff made beautiful instruments for the love of it; he was indifferent to wealth. He created designs to fulfill certain requirements and brought them into being with unexcelled faithfulness and accuracy of workmanship. The sturdy beauty of his designs, their consistency of proportion and their extreme and faithful accuracy made his instruments world-famous. Even after his organization had expanded he insisted upon personal supervision of the individual construction of each instrument manufactured."

CHARLES CLIFTON, of the Pierce-Arrow Co., was re-elected president of the National Automobile Chamber of Commerce at the annual meeting in New York, June 7.

Business Notes

A. F. MCCLINTOCK has been appointed assistant sales manager of the Reading Iron Co., Reading, Pa.

BUCYRUS CO., South Milwaukee, Wis., manufacturer of power shovels, and excavating and dredging equipment, announces the appointment of E. J. Wilkie as northern sales manager, succeeding E. R. Weber, resigned. Mr. Wilkie will have general charge of the sale of Bucyrus products in Wisconsin, Minnesota, North and South Dakota, Michigan and Montana, with headquarters in South Milwaukee.

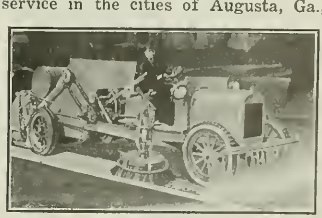
E. M. BREED, for several years assistant manager of sales for the Pelton Water Wheel Co., San Francisco, has been appointed sales manager with headquarters in San Francisco. Mr. Breed has had a wide experience in hydro-electric work, having been connected with the Pelton company in various capacities for the past fifteen years.

CHAMPION ENGINEERING CO., Kenton, Ohio, has opened a new sales office in Chicago to take care of increasing business in the crane and caterpillar sluice gate lines. This office will be in charge of W. B. McCracken, transferred from the company's operating department to the sales department.

Equipment and Materials

Pick-up Motor Street Sweeper Has Gutter Cleaning Attachment

A one-man motor-driven pick-up street sweeper with auxiliary gutter cleaning attachment and water sprinkling system has been designed by the Foamite-Childs Corp., Utica, N. Y., and machines of this type are already in service in the cities of Augusta, Ga.,



Elmira, and Massena, N. Y. The equipment consists of a rotary broom 32 in. in diameter and 6 ft. wide mounted at the rear of a Reo speed wagon and delivering into an inclined conveyor which discharges into a closed storage hopper of 50 cu.ft. capacity. Tests have indicated that the machine operates most effectively at a speed of 9 miles per hour.

The rear broom is built up on a grooved wooden core, with end castings to protect the fiber, and is filled with either steel or split bamboo. As the broom wears, the distance between broom and conveyor is automatically shortened to insure uniformity in the delivery of street dirt to the conveyor.

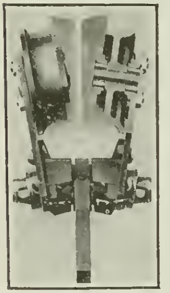
The conveyor drive is equipped with wood shear pins which break at the entry of any large heavy object which might foul the machine. The broom also stops when the shear pins break. The conveyor is of the rubber squeegee type with removable bottom. The dirt storage hopper has a smooth interior, without shelves or bridges, so that dumping can be done quickly and completely.

The gutter broom at the side of the machine works automatically in and out along the curb, brushing the dirt out under the sweeper where it is caught by the large broom at the rear. The gutter broom has a steel fiber filling 42 in. in diameter built in six segments that are easily removed and replaced when the broom wears. A feature of the sweeper is that both rear and gutter brooms may be made to revolve while the sweeper stands still.

The water sprinkling system in front of the machine consists of a 150-gal. galvanized iron tank with brass strainers at intake and outlet from which water runs by gravity to a rotary gear pump that forces water to the nozzles.

Roller Bearing I-Beam Trolley

A combination of strength and flexibility was sought in the design of the steel-plate, roller-bearing I-beam trolley which the Yale & Towne Manufacturing Co., Stamford, Conn., has placed on the market. The equipment, as shown in the illustration, consists of a pair of flanged wheels attached to side plates from which a shackle plate is supported by a single equalizing pin. The trolley has a rated capacity of 2 tons, although under test it has sustained a load of 14 tons. To each side plate are riveted spreader castings which give a large bearing surface for the equalizing pin and are so shaped as to protect the trolley and act as a bumper which engages the track stop on the lower flange at the end of the I-beam track. The axles are set at the same angle as the surfaces of the I-beam flanges and are pressed into wheel hubs and supported by inner bearing plates subjected to practically no bending strain.



The non-rigid construction of this trolley, its manufacturer claims, allows it to pass around a curve of sharp degree without binding.

Publications from the Construction Industry

Caterpillar Type Mounting—Erie Steam Shovel Co., Erie, Pa., has issued a 20-p. illustrated bulletin featuring its lubricated caterpillar type mountings for power shovels. The lubrication system is explained in detail and another feature emphasized is the use of removable bushings on the link pin bearings.

Wood Preservation—C. A. Wood Preserver Co., St. Louis in a 44-p. booklet entitled "Evidence" presents data indicating the effectiveness of its carbolineum treatment to prevent rot and decay of timber. A number of testimonial letters indicate the value of wood preservation in a variety of uses.

Motor Vehicle Statistics—National Automobile Chamber of Commerce, New York, has recently published the 1923 edition of its "Facts and Figures of the Automobile Industry," a book of 96 pp. illustrated. The publication contains a considerable amount of data of interest to highway engineers and contractors, covering the registration of motor vehicles, annual production of trucks and passenger cars, notes on motor vehicle taxation, mileages of federal-aid roads, motor vehicle revenue and similar statistical data.

Reinforced-Concrete Pipe—Lock-Joint Pipe Co., Ampere, N. J., in a 12-p. illustrated pamphlet, presents details of its three types of joint: Lead and iron; lead and steel; and copper. The text is supplemented by detail drawings.

Portable Hoists—Sullivan Machinery Co., Chicago, has issued two new bulletins, one on its single-drum and the other on the double-drum Turbinair portable hoists for scraper loading. These are reprints of earlier editions to which new matter has been added.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

To Survey Seasonal Operation in Construction Industries

Savings, not only to the building industry and its workers, but to the public generally are expected to result from the activities of a committee on seasonal operation in construction industries, the appointment of which by Herbert Hoover, chairman of the President's Conference on Unemployment, has been announced by the Department of Commerce. This saving should be reflected in lower relative cost of dwellings and other buildings. The members of the committee are:

Ernest T. Trigg, manufacturer, Philadelphia, chairman; John W. Blodgett, manufacturer, Grand Rapids, Mich.; John Donlin, president, Building Trades Department, American Federation of Labor, Washington, D. C.; L. F. Eppich, president, National Association of Real Estate Boards, Denver; A. P. Greensfelder, contractor, St. Louis; John M. Gries, Department of Commerce, Washington, D. C.; Otto T. Mallery, public works expert, Philadelphia; Rudolph P. Miller, engineer, New York; James P. Noonan, president, Brotherhood of Electrical Workers, Washington, D. C.; William Stanley Parker, architect, Boston; and Edward Eyre Hunt, secretary. The committee at a meeting this week expects to lay out plans for a thorough study of the facts.

Previous surveys have indicated that most construction activity is concentrated in seven to ten months of the year, which means that building trades workers can not find work in their trade during several months, and that contractors' organizations and equipment, architects, engineers, building material producers, and others connected with construction, must usually remain idle for similar periods. This idle time represents waste and direct losses to the construction industries themselves, their workers, and the public.

The committee was formed in the hope that by examining the facts and proposed remedies it might be able to suggest sound solutions and obtain general co-operation in effecting them. It is the general impression that seasonal building has been due perhaps more to custom than to weather, and it is expected that the investigation will throw light on this and other points.

Weekly Freight Loadings Pass Million Mark Four Times

For the third consecutive week and the fourth time this year, according to the Car Service Division of the American Railway Association, loading of revenue freight exceeded the million mark for the week ended June 23, the total for the week being 1,002,740 cars. Freight loading so far this year has been the heaviest in history. The total for the week of June 23 was an increase of 13.6 per cent, or 136,419 cars, over the corresponding week last year, and an increase of 227,293 cars over the corresponding week in 1921.

The total freight car loadings for this year (up to June 23) have been 22,991,055, as compared with 19,157,422 for the same period in 1922.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 11 to 28, are the following:

Office and sales building, Chicago, Ill., to Wells Bros. Construction Co., $8,000,000.

Hotel, Seattle, Wash., to Grant-Smith Co., $3,000,000.

Apartment hotel, Minneapolis, Minn., to Standard Home Bldg. Co., $1,300,000.

Dam and power house, Glens Falls, N. Y., to Parklap Construction Co., $1,000,000.

Power plant, Cahokia, Ill., second unit, to Fort Pitt Steel and Iron Works, Pittsburgh; two 40,000 hp. turbines, one to Westinghouse Electric and Manufacturing Co., East Pittsburgh, and the ther to General Electric Co., Schenectady, cost of both, $1,000,000.

Store and theater, St. Louis, Mo., to Mississippi Valley Steel Co., and Ben Hur Erecting Co., $1,000,000.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 11 to 28, are:

Store addition, Newark, N. J., for Goerke Co., $5,000,000.

Temple, Louisville, Ky., for Kosairs Association, $1,750,000.

Sanitarium, Ft. Worth, Tex., for Methodist Conference, $1,000,000.

Office building, Toronto, Ont., for Manufacturerers' Life Insurance Co., $1,000,000.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Lumber, Minneapolis, 60,000,000 to 75,000,000 ft.); time required for delivery of carload lots to city job, example (hollow tile Atlanta 4 @ 5 days); and stocks on hand in general terms, example: (brick, New York, scarcity.)

	San Francisco	Los Angeles	Denver	Minneapolis	Detroit	Cincinnati	New Orleans	Atlanta	New York
Sewer pipe	Large reserve stocks	Enough, no large surplus	Del. 24 hr., local plant	Situation easier	Plenty	Sufficient	Equal to demands	Del. take 4 to 5 days	Small reserves in city
Cement	Stocks low	Scarcity increasing, due to demand	Normal	Ample	Immediate del. from nearby mills	Scarce	Ample	About 50 to 75 cars	Stocks in city small; mill shipments quick
Lime	Fairly well supplied	Enough, no shortage	Sufficient	Del. from mill on short notice	Plenty in warehouse; del. good	Plenty	Abundance	About 75 cars	Dealers' stocks small; mill del. prompt.
Common brick	Plenty	Sufficient for all demands	4,000,000 to 5,000,000 on hand	Plenty in yards	Fairly supply in local yards	Enough	Plenty; demand slowing up	Plenty	Scarcity
Hollow tile	Stocks in good condition	Strong demand; stocks holding out	Stocks normal	Dealers' stocks ample	Small stocks Del. take 5@6 days	Supply ample	Dealers' stocks sufficient	Del. take 4 to 5 days	Limited stocks in city, prompt del. from nearby plants by water
Lumber	Plenty; shipments heavy	Heavy shipments rec'd; no shortage	Mill deliveries easier	60,000,000 to 75,000,000 ft. in yards	Stocks increasing; demand decreasing	Dealers' stocks sufficient	Stocks low, demand slower	Plenty	Del take 6 to 7 weeks from mill
Asphalt	Large native reserves	Demand steady; supply well maintained	About 10 cars	Plenty	Small reserve. Shipments as wanted		None in stock	50 to 100 cars	Heavy reserves N. J.
Structural steel	Bar stocks large; structurals fair, low on certain sizes	Mill deliveries take about two months	Warehouse stocks sufficient	Situation easier	Ample supply for immediate local needs	Difficulty in getting mill del on bars	Enough; demand lessening with advance of season	6 to 8 cars on sidings	Mill shipments continue heavy

Production and Materials Stocks in Nine Cities

Steel and Lumber Demand Lessened—Output Slowing Down—Fewer Brick Available—Cement Scarce in Spots

Iron and Steel—The June pig-iron output averaged 122,280 gross tons per day as against 124,764 during the preceding month. This rate represents a falling off of nearly 2 per cent from the May average, which was the heaviest recorded in the history of the industry.

Steel mill operations are proceeding at about 85 per cent of capacity or slightly under the May production rate. Hot weather and labor shortage will probably cause further reduction in the July ingot output. Steel stocks have been restored to normal volume but with considerable falling off in new business, particularly in fabricated structurals.

Unfilled steel tonnage figures issued by the U. S. Steel Corporation, totaled 6,386,261 tons on June 30, against 6,981,351, May 31; 7,288,509, Apr. 30; 7,403,332, Mar. 31; 7,283,989, Feb. 28, and 6,910,776 on Jan. 31, 1923.

The following table shows steel ingot production in gross tons for the first half of the current year, compared with the corresponding period in 1922, as reported by the American Iron and Steel Institute:

	1923	1922
January	3,644,629	1,593,482
February	3,294,264	1,745,022
March	3,858,675	2,370,751
April	3,760,997	2,444,513
May	4,000,695	2,711,141
June	3,574,567	2,634,477
Total 6 months	22,133,827	13,499,386

Lumber—Production stands at about 4 per cent above normal or a trifle under the level prevailing one month ago. Shipments represents 104 per cent and orders, 79 per cent of normal production. One year ago production was 10 per cent below normal; shipments, 97 per cent and orders, 84 per cent of normal production. The present situation is one of slight reduction in output but a heavy falling off in both shipments and demand. The following table shows lumber movements during the four weeks ending June 30, compared with the preceding four weeks:

	Four Weeks Ending June 30 ft.b.m.	Four Weeks Ending June 2 ft.b.m.
Cut	1,054,593,013	1,102,856,280
Shipments	955,820,785	1,035,352,851
Orders	767,262,177	857,074,302

Cement—Stocks on hand throughout the entire country June 1, totaled 10,115,000 bbl., as against 12,893,000 for the corresponding period in 1922, according to the Geological Survey. Production amounted to 12,910,000 bbl. during May, compared with 11,176,000 for the same month last year. Shipments totaled 14,257,000 bbl., against 12,749,000 during May, 1922. Compared with a year ago, the cement situation is one of increased production, and still more greatly increased shipments, leaving reserve stocks at mills over 2,000,000 bbl. under the amount on hand June 1, 1922.

Brick—Burned brick on hand totaled 137,520,000 as of June 1, compared with 150 316,000 for the month preceding, according to the Common Brick Manufacturers' Association of America. Orders on books decreased 25 to 50 per cent, compared with the May 1 record, in all districts except two, located in the Middle West. No slackening in production is anticipated unless there occurs a much greater cut in new business than has yet appeared.

San Francisco—Fairly heavy stocks of triangle mesh, expanded metal lath track supplies and lime. Stocks low on cement, rivets, blue annealed steel sheets and certain sizes of steel structurals. Large reserves of asphalt, road oils, sewer pipe and steel bars; plenty of railway ties, cut nails and common brick. Dealers' reserves of crushed stone, hollow tile, galvanized steel sheets and explosives in good shape; stocks of black steel sheets and wire nails, however, in poor condition.

Los Angeles—Enough sewer pipe but no large surplus. Increased scarcity of cement, due to heavy demand, causing anxiety among builders and contractors. Cement mills increasing output. No shortage of any other materials.

Denver — Between 4,000,000 and 5,000,000 burned brick on hand, against 500,000, one month ago. Lumber production exceeding demand.

Minneapolis—Situation easier in all materials. Dealers, generally, report stocks of brick, tile and cement in good condition. Lime not kept in large quantities in dealers' warehouses but shipped in from mills on short notice. Lumber stocks normal for season with 60,000,000 to 75,000,000 ft. in Twin City yards.

Detroit—Plenty of all materials except hollow tile and asphalt. Large deliveries of tile available on five to six days notice; small supplies in stock. Asphalt shipped from refineries as wanted; dealers' reserves small.

Cincinnati—Scarcity of cement; other materials plentiful. Difficulty experienced in obtaining mill deliveries on reinforcing bars.

New Orleans—Lumber demand somewhat lessened; stocks low. Abundance of other materials due to slowing up of demand as summer advances.

Atlanta—About seventy-five cars of lime; between fifty and one hundred cars of asphalt; from fifty to seventy-five cars of cement and from six to eight cars of steel structurals, now on sidings. Plenty of brick and lumber. Sewer pipe and hollow tile deliveries take four to five days from mill.

New York—Scarcity of brick continues. Brickyards are unable to keep abreast of demand, owing to fuel and transportation difficulties encountered last year and labor disturbances occurring during the current season. Building materials dealers maintain small local stocks because of limited space; quick mill deliveries by rail and water are depended upon to supply the market. Therefore, a shortage at the mill rather than at the warehouse, would seriously affect the New York builder.

Decrease in Brick Orders

Current reports from brick manufacturers from all parts of the country, according to the monthly statement issued July 1 by the Common Brick Man-

ufacturers' Association of Cleveland, show that there is a general decrease in orders on books. Only two districts show gains over the previous month, and all others are from 25 to 50 per cent below the May record. In the Illinois, Indiana and Wisconsin district, influenced very largely by figures from Chicago, orders on books have been increased by 15,000,000 bricks since last month. Nebraska, Iowa, Kansas and Missouri also report an increase in orders. The latter states were among the last to show evidences of the building tide of the present year.

There has been no slackening in production, the manufacturers report, and there probably will be none until there is a greater cut in new business than has yet appeared. The price remains stable, Chicago continuing to be the minimum price market with brick at \$12 per thousand delivered on the job. New York has the highest price, due, according to manufacturers, to heavy delivery and towing charges and dealers' profits. New York, it is pointed out, is the only large building center where the entire supply of common brick is handled through dealers.

Summer Dullness in Lumber

With production at 261,887,887 ft., shipments at 238,716,310 ft. and orders at 180,939,467 ft., there were further seasonal recessions in the nation's lumber movement in the week ended June 30, according to reports from 385 of the leading mills of the country as compared with 422 mills the week before, says the National Lumber Manufacturers' Association, but they were about what the customary seasonal curve would indicate. Production and shipments were above the 1922 rate.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the the issue of July 5; the next, on Aug. 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	\$3.64	\$4.30	—\$4.30	\$3.40	\$3.55	\$4.20	—\$3.60	\$4.10	\$4.25
Structural rivets, 100 lb.	4.40	5.00	4.95	3.75	4.25	5.40	5.00	4.75	6.00
Reinforcing bars, $\frac{3}{4}$ in. up, 100 lb.	3.54	4.25	3.80	$3.32\frac{1}{2}$	3.45	3.85	—3.50	4.10	4.00
Steel pipe, black, $2\frac{1}{2}$ to 6 in. lap, discount	44%	52%	45%	47%	53–5%	36%	35.2@47.6%	40%	32.76
Cast-iron pipe, 6 in. and over, ton	62.30	+58.00	63.00	60.20	60.50	69.00	62.00	70.00	60.00
Concreting Material:									
Cement without bags, bbl.	+2.80	2.85	2.25	2.20	+2.50	2.84	—2.63	2.90	2.25
Gravel, $\frac{3}{4}$ in., cu.yd.	2.25	1.90	2.25	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	1.95	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, $\frac{3}{4}$ in., cu.yd.	1.75	2.00	2.50	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	—63.00	42.00	—52.25	58.50	43.75	—48@53	41.00	31.00	—70.00
Lime, finishing, hydrated, ton	18.20	23.50	22.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	2.35	1.50	1.50	2.70	+ 2.10	2.80	10.00
Common brick, delivered, 1,000	+23.50@24.60	14.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.109	.115	—.0724	—.0816	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1573	.109	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	1.13	1.20	—1.32	—1.28	—1.24	—1.34	1.24	.86	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	$.82\frac{1}{2}$	.55	.35@.50	.50	$.50@.62\frac{1}{2}$	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, $93\frac{3}{4}$c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is \$1.80 for Kelly Island and \$1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size $5\frac{1}{2}$ x 8 x $11\frac{1}{2}$. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.20). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; $2\frac{1}{2}$-in., \$32.76; 6-in., \$108.

Changes Since Last Week

Slight weakening in steel warehouse quotations is beginning to appear, consequent to recent concessions in mill prices, due to lower costs of iron and a lessening in demand for steel. Dallas reports a reduction of 20c. and San Francisco, 35c. per 100 lb. on structural shapes. Plates and shapes are holding steadily at \$2.50 per 100 lb. at Pittsburgh mill on the majority of orders. Base price of bars still \$2.40. Demand has been more active in plates and structurals in the last two weeks than during the two weeks preceding. Tank construction is taking the bulk of the plate business, with railroad requirements next in order of heavy buying.

The June pig-iron output was nearly as heavy as the month preceding, despite hot weather. The third-quarter buying movement, however, is not developing according to expectations and there is a tendency to shade pig-iron prices to points but slightly above the cost of production.

Lumber prices show downward tendencies in several important centers, consequent to a falling off in demand. New York quotes a reduction of \$1 and Dallas, \$2.75 per M. ft. on yellow pine timbers, while still heavier reductions occurred in Denver and Montreal on Douglas fir.

Linseed oil dropped 1c. in Chicago; 3c. in Dallas and 5c. per gal. in Minneapolis and Denver, during the week.

Common brick is quoted at \$20@\$21 per M. wholesale, alongside dock, New York, as against \$20 since the first of the year. Cement is also firmer at \$2.80 per bbl. delivered, without bags. Pine lumber, however, declined \$1 per M. ft. on structural timbers.

Cement advanced 11c. per bbl., July 9, in Duluth, Minneapolis and St. Paul.

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E. J. MEHREN, Editor
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Work for Engineering Societies

THE resolution on the Davis dismissal adopted by the American Society of Civil Engineers last week is a good start on the campaign of protest that engineers should get going as soon as possible. Washington officials are not altogether deaf to organized expression of opinion, even though it does come from a group so little political minded as the engineers. By the time he gets back from Alaska Secretary Work should have on his desk the protest of every one of the hundreds of engineering societies of the country. This is a situation where mass and distribution will have the most effect. Not only should the Secretary be impressed with the separate protests but each society would do well to take up the matter with its representatives in Congress. It will not do to let this most serious attack on the engineering profession pass by as a mere matter of departmental routine. The politician considers successful any move he can get away with. He banks on popular indifference. Let the engineering profession show that it can defend itself.

Robert W. Hunt

WITH the passing of Robert W. Hunt one of the few remaining pioneers of steelmaking departs. His early work fell in the period when scientific method struggled for recognition in the iron industry, and Captain Hunt did much to hasten that recognition. He will long be remembered, the world over, both for his years of practical activity in the mills, with their fruitful results in the development of working methods and machinery, and for his long, successful career in testing and inspection of mill production. But his memory rests even more securely on the rugged honesty and openness that seemed to mark him as a man among thousands. It is this characteristic which made Robert W. Hunt an inspiration and a force of influence. And surely this same characteristic of his mind was a chief factor in determining his progress and his achievements. The world needs men of his type.

Unified Railway Terminals

THE unification of terminals, or the operation of terminal facilities of different railways in the same city as a unit, for the public benefit, is a problem of recent growth which may assume wide importance, even apart from the problem of railway consolidation with which it is closely related. The concentration of passenger facilities at Portland, Ore., into one station instead of two stations, as described in this issue, is an example of what may be accomplished by co-operation between individual railways and between a group of railways and the city. With all service combined in one union station during war conditions, the advantages to the public were so evident that a proposal to revert to the original two-station plan aroused protest. Conferences between the parties interested resulted in the adoption of a one-station plan which is beneficial to the railways, the city and the public. Freight terminals present a somewhat more complicated problem owing to their greater number and extent, in any one city, but probably there are cases where concentration and co-operation may be applied with mutual benefit, even without complete unification. It is true that in some places, notably in the few very large cities, complete unification is undesirable as tending toward a traffic congestion which latter day municipal planning is trying to avoid, but study of the possibilities of terminal amalgamation would be worth while in most of the cities under a half-million.

To Open Up Alaska

THE visit of the President and some of his cabinet to Alaska doubtless has for its primary purpose the education of those officials, but it should also be quite as important in focusing attention on that much abused peninsula. Newspaper men accompanying the party will see to it that the people all over the country are informed as to the chaotic condition of control in Alaska and the gradually decreasing productivity of a potentially rich territory. Jurisdiction over Alaska is divided among 35 different departments and bureaus of the federal government, most of which center in Washington. A greater measure of self government and of home rule is imperative but what is more necessary is a revision of the excessive application of the theory of conservation which has successfully throttled development. There is need for Congress to reconsider the principles of conservation laid down in the Roosevelt administration, as they apply to Alaska, and to permit judicious private exploitation. Alaska too long has been thought of merely as a source of mineral wealth. It has vast possibilities in other natural resources, notably in timber and pulpwood, and they should be unlocked. The Presidential trip should result in some useful activity in the coming Congress.

Building Accidents Analyzed

AN EXCELLENT piece of analysis has been done by the committee of the New York Am. Soc. C. E. section in its report on the general subject of building accidents reprinted in this issue. Such accidents are sporadic, and they always bring in their train upheavals of public opinion demanding some reform in the condition that caused them. Interest in such reform, however, as a rule soon dies out and conditions remain about as they were before, that is to say, responsibility for safety continues to be left in the hands of an inadequately manned building department, which when accidents do occur can generally be shown to have had very little to do with the failure. The committee's report is an analysis of the causes of building acci-

dents, and a plea for reform of professional organization and attitude, which, it is hoped, will tend to the lessening of such accidents. Specific recommendations toward this end are given, but they reduce to one main idea, that is, that responsibility for the safety of buildings must be centralized on some individual in each building. The committee evidently feels that it is hopeless to expect that law or governmental supervision can insure safe construction. They do feel apparently that a method of licensing might be developed whereby it could be insured that a competent technical direction will be legally insisted upon in every building. Methods whereby such centralized responsibility may be brought about are set forth in the report, which could well be made the subject of study by every local engineering society in the country, with a view to activity in this same direction in each of our large cities. There is plenty of knowledge of how to build safely. The difficulty is in seeing to it that those who do not have that knowledge are kept out of the building business.

Bridging the Golden Gate

DREAMERS have often talked about bridging the mile-wide entrance to San Francisco Bay, the Golden Gate. Occasionally, too, the talk has taken a turn that gave it some measure of popular attention. But never before the present discussion of the subject has the subject been within the range of practical planning and serious business consideration. There is now in existence a very evident purpose on the part of San Francisco to overcome the great handicap of its separation from the counties to the north, and a Golden Gate bridge is no longer the distant dream that it has been at all times in the past.

For a number of reasons, it has never been difficult to draw attention to the idea of such a bridge. The Marin County hills to the north would become a great suburban residential district, with corresponding increase in the value of property there. The West Coast metropolis would gain a direct highway outlet to the northern counties, connecting large sections of country that now have communication over long circuitous routes and giving the densely populated tip of the San Francisco peninsula access to the regions north and northeast—an urgently felt need in these days of dense automobile traffic. Last year something like 74,000 motor vehicles were registered from the 46 square miles of the San Francisco peninsula, which now must travel to and from the city by way of a single route to the south.

The great cost of the bridge project, together with its formidable engineering difficulties, has hitherto stood in the way of its serious consideration. A fear that there might be opposition to a Golden Gate bridge on the part of the War Department has no doubt also been of influence, though so far as known there is no tangible foundation for such a fear. Since the bridge would connect two counties its financing by public funds would present the usual difficulties of inter-county construction, but enormously magnified by the size of the project and the disparity in conditions of the two counties. And as to private financing, the certainty of adequate return on the great cost was lacking.

The inter-county difficulty has largely been swept aside, and the problem of financing thereby largely simplified, by the passage of an enabling act by the recent California Legislature, which authorizes counties to form a bridge and highway district with power to levy assessments and issue bonds for the work they may desire to carry out in co-operation. A committee has already been formed to proceed under this act. The city engineer of San Francisco has drawn public attention to a plan for a 4,000-ft. span across the Golden Gate which it is claimed would cost only $25,000,000. Two other schemes, using a location somewhat inside the Gate and more nearly in the natural line of traffic, would provide even cheaper crossings, and do so by more approved methods, though following a somewhat longer water route. Thus, the elimination of the difficulty of private financing seems to have brought the scheme within the range of practicability at once, and in so doing has served to give new expression to the traffic demands which are ready to support the project.

Thus, another of the country's great bridge crossing problems that remain to be solved is brought into view as an early possibility. The engineering difficulties which it presents are of great magnitude, yet the present resources of the art make them less serious than those of financing. Now that the legislature has made it possible to underwrite a publicly owned bridge, the project is within measurable distance of attainment. Its actual execution, it would seem, awaits only upon the definite determination of the people of San Francisco.

Motor Taxes Are Building the Roads

DESPITE all the arguments of all the automobile-association tax experts the people are assessing the cost of highway improvement on motor-vehicle users. It seems a curious situation. Apparently the car and truck owner, who, as an association member, subscribes to its contention for reduced taxes and their use only for maintenance is, as a citizen, ready to assume increased taxes and to approve their use for original construction when it is a matter of bettering his own traveling conditions. The philosophy of the situation matters little, however, in the face of the facts. These are that over the country the policy is confirmed of raising funds for roads by taxing motor vehicles and the fuel which they consume. A number of states indeed are talking of a tax on tires.

Vehicle taxation for road upkeep is an old practice and ever since they began to be required automobile license fees have been appropriated to road work. Always, however, a general property tax has been considered a main factor in providing money for highways. There is plain indication that the situation in respect to the general tax is approaching a change.

In Wisconsin, for the first time in a purposeful way, motor vehicle users are being taxed not to raise funds primarily for increased road improvements but to relieve present property taxes from a large part of the burden of highway building and upkeep. The new gasoline tax and the new license rates increase by $4,000,000 the taxes which automobile and truck owners must pay. As a result general property taxes will contribute $4,000,000 less toward road construction and maintenance. This is extension of motor-vehicle taxation well in advance of anything undertaken elsewhere but exactly the same trend of thought is being exhibited all down the line of road building states.

In the seven states of the middle south, the Caro-

linas, the two Virginias, Tennessee, Kentucky and Missouri, it is planned to finance an aggregate of $400,000,000 in bonds by motor licenses and gasoline taxes. Not a penny increase in property tax will be asked to pay the interest on and amortize this enormous debt. Texas in recent legislation has doubled the taxes imposed on motor-vehicle users. Indeed in every state but one which last winter took any action on license fees there was an increase in rates.

While there is developing a general increase in motor vehicle license fees, a clearer indication of popular thinking, that the cost of road improvement is the debt of those who operate motor vehicles, is exhibited by gasoline tax legislation. The number of states imposing taxes on gasoline has doubled in the last six months. Recent legislation has, however, shown a strong tendency to impose higher rates. As has been stated, a tire tax, in addition to the gasoline tax, can be foreseen as a possibility.

It requires no further statement of fact to demonstrate that the motor vehicle is being taxed and that it will continue to be taxed and probably the tax rates will be increased instead of reduced. The United States as a whole has embraced the policy of making the motor vehicle user pay for the roads which he uses. And the motor vehicle user is showing astonishing willingness to assume the debt. Indeed there is no longer much force in the railway argument that they are being taxed to build up a rival transportation system which pays no taxes.

Progress in Rapid Transit

UNDER the pressure of growing necessity a number of our largest cities are again taking up actively the development of plans for better city transit. Looking aside from Philadelphia, where one element of the trunk-line subway project developed six or seven years ago is now being put under contract, we find that serious thinking ahead is being done at New York, Detroit and Chicago. Reports made public within the past week in two of these cities show, moreover, that the thinking is independent and energetic. The situation for real progress in rapid-transit development is more hopeful than at any time for a dozen years past.

Of the many ideas embodied in the Chicago report of the local transportation committees of the common council, peculiar interest attaches to that of making elevated railways the chief component of the comprehensive plan. The completed rapid-transit network as projected is to be seven-eighths elevated railway and only one-eighth subway; of the new lines in the network, four-fifths are elevated and only one-fifth subway. This is in striking contrast to what is found in all other rapid-transit planning of recent years, where subways were the principal ingredient.

Elevated railways are cheap, while subways are costly. But a strong prejudice against elevated railways is prevalent, due largely, we believe, to the many offensive features of the noisy, open-floor structures of New York and Chicago. Because of this prejudice the possibilities of better elevated-railway construction have been ignored, with the result that rapid-transit planners have found it expedient to bow to the demand for subways. It was inevitable that the systems so planned would prove enormously costly and that a network of lines extensive enough to carry rapid transit to all corners of an area like Chicago would prove to be a financial chimera. When elevated railways are restored to a more important position in the scheme of rapid-transit affairs, rapid-transit progress will be brought measurably nearer.

A definite aim to distribute instead of concentrate traffic is another feature of the Chicago plan which brings to the front a new idea—new in the sense that though recognized in the past academically, as a very desirable thing, it has rarely found concrete representation in a rapid-transit project. But this and other points of the report which the interested reader will notice may be passed over in the present comment, in favor of another matter discussed in both the New York and Chicago reports, which promises to have great importance, possibly in the very early future. This matter is the relation of the suburban or commuting traffic of the steam railroads to the city transit.

Nowhere has it been possible to extend the municipal rapid transit system far enough to tap the suburbs and take over the commutation traffic developed by the railroad lines. Nor will it ever be possible to do so. The railroads will continue to build up suburban population along their lines and must serve as the twice-daily means of transportation for this population. There follows inevitably a concentration of traffic at the city terminals of the railroads which increases in seriousness as the city grows and which ultimately leads to conditions, in Chicago and New York for instance, that are excessively burdensome and tend to disorganize the whole transportation system of the city.

To remedy this situation a radical cure must be applied. If the railroads are to continue to carry the commuting traffic, and if the concentration of this traffic at single terminals within the city is to be avoided, one of two things must be done. Either the railroads must be extended as rapid-transit lines within the city limits or the suburban traffic must be transferred to the city transit lines at outlying points and distributed by those lines. Local conditions will determine which plan should be used. For Chicago, where the suburban traffic problem is not acute, the report recommends the latter plan as an ultimate goal, to be attained when the excess capacity of the city transit system is sufficient to handle all or part of the suburban traffic. For New York, where the problem is one of immediate urgency, the report considers that as the city transit system is already overloaded with no prospect of growth greater than the increase in the city's demands upon it, the steam railroads should extend their suburban lines to new stations in lower Manhattan.

The problem and its solution are equally obvious. But hitherto the pressure of purely intramural transportation problems has been paramount in virtually every community that has had to deal with rapid transit. Consequently the suburban commuting problem has been ignored, with the rather undesirable result of increasing greatly the concentration of housing within city areas, to the disadvantage of the open and healthful suburban areas. Future development of rapid-transit thinking will, we believe, follow a rather different course. It may even go so far, in some instances, as to make the co-ordination of transit and railroad transportation the controlling element of planning. The emphasis given to the problem by the two present reports assures early progress toward more comprehensive rapid-transit planning.

Building Accidents and Their Prevention

Report of a Committee on Structural Safety in Building, Presented to the New York Section of the American Society of Civil Engineers

After the disastrous collapse of the Knickerbocker Theater in Washington, D. C., on Jan. 28, 1922, which followed only a few weeks after the failure of an uncompleted moving picture theater in Brooklyn, the subject of building failures and how they may be prevented in future was discussed by the New York Section of the American Society of Civil Engineers. At the meeting of Oct. 18, last, several methods tending to improve the safety of buildings proposed by members were referred to a committee, which was charged with a general study of the subject of structural safety in building. This committee, composed of William Cullen Morris, Daniel L. Turner, and F. E. Schmitt, presented a report at the meeting of May 16, most of which is reproduced here.

A thoroughgoing change in present building methods is recommended as the best means of improving present unsatisfactory building conditions. The entire study and the recommendations are limited to building operations of technical character, and do not apply to such simple building work as may be carried out safely by craftsmen without technical direction.

MANY practices in the conduct of building are unsound and unsafe. This condition affects seriously the professional work of engineers as well as the security of the public. Its fundamental cause lies in the fact that incompetent persons are allowed to build, and do build. While this evil is deeply rooted in existing customs, its complete elimination is necessary to place building on a sound basis.

Effective reform rests on practical application of the view that building is a specialized technical activity involving a distinct hazard. In accordance with this view, building should be restricted to persons possessing the knowledge and skill required for carrying it on properly, namely architects and structural engineers. Combining competence, responsibility and authority in one person will effectively guard safety. The proper operation of this system of procedure should, of course, be protected by administrative control by the public building authorities, as a means of enforcement and as a check on full discharge of responsibility. Further, in view of the special position of professional men under the system indicated, co-operation by professional organizations in supervision of its working will be of value.

The subject of safe building is peculiar to no one city but is of nationwide concern and constitutes a single problem. It involves the engineering and architectural professions, the contracting industry, and civic and property interests. If effective reform is to be attained, representatives of all these groups should work together in shaping it and bringing about its adoption. Such a co-operative body should be so constituted, moreover, as to have broad geographical scope and influence. The committee recommends:

I—That the Board of Direction of the New York Section develop a plan for assembling a broadly representative body to devise and promote the adoption of a plan for eliminating unfit persons from direction of building as proposed by restricting it to architects and structural engineers and the practical definition of competence by state licensing; and that the Board initiate the organization of such a body through the Society.

II—That in order to oppose the practise of designing by code and to emphasize the necessity of applying independent technical judgment in design, the Section be asked to express itself in favor of defining a building code as a minimum and to promote the adoption of such definition by statute.

III—That consideration be given to the possibility of establishing continuous professional action on structural engineering matters and on building accidents, with a view to assuring the maintenance of sound conditions within the profession in connection with building, assisting public building administration, and providing for the prompt detection and correction of faults in established technical practices in building.

IV—That, since the architectural attitude toward the responsibilities involved in building affects the corresponding engineering attitude, the Board endeavor to bring about joint consideration of these responsibilities with representatives of the architectural profession.

V—That the special problem of assuring and maintaining the safety of existing buildings, which was not covered by the present committee's work but which appears important, be made the subject of a separate inquiry.

General Building Conditions—Building failures occur under quite varied circumstances. As all such circumstances bear on the value of reform measures or safeguards, the committee sought information on building conditions and examined some 40 failures covering a period of more than 20 years. Of these 40, only two or three can be classed as unpreventable.

In general, the facts establish that building failures are not chargeable to insufficiency of existing technical knowledge, and that the problem of assuring safe building is organizational rather than technical. Safe design and construction methods are known to men skilled in the art, but the actual conduct of building does not always assure that such methods will be used or such men be in control of the work—even in apparently normal practice, as in the Knickerbocker Theater case and some others. Common faults in the direction of building work are: Ignorance of what good building requires, a belief that building codes guarantee safety with ample margin for neglect or variation, dependence on the city building department, neglect of duty, confusion as to where responsibility lies or even absence of responsibility for some part of the work, and often plain cupidity. Technical men are sometimes involved, through incompetence or neglect of duty. It is stated by building officials that sharp practice in taking advantage of inevitable shortcomings of the building law is a factor in unsound building, and that deliberate evasion of the law and even substitution of fraudulent plans for approved plans are known.

Briefly characterizing present conditions of building control, it may be stated that it is possible for a man with no knowledge of building to present plans for a building, to obtain a permit for erecting it, to employ craftsmen, subcontractors or a general contractor of any character, to create public dangers subject only to the objections of a building inspector should such a man chance to become aware of the condition, and finally to put the structure to public use. He may engage an architect or an engineer and may dismiss him at any time—even at a stage when competent supervision is vital—and may direct the work himself. Or, he may in good faith engage as architect or engineer a man who is incompetent, who sells material or who solicits employment on the claim that he can save a few tons of steel over another designer or have a thinner wall

approved by the department, or who is satisfied to represent an important truss by a rough diagram, trusting that proper construction will somehow be obtained.

Remedial Proposals—Several building reform proposals were advanced at the Section meeting of Oct. 18, 1922. The three principal ones are: (a) that of J. B. French, requiring that a structural engineer certify to the safety of any building of public assembly before it is opened to use; (b) that of R. P. Miller, restricting building permits to responsible persons registered with the city building department; and (c) that of L. D. Rights, making the owner legally liable in case he fails to employ a competent architect, engineer and superintendent.

The Miller and French proposals if applied effectively would have been of value under the conditions of some of the recorded failures. In many other failures, however, they would not have made the work safe; additional changes in building methods and control would have been required. The Miller plan, a direct attempt to eliminate unfit persons from direction of building, approaches closely to effective cure of the existing evils but its weakness in failing to provide technically competent conduct of work is vital. Basing the grant of a permit on "responsibility" in place of competence is believed to be open to decisive objections. Yet the plan has the great merit of being the readiest and simplest of the remedies for building evils so far proposed. The committee believes that, however modified, it should include the French plan, which is a necessary element in building reform.

The third proposal, to hold the owner liable for employment of competent men to plan and erect this building, has a fundamentally important purpose. Its practical value depends on the means used to bring about the specified result. No such means have been suggested. The owner's financial liability for damages resulting from failure of his structure, which exists under the common law, is not a sufficiently powerful motive, as past failures demonstrate, and any attempt to attach criminal liability to the owner is believed to be questionable in both its legal and its practical aspects. The principle that safety requires that building work be planned and directed by competent men is not likely to be applied much more effectively than at present so long as the owner is left free to choose. If the principle is valid it is a proper subject for mandatory legislation. The owner's interest will in any event supplement the architect's or engineer's responsibility, since both parties would be subject to penalty. But the primary authority and responsibility for the work must be placed definitely in the hands of the technical man. Any uncertainty on this point will merely perpetuate the present causes of building failures.

Other proposals for guarding against unsafe building, advanced on earlier occasions by various investigating bodies, were also examined by the committee. It appeared that most of them were the response to one particular failure or one set of faulty conditions, and would fail under other conditions. A general proposal to bond every building operation, with evident expectation that the surety would guard the safety of the work, is not believed to be either effective or practically acceptable. Three important proposals are those contained in the report of the Brady-Eidlitz-Just board[1] in 1905, and those made in 1922 by expert committees of the Associated General Contractors and the Washington chapter of the American Association of Engineers[2] after investigating the Knickerbocker theater collapse. Most of their individual recommendations are necessary parts of an adequate system of building reform; the first-mentioned report is particularly noteworthy.

Technical Direction by Public Agency—All thoughtful discussion of building safety has recognized that competent technical direction is the necessary fundamental. Many believe however, that this can be obtained only by governmental agency; in other words, that there is no hope for better building except through more complete plan examination and field inspection by the public department. Even the likelihood that such development would reduce the engineer's and architect's functioning to minor rank does not appear to discourage these opinions. The committee is convinced that improvement does not lie in this direction, and that on the contrary the public supervisory functioning should be adjusted to the purpose of assuring efficient and dependable functioning of the private parties to a building operation. It may be remarked that if full technical guidance of building were to be supplied by the city building department, the cost of carrying it on would be multiplied ten to thirty times, and a quite unmanageable administrative machine would be created.

Provisions for Effective Technical Control—Responsible technical direction of building work with full authority is provided at present in building operations of the higher grade on the initiative of the owner himself, who retains an architect or engineer and leaves this technical man free to work out the problem with full responsibility until ultimate completion and even beyond. Where the system is applied in full, it is entirely effective. The combination of technical competence with complete authority over the work and responsibility for the result represents the basic essential of sound and therefore safe building practice. In the lower class of building work, and especially in speculative building, this system is more or less completely disregarded. The elimination of unsafe building conditions may be brought about by compelling the application to this class of building of the same sound system of building direction that is adopted in high-class building work as a matter of course. While it is true that the owner's interest would even now be served by the adoption of the same system in his work, whatever the kind or grade of building to be constructed, this advantage is not powerful enough to overcome his willingness to gamble against the chance of mishap for the sake of a cheaper result. Legal institution of the system must therefore be resorted to. The method of doing this should, for practical reasons, take account of the weaknesses of present building control.

A list of such weaknesses, compiled largely from the facts of actual failures, is given in the belief that it represents more or less completely the prevailing situation in most cities:

(a) Unauthorized building may go on.

(b) An incompetent or irresponsible person may apply for a permit to build.

(c) The applicant does not undertake to conduct the work and does not assume responsibility for the result.

(d) Plans may be drawn by an incompetent person, or by one not competent in some essential part of the work; plans drawn by a competent person may be changed by an incompetent one; neither designer nor user warrants the adequacy of the plans.

(e) Where structural engineering enters into the plans, this part of the design may be furnished by others than the designer, including material men, without assumption of responsibility and without proper check on its adequacy.

(f) A permit may issue to any one, regardless of competence, and frequently any one may build under the permit.

(g) Permits are sometimes issued on incomplete plans, and even on unapproved plans.

(h) The permit usually imposes no obligation beyond following the building law, and fails to make safe building a condition of the permit.

(i) Competent technical direction of the work is not required.

(j) Difficult engineering operations may be undertaken without engineering direction.

(k) The technical authority is not final, and if the architect's or the engineer's authority on the work is overruled by less competent persons the building department is not concerned.

(l) Inspection by the building department, weak as it is, constitutes the main protection against violation of building law or safe practice.

(m) Control powers as represented by stop orders, suspension or revocation of permit, or special inspection charges, are not always provided or used.

(n) Competent certification of completion in accordance

with the plans, the building law requirements and the demands of safe construction is not made a requirement.

Three of these defects in control, namely (a), (g), and (m), are mere administrative shortcomings, and require no essential change in building control; for example, both police co-operation and prominent placarding of building operations have been found effective in preventing unauthorized building. All the other defects, however, involve either a failure to demand that building be directed with competence, or failure to insist on proper discharge of the responsibility arising out of the work.

A system of technical control devised to meet the conditions indicated by these defects requires the following main provisions:

(A) The conduct of building work is to be limited to structural engineers and architects.

(a) Application for a permit must be made by an architect or a structural engineer. Permit is to be granted only to the applicant, is to be non-transferable, is to stipulate his continuous direction of the work, and is to authorize building only by the permit holder himself or by a registered builder.

(B) Architect and engineer are to be held responsible in design, detailed supervision and inspection of execution for safe conduct and completion of the building operation, and are to be placed in full authority over the work.

(b) Plans for a building must be prepared by an architect or a structural engineer and must bear his personal certification that he prepared the plans, that they conform to the law and that they are adequate for safety. The applicant must certify that he has checked the plans and accepts them as his own. Preferably he should be required to submit proof of the adequacy of the design in its main features, and on demand of the department also of any details.

(c) Application for the permit must include a specific undertaking to conduct the work and assume responsibility for its adequacy until completion. The permit must embody this undertaking.

(d) In all dealings with the work under the permit the department must recognize the permit holder as in charge to make his authority over the work fully effective.

(e) A certificate of completion, adequacy and conformity to plans and law must be rendered by the permit holder, the certificate to be filed of record with the plans.

(C) Engineering competence is to be provided for the design and construction of buildings or parts of buildings involving engineering elements.

(f, g, h, i) Provisions identical with (b) to (e) apply to engineering work, but should be established separately because past failures have shown that there is special danger in indefinite merging or overlap of architectural and engineering responsibility. Personal certification of design is here also essential, regardless of whether the designer is in independent practice, is employed professionally, or is a material man or contractor. Supervision and certification of completion are to follow.

(j) Special engineering work, as difficult shoring or underpinning, requires special direction, and the department must have power to demand such direction at any time.

(D) Means are to be provided for enforcing these requirements through the administrative procedure of the building department, with revocation of permit and assessment of costs on the property as measures of control.

(k) The efficiency of the building department must be increased in order to administer these measures. Its inspection staff should be raised to the architectural and engineering grade.

(l) Control must be improved by requiring the approved plans to be kept on the work, by specific vesting of power in the department to require additional safety measures or special direction, by more careful safeguarding of changes of plan during construction, by use of stop orders, by provision for revocation of permit, and by provision for assessing the cost of all special control proceedings on the property as a lien.

(m) Power must be vested in the department to refuse plans or applications for permits from an architect or engineer who has made himself subject to revocation of a permit.

(n) Registration of builders with the department is desirable for more effective control.

(o) Registration of building supervisors for minor work is a desirable auxiliary.

(E) Competence of architects and structural engineers is to be established by a licensing system.

(F) Revocation of license for cause is to be provided for.

This outline is given not as presenting full working details but as indicating the essentials sufficiently for proper consideration of how building practice would function under mandatory technical control. The actual details should be framed by a body composed of representatives of the several parties concerned, after joint study of the subject. Such study could properly be extended to include a determination of the scope of building control, so as to decide what classes of structures not intended for occupancy affect public safety so directly as to require the same control as buildings.

Defining Competence—The necessary definition of what constitutes a structural engineer or an architect may be attained by state licensing. Licensing alone merely defines the technical man, and cannot materially improve building conditions unless provision is made for placing him in control of building work. The Illinois license and restriction laws for architects and structural engineers seem to be operating fairly well so far as they go; as they protect only design and fail to demand competence in direction of construction they can have only a limited effect.

Supervisors and Builders—Establishment of a separate grade of building supervisor is believed to be warranted only for the proper care of minor building work, and such operations as demolition. Work of definitely technical kind should be directed by the designer or bv a man of equal grade who will accept the design on his personal checking and assumption of responsibility. Local registration of building supervisors with the building department is preferable to state licensing, and will facilitate closer check on their functioning. Registration of builders, proposed some years ago by R. P. Miller and endorsed by the Building Officials' Conference, is also considered desirable, less for eliminating incompetence than for strengthening the department's control over building practice by enabling it to place a penalty on the builder who works unsafely or in violation of law.

Professional Co-operation—Certain professional questions are connected with safe building. Since good building depends ultimately on the skill and integrity of engineers and architects, the attitude of the professions will influence the results obtained. When these professions further are established as solely competent to carry on building, the professional status is an even more important subject of consideration. The committee believes that the questions concerned merit careful study. It recommends that professional co-operation in bringing about and maintaining safe building conditions be considered, and suggests three elements of such co-operation: (a) Definition of the professional obligation incurred in engagements connected with building, and provision of means for combating incompetence and malpractice; (b) Formation of local groups or committees to maintain contact with building administration and its problems in the interest of sound building; (c) Provision for current study of building failures with a view to improving technical practices.

Existing Buildings—Representations have been made to the committee that the public confidence in the safety of theaters and halls has been sufficiently disturbed to war-

rant a general inquiry into their condition. While no widespread doubt of this kind is apparent, this fact in itself does not dispel the uncertainties arising from the collapse of the Knickerbocker theater. A general structural survey of theaters and halls by expert committees of professional engineering bodies acting in a disinterested way would constitute an important public service. Because of the magnitude of the undertaking, however, the committee is not prepared to recommend present action.

Quite apart from theaters, supervision of the safety of existing buildings is a matter of growing concern, particularly in regard to buildings of some age, to changed occupancy and to reconstruction. The collapse of the Stratford apartment house two or three years ago carried a warning of the possible instability of old buildings. Public building control faces many difficulties in assuring public safety with regard to existing structures, which rarely are in competent care. The committee believes that the subject should have consideration in any revision of building department functions. It also believes that a separate inquiry into the relation of existing buildings to public safety is desirable.

Appendices

Analysis of Building Failures—Analysis of numerous building failures with respect to the individuals at fault showed that each one of the typical parties to a building operation has been responsible for one or more failures, but owner and architect by far most frequently. Often no supervision was provided, and this is chargeable to the owner; the list of owners thus at fault includes responsible, well informed individuals and corporations. The entire history of failures as well as the experience of building officials reveals a widespread lack of appreciation, on the part of non-technical owners, of the essentials of safe procedure to assure proper technical results.

Where architectural supervision was provided, it was in some cases plainly superficial and ineffective, serving as a check on the contractor's bills rather than as a safety measure. This is charged against the architect as a fault. The same applies to cases in which the architect did not provide the necessary engineering skill for design and supervision of structural engineering phases of the work. Correction of these faults must be sought through definite assignment of responsibilities and through a clarification of the question of what constitutes adequate performance of a professional engagement.

A study of the part played by the separate functions or agencies which enter into building work led to the following conclusions: (1) Deficiencies in building codes cannot be charged with any material part in failures, though the complexity and great detail of codes has often been confusing and even misleading to a dangerous degree. (2) Bad designing has caused many failures, due variously to incompetence, negligence, failure to provide sufficient detail in the design, failure to engage an engineer for needed structural or foundation design, improper delegation of parts of the designing to material men and others who did not assume effective responsibility and whose designs were not checked. (3) Plan examination, while often inadequate, has not been directly responsible for any failures, though it has contributed to some. (4) Loose control of authorization to build is a marked source of danger in some cities and produced one recent failure. (5) The grant of building permits is not limited to persons competent to carry out a building enterprise. (6) The form of contract does not appear to be related to safety, as instanced by the fact that at least one failure occurred in a cost-plus contract. (7) The practice of the owner subcontracting direct is highly hazardous. (8) Bad work by the contractor is a minor though not negligible factor. (9) Supervision of building, though vital to safety, is almost always absent or is of superficial character in that class of building which is recognized by building officials as troublesome or dangerous and which has contributed many items of the failure record. (10) Municipal inspection is so inadequate as to afford little protection in case of faulty performance by the private parties.

More generally, it appeared that the organizational system and precautions applied in general construction work, and found to be adequately safe there, are frequently absent from building. The control by public building departments does not insist on their being provided, but dependence on that control appears to be one motive for not providing them. It is obvious that a system similar to that used in general construction would assure safe building, through its centralization of authority and responsibility in a technical competent person.

Differences of location and time were found to be unrelated to the results of these analyses, but all the data gathered, including the facts of the earlier failures, proved consistent in respect to underlying conditions. Building departments differ in excellence, and most of them have improved steadily, so that some cities now have substantially as good building administration as is to be expected under present functions and powers. On the other hand, building is growing more complex, and its demands on the ability and integrity of technical men are increasing. This development appears to be proceeding more rapidly than the gradual improvement of practice, especially in view of the spread of difficult and hazardous building to smaller communities, where the protection of public safety in building is least efficient. All things considered, the problem of structural safety appears to be growing more critical, rather than the opposite.

The Building Department—Proper organization of work in the degree found necessary in other construction is commonly thought unnecessary in building, partly because the work is looked upon as non-technical and simple, but partly because of the dependence placed in the municipal building department for ultimate safety. This dependence is apparent in the attitude of press and public toward building questions, and even in that of many technical men. It involves a belief that engineers, architects and builders are fallible but the building department's plan examination and field inspection protect or ought to protect the public. Unfortunately, also, the daily work of building officials shows much fallibility, negligence and incompetence, and violation of law, on the part of persons who propose to build. The official of one large city states that every set of building plans submitted to his office requires to be changed before it can be approved.

Dependence on the building department for safety is not warranted by the facts. Further, the function of the department, a policing function, is to inspect rather than supervise and direct building work. When the parties who engage in building rely on the department to assure safety, their own sense of responsibility largely disappears, and it is found especially in purely speculative operations that the municipal plan examination and inspection reduce by as much or more the care and conscientious effort of the designer as well as of those who should provide direction and supervision of the work. It enables these private parties to transfer some of their work and duty to the department, and the opportunity is extensively taken. The Knickerbocker theater collapse was a consequence of improperly guarded transfer of responsibility by the designer to other parties with final dependence on the building department. Any method proposed for improving building practice which does not furnish a fundamental corrective for this condition is certain to prove a disappointment.

Most building departments are heavily overburdened, and operate in reasonably satisfactory way only by virtue of hard work on the part of overtaxed and underpaid examiners. There is some evidence that this condition is becoming more serious. Plan examination is superficial at best, often being done by a process of sampling. In smaller places cases are known where the building official is not competent to pass on plans for other than the most simple building work, and approves them without examination. Field inspection as now conducted is in some degree a check on conformity to the law, but it cannot be regarded as an important assurance of safety. In short, building departments do not fully examine plans and do not fully inspect. To do even their present work properly, however, they are in urgent need of improvement both in quality and in size

of office and field staff. Vastly greater improvement would be required to fit them for carrying the full responsibility of safeguarding building, were this result at all practicable.

The building department should not assume any part of the duty to provide technical knowledge and skill to the building operation. This duty clearly rests on those persons who engage in the operation, and the department should confine itself to its obvious charge of enforcing and supervising the responsibility of the builders.

Building Codes—Building codes, commonly held to be important instruments of safety, appear to have been developed to a degree of elaborateness of detail which operates to the detriment of safety in some instances. They are usually specifications that attempt to cover all elements of building construction. Many designers use them as their sole guide. "Building code designing" has become a byword, and its effects appear in a number of past failures.

Complete specifying of sound practice is impossible in the field of building as it is in other fields of construction; yet the view prevails even among architects and engineers to some extent that any design which can be interpreted as complying with the building code is safe, relieving them as designers from further responsibility. It seems desirable to emphasize the danger of this view by defining the code as a set of minimum, not necessarily sufficient, requirements, and by charging the designer with responsibility for safe designing regardless of the minimum fixed by the code. The department then should have discretionary power to reject plans and to stop work even though conforming to the code and the plans. Its work would be assisted if designers were required to present affirmative proof of the sufficiency of their plans, rather than that the department should bear the burden of disproof.

The detailed codes now current are known to be burdensome to the capable and conscientious designer while at the same time they are not adequate to prevent bad design. Simplification of codes therefore is a desirable improvement. However, it is by no means as vital to building safety as the revision of building control, and for the present purpose may be disregarded as secondary.

Uniformity of codes has been much discussed, apparently in the belief that it is both a safety and an economy measure. The present study has not indicated any relation between the safety of building work and uniformity or variation of codes. It seems likely that uniform codes would have some advantage in the way of convenience to users; they are not believed to promote safety.

Professional Relation To Building Safety—(a) Many building failures have brought to light undesirable professional conditions. Professional incompetence has repeatedly been recorded. In other cases, sometimes perhaps under the pressure of low fees or excessive expense, there has been obvious neglect of part of the professional man's duty to assure safe completion of a piece of work that he has entered upon, as by failure to give supervision in the field, or by inadequate supervision.

No standard appears to exist by which the professional duty assumed in any case may be determined. Commonly the terms of employment are considered to limit the obligation, so that a designer frequently sells plans, or inspects the execution of his design only superficially. While legislative defining of responsibilities would tend to clarify the situation, it is desirable that professional standards be superior rather than inferior to the law's requirements.

(b) The public and the profession have a joint interest in protecting the system of public building administration from the various harmful influences that work against its efficiency. Professional co-operation with the building department would be of distinct service in combating the exercise of political pressure to weaken the forcefulness and impartiality of building law administration, the grant of violation permits by city councils, ordinary deterioration of the department, the effects of obsolescence of the code, and other causes of unsatisfactory building conditions.

(c) Some building failures have revealed imperfections in technical knowledge of building work, or in current technical practice, which have had to wait for their removal on the slow process of amending the building laws or else on spontaneous general change of practice. The prohibition of cast-iron column construction for high buildings and the elimination of faulty practice in reinforced concrete, for example, came about slowly in the absence of professional action on a series of failures. Service to the community obligates the profession to undertake on its own initiative the prompt study of points of imperfection revealed by structural accidents. As a prerequisite to such study the technical facts of failures need to be determined by current investigation of failures as they occur.

It is believed that means for dealing with these questions continuously should be provided by professional action.

[1]Abstracted in *Engineering News-Record* of March 30, 1922, p. 532.

[2]After a series of flat-house failures in New York City in March, 1905, a board consisting of Thomas J. Brady, Otto M. Eidlitz and George A. Just recommended to the borough president of Manhattan, New York City, that (a) architects be required by law to supervise the construction of buildings for which they furnish plans; (b) the competence of architects be assured by some system of license or registration; (c) permits be issued only to persons so registered; (d) mason and structural contractors be licensed; (e) work by persons not licensed be declared unlawful. These recommendations were reproduced in *Engineering News* of April 13, 1905, p. 391.

Suggestions for Engine Terminal Improvement

DESIGN of locomotive terminals was treated from three different points of view at a meeting of the Western Society of Engineers recently. R. N. Begien, then general manager of the Baltimore & Ohio R.R., discussing the operating requirements, laid stress on the economies resulting from greater service and fewer locomotives when there is rapid handling of the engines in cleaning fires and taking coal and water so as to make ready promptly for another trip. For the design of an efficient terminal, knowledge of operating conditions and terminal work is an essential supplement to engineering knowledge. The mechanical and engineering requirements were discussed by L. K. Sillcox, general superintendent of motive power of the Chicago, Milwaukee & St. Paul Ry., and W. T. Krausch, engineer of buildings, Chicago, Burlington & Quincy Ry.

Mr. Sillcox analyzed the time consumed in "turning" an engine, that is, in making an inbound engine ready for an outbound trip. This time averages 11½ hr., but detentions increase the delay to 16 hr., so that a locomotive averages only 8 hr. of service per 24 hr. Increase of this period may be obtained by wider and better spacing of terminals in order to give longer runs, or by improving the facilities for handling the engines at terminals. He emphasized the fact that increase in capacity and equipment of roundhouses has not kept pace with the increase in number and size of locomotives to be served. As an instance of the economic aspect, he explained that if the average frequency of turning could be reduced to 1.3 times per day instead of 1.4 times, as at present, with a reduction of 50c. in cost of terminal service per engine turned, the annual saving on 2,000 locomotives would be about $650,000, which at 10 per cent for interest and fixed charges would support an investment of $6,500,000.

On the engineering requirements, Mr. Krausch said that in many cases an existing terminal can be so improved at moderate cost as to increase greatly the efficiency and economy of its work. In other cases it is economy to plan new terminals on new sites. He emphasized particularly that the only way to get improvement in operating results is for the engineering, mechanical and transportation department to: "Get together, stay together and pull together."

Experiments in Water Coagulation with Aluminum Sulphate

Relation of Hydrogen-ion Concentration to Precipitation and Dissolution of Aluminum Hydroxide

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HILDEBRAND, BLUM[1] and others have made studies of the precipitation of aluminum hydroxide using the hydrogen electrode to measure the reactions involved. Buswell and Greenfield[2] and Buswell and Edwards[3] have studied the precipitation of aluminum hydroxide on a filter-plant scale, and give data showing that its precipitation and resolution depend, in a large measure, upon the hydrogen-ion concentration. Studies made by the Virginia State Board of Health also show that this is true, but that the conditions for optimum precipitation depend upon the organic content of the waters and other available factors.

The purpose of this paper is to give experimental data showing the influence of the hydrogen-ion concentration alone upon the precipitation and dissolution of aluminum hydroxide, using a dilution and temperature comparable with those found in a filter plant. A dilute solution of aluminum sulphate was precipitated, (1) with varying amounts of sodium carbonate and (2) with varying amounts of calcium hydroxide. Hydrogen-ion concentrations were determined colorimetrically in the solutions containing the precipitates. Color standards were prepared using buffer solutions whose strengths were determined by electrometric titrations. The precipitates were filtered, ignited and weighed as Al_2O_3.

The table accompanying this article gives the amounts of aluminum as aluminum oxide precipitated from 500-cc. solutions of aluminum sulphate. Curves were plotted giving the hydrogen-ion concentrations as ordinates and the parts per million of Al_2O_3 precipitated as abscissas. Using aluminum sulphate and sodium carbonate, the maximum precipitation occurred within the zone whose limits of hydrogen-ion concentrations were approximately from pH 6 to pH 7. In solutions more alkaline than pH 6.8, dissolution of the hydroxide as the aluminate began and continued with increasing alkalinity until the entire floc was redissolved at a pH of 10.5.

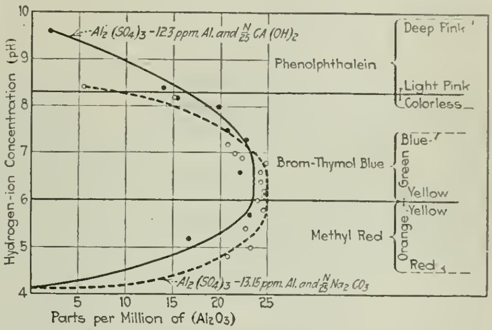
Alumina precipitated at the pH indicated from solutions of aluminum sulphate containing 25 p.p.m. alumina.

Na_2CO_3 and $Al_2(SO_4)_3$ pH	Al_2O_3 P. P. M.	$Ca(OH)_2$ and $Al_2(SO_4)_3$ pH	Al_2O_3 P. P. M.
4 8	20.8	5.2	16.6
5 0	23.2	5.7	23.2
5 4	22 8	6.6	23.0
5 8	24 8	7 3	22.6
6 1	24.8	7.5	20.6
6 2	24 8	8.0	19.6
6.4	24 4	8.2	15 4
6.6	24 4	8.2	15.0
6 8	24.8	8.4	14.0
7.0	21 6	9.6	2.0
7.2	20 8	.	...
7.4	18.4	...	...
8.2	15 2	.	...
8.4	5 6	.	....

As the calcium aluminates are less soluble than the sodium aluminates, dissolution of the precipitate formed from calcium hydroxide did not begin as soon as the dissolution of the hydroxide formed from sodium carbonate. At a hydrogen-ion concentration of about 7.3 the maximum amount of hydroxide was still precipitated with $Ca(OH)_2$. Anything more alkaline than this, however, caused the soluble calcium aluminates to form.

It is of interest to note that with either curve the inflection points showing the beginning of dissolution occur before a hydrogen-ion concentration of 8.3 is reached. At this point phenolphthalein changes from colorless to pink. It is occasionally the practice in filter plant operation to control the precipitation by means of this indicator. From the figures published in this article it is quite evident that a pink color with phenolphthalein shows that the water is alkaline enough to dissolve part of the aluminum hydroxide, and more so in the case of sodium carbonate than when lime is used.

Brom-thymol-blue begins to change from yellow to blue at a hydrogen-ion concentration of 6.0. As the number of hydroxyl ions increases, formation of the blue color begins and gives a series of shades of green as the blue becomes more and more predominant. The dye is blue at a pH of 7.0 but intermediate tints of blue can be recognized until 7.6 is reached and the dye is completely blue; and then no further addition of alkali can change this color. By adjusting the alkalinity of the water until a tint of green color is reached with this indicator, it is possible to obtain the optimum zone for the precipitation of aluminum hydroxide. This results in economies in filter plant operation, in a water free from soluble aluminates and in a reduction of the corrosion of pipes.



RELATION OF H-ION CONCENTRATION TO PRECIPITATION AND DISSOLUTION OF ALUMINUM HYDROXIDE

Although the curves show that the residual reaction of the effluent should be on the acid side of neutrality to obtain the maximum precipitation of alum, there is an important reason why the filtrate should be alkaline. A bicarbonate alkalinity having a pH in the neighborhood of 8 or 9 is very much less corrosive than a more acid water, as the excess bicarbonate acts as a buffer and prevents the CO_2 from attacking iron. If it is desired to secure a water of such alkalinity, it should be secured by adding lime or soda after filtration, as has been done recently in Baltimore (*Engineering and Contracting*, Aug. 9, 1922).

The author wishes to ackowledge and give credit to Edward Martin, M. D., C. A. Emerson, Jr., and W. L. Long, who, at the time the above work was done, were respectively commissioner, chief engineer and chief chemist of the Pennsylvania Department of Health.

References: [1]W. J. Blum, Am. Chem. Soc., Vol. 30, p. 1,282 (1916). [2]A. M. Buswell and G. P. Edwards, *Chem. & Met. Eng.*, 26-826 (1922). [3]R. E. Greenfield and A. M. Buswell, *Jour.* Am. Chem. Soc., 44-1435 (1922).

Passenger Terminal Improvements at Portland, Ore.

To Secure Joint Terminal City Vacates Streets and Railways Give Land for Widening Streets—Terms of Agreement

CONSOLIDATION of all railway passenger business in one union station at Portland, Ore., and the abandonment of a second terminal station, has necessitated not only material alterations and improvements in the railway terminal facilities but also extended negotiations with the city in regard to vacation of streets for railway purposes and the donation of certain railway property to the city. The general situation is explained by the plan, Fig. 1.

The principal passenger terminal is the union station at Broadway and Hoyt Sts., built in 1894 by the Northern Pacific Terminal Co., which is owned jointly by the Northern Pacific Ry., Southern Pacific Ry. and Oregon-Washington Railroad & Navigation Co. In 1906, the Spokane, Portland & Seattle Ry. built a smaller station at Eleventh and Hoyt Sts., and this was used also by the Great Northern Ry. During the period of federal administration of the railways the two latter lines were diverted to the union station, but when the railways were returned to private ownership the Northern Pacific Terminal Co. notified these new tenant lines that it would be unable to accommodate them.

This proposed separation of railway terminals led to protest on the part of the city and various civic organizations, coupled with a demand for more adequate facilities, on the ground that public convenience would best be served by a single but larger terminal station. As a result, a joint study of general improvement of both the passenger and the freight terminals was undertaken in 1920 by the several railways.

Revision of Terminals—A serious obstacle to expansion of the union station trackage was the existence of the Terminal Co.'s freight yard and engine terminal alongside the passenger tracks. After the study of the situation it was decided to provide a new freight yard and engine terminal outside the city and about two miles northwest of the union station. The first unit of this new freight terminal, known as the Guild's Lake yard, was completed in 1922, a large amount of filling being pumped in from the river by hydraulic dredges to form the site. With the ground at the passenger station thus cleared it was possible to provide at once two additional passenger tracks with a 19-ft. platform 1,600 ft. long. The remaining space was utilized for a local freight yard having team tracks, automobile loading platform, track scale and a crane for handling heavy freight. There is room also for another platform and two more passenger tracks when required.

In addition to team track purposes, this yard is used for receiving and delivering transfers of the three railways owning the Northern Pacific Terminal Co. This latter company does not move cars to and from the yards of the trunk lines, but it does handle all switching business for tenant lines and has joint use of a double-track line between the passenger and local freight terminal and the new outlying Guild's Lake yard.

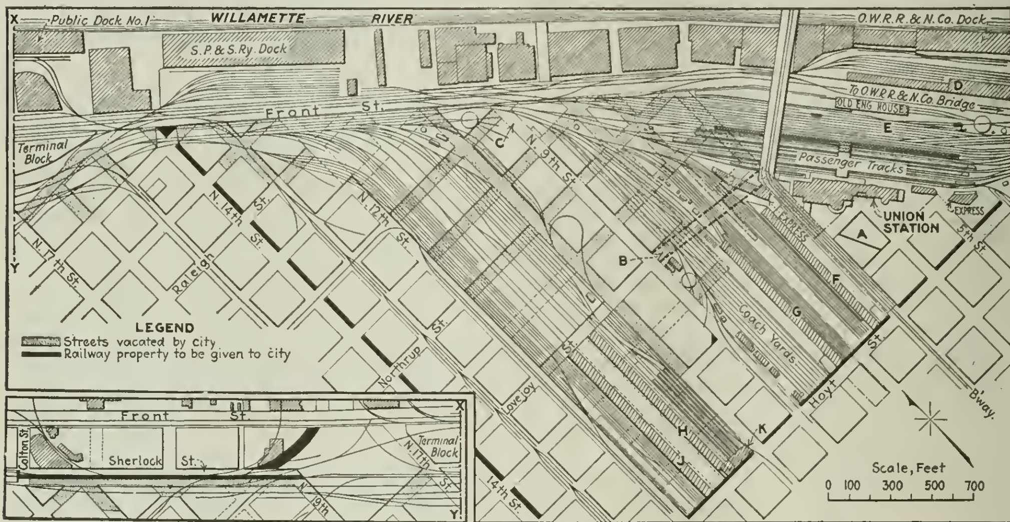


FIG. 1—IMPROVEMENTS FOR RAILWAY TERMINALS AT PORTLAND, ORE.

A, block for parking space. B, new viaduct to Broadway Bridge. C, new viaduct on 9th St. to cross Front St. D, freight house of O.-W. R.R. & N. Co. E, old freight yard and engine terminal of Northern Pacific Terminal Co. F, freighthouse of Northern Pacific Ry. G, freighthouse of Southern Pacific Ry. H and J, freighthouses of S., P. & S. Ry. K, old passenger station of S., P. & S. Ry. Improvements in freighthouse facilities are to be made in 1924.

At present all the lines are using the union station and the traffic averages 48 inbound and 48 outbound scheduled trains daily, about twenty of these being local electric trains of the Southern Pacific Ry. to and from Willamette Valley points.

As now enlarged the station has four 19-ft. platforms 1,100 to 1,330 ft. long, connected by a 60-ft. transverse concourse opposite the headhouse, as shown in Fig. 2. Umbrella roofs cover the platforms for lengths of 150 to 300 ft. and over the concourse is a high shed roof. These platforms serve nine through tracks and four stub

tracks, the latter being for baggage, express and private cars. Provision is made for a fifth covered platform and two additional tracks, replacing three of the present freight tracks. Entrance to the station is to be improved and the block opposite the headhouse will be developed for parking purposes and as part of an attractive approach. A new station building will be erected eventually. During 1923 there will be expended about $150,000 in track changes, street improvements and other work involved in the recent agreement between the Terminal Co. and the city.

Extensive improvements in freighthouse facilities and the local freight yard adjacent to the passenger station are contemplated, but these plans are not yet completed. Coach cleaning and storage tracks are now arranged along 9th St. north of Hoyt St. (see Fig. 1), but the second unit of the outside freight yard at Guild's Lake will provide a new location for these facilities, the space then vacated being utilized for freighthouse purposes. It is expected that this second unit will be built in 1924.

Viaducts and Street Widening—Since streets and railway tracks are at the same level, both street and railway traffic will be facilitated by the construction of viaducts carrying streets over the tracks at certain points. A viaduct along 9th St. and crossing the tracks at Front St. is to be built within three years. A viaduct crossing the terminal tracks will form an extension of Lovejoy St. from 12th St. to the Broadway Bridge over the river, an easement for this structure being granted by the terminal company. This will provide a new approach to the bridge, at right angles with the present inclined approach on Broadway, beginning at Hoyt St. The present street beneath this incline will be vacated, as shown. Another viaduct for pedestrians will extend from the station to the bridge.

Street widening is an important part of the general terminal improvement project. When the city widens 14th St. from Hoyt St. to Front St., the railroads will dedicate a 20-ft. strip of land from their properties. For the widening of Hoyt St. from 4th to 14th Sts., after three years from the date of agreement the railroads will dedicate a 10-ft. strip when the city undertakes the work and acquires the other necessary property from private owners. On Sherlock Ave., the city will vacate the west side for use by the railroads and in return the railroads will dedicate a 20-ft. strip along the opposite side, as well as a 50-ft. strip for a connection to Front St., as shown in Fig. 1.

Vacation of Streets—Improvements in railway terminal facilities at Portland have been hampered by the fact that a large part of the area occupied by passenger and freight facilities of the Northern Pacific Terminal Co. and individual railways is laid out in streets and blocks. With city ownership of strips of land designated as "streets" extending across railway property, the railways have been at a disadvantage in developing their property, although they owned most of the land in the "blocks." Negotiations with the city authorities were started, therefore, in order to secure the vacation of these obstructive "streets" as an offset to public benefits resulting from improvements made by the railways.

For many years Portland has had a restriction in its charter prohibiting the city from vacating streets in areas near the railway terminals or the river, the purpose of this being to prevent private interests from shutting off public access to the river front. In view of the existing situation, however, the negotiations resulted in the approval of plans submitted by the railways, and a charter amendment removing the restriction as to certain specified sections of streets, with an aggregate area of 658,000 sq.ft., was passed by public vote in June, 1921. This extensive exchange of property is indicated clearly by Fig. 1. On the part of the railways the principal features of the agreement with the city, as adopted on June 20, 1922, are as follows:

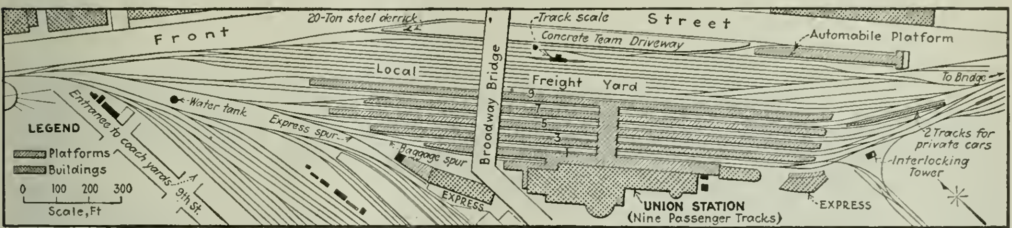


FIG. 2—PASSENGER STATION AND CITY FREIGHT YARD OF NORTHERN PACIFIC TERMINAL CO., PORTLAND, ORE.

1. Provision of adequate terminal facilities for both passenger and freight traffic.

2. Dedication to the city of certain railway property needed in future street widening. There are seven widenings in all, but mainly along Hoyt St. and 14th St., and on Sherlock Ave. from 19th St. to Colton St., where the west side of the street will be vacated for railway purposes as noted above.

3. Permission for continued use and maintenance by the city and public service companies of sewers, water mains and other public utilities in the vacated streets, the railways assuming responsibility for damages to these utilities resulting from the changed use of the property.

4. Agreement to pay for the paving of certain streets not vacated in the terminal district, when required by regular street improvement proceedings.

5. Agreement to pay proportionate shares of the cost of the viaducts over the railway tracks at 9th St. and Lovejoy St. when these improvements are initiated by the city. About 80 per cent of the cost of one of these viaducts will be paid by the railways, since the charter apportions 20 per cent of the cost to the city, 20 per cent to the abutting property owners (which are the railways) and 60 per cent to the railways affected.

6. Removal of longitudinal tracks in Front St. so as to leave a width of at least 60 ft. free from tracks. Repaving will be done by the railways. This is an 80-ft. street having docks, elevators and manufacturing plants on the river side and railway property on the opposite side. As a result of the agreement between the railroads

and the city, Front St. is being improved with a 10-in. reinforced-concrete pavement, the relocation of tracks and the installation of safety islands for a line of steel poles. This improvement extends from Glisan St. north to Nicolai St., about 1½ miles, and its cost is estimated at $240,000.

7. Improving a vacant block in front of the union station to provide adequate parking space for automobiles and giving the city control of the parking on the northeast half of the block (see plan) until such time as it is required for railway purposes.

Under the terms of this agreement the railways are to carry out the main part of these undertakings within three years, or before July 24, 1925. In the negotiations and preparation of plans, each of the five railways had its representatives. The city was represented by O. Laurgaard, city engineer, and the Northern Pacific Terminal Co. by A. E. McKennett, chief engineer. The railway improvement work is carried out under the direction of Mr. McKennett, while the street improvements, viaducts and track work in street areas will be done under the direction of the city engineer.

To Unify Segments of Intercoastal Canal

Col. George M. Hoffman, the district engineer for the War Department at New Orleans, has submitted a preliminary report on the whole intercoastal canal project between New Orleans and Corpus Christi, Texas, and has recommended a survey with the idea of unifying the various segments which make up the waterway. The The barge line operations on the Mississippi River, together with the purchase by the Government of three private canals which allow the free use of the existing segment between New Orleans and Morgan City, has greatly stimulated the desire of the communities further west to have the advantage of through traffic.

Concrete Memorial Bridge Has Attractive Appearance

Washington St. Bridge at Wilmington, Designed as Memorial to Delaware Soldiers, of Pleasing Line and Surface

ONE of the most attractive of the several bridges which have been built as memorials to those who served in the World War is the Washington Memorial Bridge across Brandywine Creek and its valley in Wilmington, Del. The structure is a necessary element in the street plan of the city and the memorial features were added after its initiation at an added cost of about $56,000. Final cost of the whole project was $823,000. In keeping with the nature of the bridge special attention was paid to the architectural design, to make it fit more into the park-like nature of the surroundings, and memorial pylons were added bearing the names of all those from Delaware who died in the World War as well as the names of the engagements in which Delaware troops were engaged in all of the wars of the United States.

MEMORIAL CONCRETE ARCH BRIDGE ACROSS BRANDYWINE CREEK AT WILMINGTON, DEL.

The bridge is 720 ft. long and 72 ft. wide and consists of five reinforced-concrete arch spans; two 70-ft., one 250-ft. and two 85-ft., together with the necessary approaches. Each span consists of three arch ribs, 11 ft., 16 ft. and 11 ft. wide respectively. The deck of the bridge consists of a 40-ft. roadway paved with sheet asphalt, two sidewalks 14 ft. 9½ in. in width and two balustrades 1 ft. 2½ in. in width. The piers of the bridge are on a 30-deg. skew and the large 250-ft. span of 40-ft. rise is one of the longest low-rise skew-arch spans in the United States if not in the world.

There are eight of the large, ornamental pylons or shafts placed on the bridge in line with the railings. Four of the larger shafts are placed over the piers of

250-FT. MAIN ARCH OF WILMINGTON BRIDGE

the large central arch and two of the smaller shafts at each end of the bridge. The large shafts extend 40 ft. above the sidewalk level and the smaller shafts 23½ ft. The bronze tablets are placed on the inside face of the shafts where they can be viewed by pedestrians on the sidewalk. On the inside faces of the smaller shafts are placed bronze nameplates 3x4 ft. On each side of the large shafts and on the approach sides of the small shafts are placed large, ornamental bronze lanterns which are illuminated by a single incandescent lamp of 250 candle-power. On the inside and outside of the large shafts are placed carved cast-stone eagles and shields of a monumental character. The balustrades were made of cast stone to harmonize with the surface treatment of the memorial shafts.

At the center of the span of the large arch a refuge bay was provided on both sides of the bridge by extending the sidewalk slightly beyond the line of the railing, thus forming a vantage point from which pedestrians may view the park below. Refuge bays were also provided at both ends of the bridge. Stone seats were placed in the refuge bays at the north end of the bridge to accommodate pedestrians who might desire to sit and rest. Large ornamental precast stone urns were placed on the end posts of the railing of the refuge bays at the north end of the bridge.

One stairway was provided for the bridge, at the south end on the east side, leading to the park sidewalk and illuminated by two bronze standards with lamps.

The lighting system of the bridge was arranged so as to harmonize architecturally with the pylons and railings, as well as to give the proper lighting effect to the sidewalks and roadway at night. The main lighting system consists of twenty-eight luminous arc lights supported by cast-iron light poles placed on the curb lines of the bridge. The secondary lighting system consists of the incandescent lamps in the twelve large bronze lanterns placed on the shafts and the two bronze standards at the stairway. The two lighting systems are on independent circuits.

The bridge was designed to carry the heaviest modern highway traffic and liberal provision was made for impact and possible future increases in traffic requirements. The assumed loads used in the design were 60-ton electric railway cars entrain on double tracks, a line of 20-ton motor trucks on the roadway at each side of the tracks and a sidewalk load of 100 lb. per square foot.

The two channel piers, each 20 ft. wide, the shore piers 8 and 9 ft. respectively and the two abutments support the 250-ft. center span with 40-ft. rise, two 70-ft. spans with 15-ft. rise and two 85-ft. spans with 18-ft. rise. Each arch has a center rib 16 ft. wide and two outer ribs 55 ft. apart on centers, that are each 11 ft. wide. The center rib of the 250-ft. span is 6 ft. deep at the crown and 11 ft. at the springing line, and the outer ribs 5 ft. and 10 ft. at crown and springing lines. Over each of these arch ribs and immediately under the floor slab there is a continuous gallery, one of which is reserved for high tension electrical conduits, the second for low tension electrical conduits and the third is used for gas and water mains. The reinforced-concrete floor slab, varying from 12 to 20 in. in thickness, exclusive of floorbeams which occur only at the expansion joints, is supported on longitudinal walls. These longitudinal bearing walls rest directly on the extradoses of the shore spans and are supported by the

ONE OF THE MEMORIAL PYLONS

spandrel columns of the channel span. The floor slab is arched transversely between ribs and is cambered 12 in. to a parabolic curve longitudinally.

The foundations of all piers and abutments were carried down to solid rock at a maximum depth of 5 ft. below water level.

The bridge was built under the direction of the Washington Street Bridge Commission, of which Frederick W. Carpenter was executive officer and consulting engineer. The design was made by Benjamin H. Davis, consulting engineer, New York, with the collaboration of Vance W. Torbert, architect, New York, as the result of a competition held by the commission. The contractor was the Walsh Construction Co., of Davenport, Iowa.

Progress and Plant Co-ordination, Concrete Road Work

Tentative Charts Laid Out at Beginning of Job for Progress Record—Later, Give Warning of Need for More Equipment

By Austin E. Page
District Construction Engineer, Pittsfield, Mass.

Checking progress on road construction by means of weekly charts on which the actual progress is plotted against the ideal schedule, was described by A. W. Dean, chief engineer, highway division, Massachusetts Department of Public Works, in *Engineering News-Record*, Jan. 11, 1923, p. 82. The planning and development of this ideal progress curve often present interesting problems. Thus, on one job last year, it was required to develop an ideal progress chart for the construction of 2.6 miles of concrete highway to be built in longitudinal half-width sections while keeping the road open to travel. The project was on a trunk line, with heavy traffic, and no construction work was to be done on the second half-width section until the first could be opened to travel, 10 days after laying the concrete surface.

The situation was carefully studied in the field with the contractor, who indicated the point at which he wished to start work and also supplied data based on previous performance, for working out the average daily output of each piece of machinery to be used. The contractor proposed equipment to include one excavating grader, one ⅝-cu.yd. steam shovel, and one 2-bag paver.

Average daily output figures supplied by the contractor are always checked against the department's record of past performances of similar equipment on other jobs and where these disagree with the contractor's figures, the records are made available to him to help him in revising his estimates. The department's records also show that, because of rainy days, breakdowns and delays, it is unsafe to plan on more than five working days per week.

Figs. 1 and 2 show the ideal progress plan as finally developed. Fig. 2 shows the proposed progress on a cubic-yard basis for the three major items of work, and Fig. 1 shows proposed station to station progress for each piece of machinery and thus determines the equipment necessary to follow the schedule outlined in Fig. 2.

It may be stated at this point that the contractor and not the engineer outlines the plan of operations. Many times, however, the contractor's plan is vague and incomplete and when it is actually placed on paper, he recognizes that it will not work out to complete the job within the time allowed by the contract. Thus, Fig. 2 showed immediately that one mixer was not sufficient and that a second would be needed about the last of August. Recognition of such discrepancies in plan leads to further study and more careful planning and results in clearer understanding of the problems to be met.

The method of developing the charts is as follows: It is decided to start excavation on the left half-section at Sta. 0 with both excavators, the grader to remove the old macadam, which is to be saved for shoulders, and the steam shovel to follow, excavating the earth. Then, from the "average daily output" figures, the direction of the first part of the "excavation" line on Fig. 2 is determined.

Concreting operations are to start on the left half-section at Sta. 0 on July 12. The gravel base must be

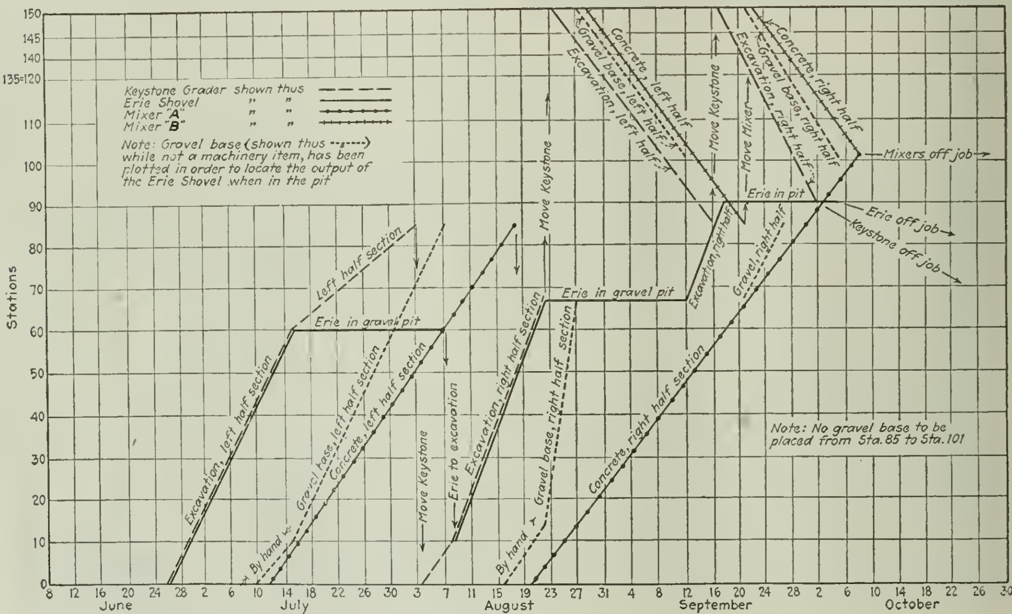


FIG. 1—MACHINERY PROGRESS SCHEDULE, TENTATIVE PLAN OF OPERATIONS

in place prior to this date and the natural method would be to place the steam shovel in the gravel pit on about July 10. The plan was developed along these lines until it became apparent that at some point on the job, the equipment would become "stalled." This condition occurs when excavating equipment approaches a section of road where one-half is covered with green concrete and the other half is open to travel and it is the nightmare of every contractor on a half-section concrete job.

The chart indicated that, to avoid this condition, more excavating work must be done before transferring a shovel to the gravel pit. Consequently, it was planned (see charts) to keep both shovels on the grade until July 15, and to place the first 200 cu.yd. of gravel base by hand shoveling. The remainder of the chart was worked out in much the same manner—selecting the most promising trial plan and working it through

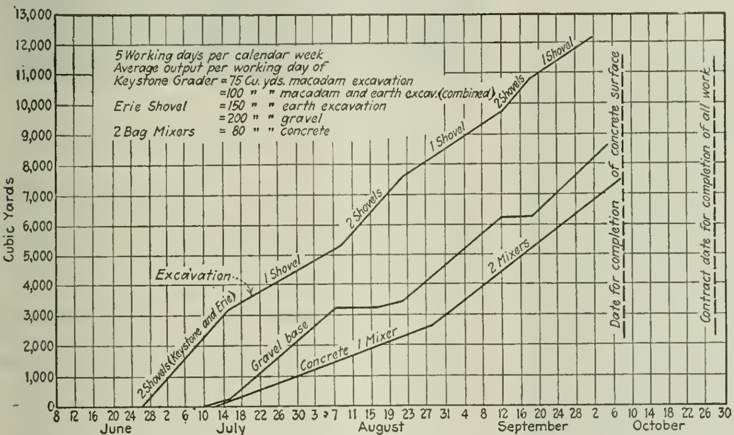


FIG. 2—DEVELOPED PROGRESS SCHEDULE FOR EXCAVATION, GRAVEL BASE AND CONCRETE SLAB

to conclusion or to a point where it was necessary to revise it.

A study of Fig. 1 will show that no construction operation takes place on the second half-section within ten days after placing concrete at any point on the first half-section.

The charts are developed together. Thus, on Fig. 2, the excavation progress line changes direction on July 15 when the grader (Fig. 1) is left alone to handle both macadam and earth excavation and again on Aug. 8 when the steam shovel rejoins the grader on the grade.

When construction work was started, the actual daily progress for the three items shown was plotted as a dotted line on Fig. 2. Thus, the progress on a cubic yard basis was immediately apparent.

Fig. 1 was used as a guide to plant layout and enabled the contractor to check the progress of each unit of machinery. It was revised on Aug. 15 because Mixer A could not keep up to schedule and again on Sept. 15 to plan for the addition of a third mixer, when Fig. 2 showed that the amount of concrete being placed by Mixers A and B was insufficient to complete the work within the time limit. It required several weeks to secure a mixer and without the warning given by the charts, it is improbable that it could have been secured in time to place all the concrete before the end of the season, as, in fact, was actually done.

Electrification on South African Railways

THE electrification project for relieving congested traffic conditions on the Johannesburg-Durban main line of the South African Government Railways, in Natal, has been modified materially as a result of the extensive line and grade improvement and double tracking west of Durban, as described in *Engineering News-Record* of Jan. 19, 1922, p. 116. The original plan was to electrify first the section from the port of Durban west 45 miles to Pietermaritzburg. But with the new second track and its more favorable grades on this section the traffic conditions were so improved that electrification was not needed for further improvement.

Serious congestion continued, however, on the single track line beyond Pietermaritzburg. New investigations were made by the consulting engineers, and on their recommendations parliamentary authority was obtained to proceed first with the electrification from Pietermaritzburg northwest to Glencoe, 171 miles, together with a 2½-mile branch from Merrivale to Howick. The track mileage to be electrified is 245 miles, with maximum gradient of 3.3 per cent uncompensated.

The contract for the supply of seventy-eight electric locomotives for this work has been placed with the Metropolitan-Vickers Electrical Co., Ltd., of England. The normal duty these locomotives will be called upon to perform is for three coupled together to haul a train weighing 1,430 short tons from Ladysmith to Pietermaritzburg—about 129 miles—in a little more than seven hours, and in the reverse direction a train weighing not less than 625 tons in about 7½ hours. The locomotives are to be capable of performing the round trip, under these conditions, once every twenty-four hours for six days a week. The gradients on the line between these points are mostly in favor of the fully loaded trains, the average between Ladysmith and Pietermaritzburg being 2.0 per cent.

Electro-pneumatic control will be employed, all the apparatus being mounted in a central compartment which will be locked in such a manner that the driver is unable to enter until the apparatus has been made "dead," thus avoiding all danger of contact with any "live" high-voltage parts. In view of the heavy grades to be met with on the line, the locomotives are arranged for regenerative control.

Most of the contracts for machinery and plant have been let, foundations for the power house at Colenso are being built and work on the building will be started soon. It is expected to have part of the line in operation by June, 1924, and the whole project completed early in 1925. The consulting engineers are Merz & McClellan, of London, England. This work is being carried out under the direction of Sir W. W. Hoy, General Manager of Railways and Harbors, Union of South Africa.

Building a 9-Ft. Siphon on the Hetch Hetchy Aqueduct

Armored With Concrete Outside and Lined With Cement Mortar Inside, Steel Pipe Crosses Reservoir Under 367-Ft. Head

By N. A. Eckart
Chief Assistant Engineer, Hetch Hetchy Project

THE CITY of San Francisco has just completed, as part of the Hetch Hetchy water supply project, an inverted siphon 9 ft. 1½ in. in diameter across the Tuolumne River at Red Mountain Bar. The siphon constitutes a short section of the main aqueduct that will later be built to convey water from Moccasin Creek power house to San Francisco. It is located 5 miles below the power house and will be the connecting link between two sections of a 17-mile tunnel to be driven from Moccasin Creek power house to a point near Oakdale, whence the aqueduct will continue in the form of a steel pipe line across the San Joaquin Valley and toward San Francisco. At the present stage of the Hetch Hetchy project a total of 112 miles of tunnel and aqueduct must still be built before water from Moccasin Creek power house can be delivered to the distributing reservoirs of the present San Francisco water system.

FIG. 1—DELIVERING 9½-FT. PIPE SECTIONS TO THE TRAM
These sections, weighing 12 to 16 tons, were skidded to place in the trench from the tramway running alongside.

The Red Mountain Bar siphon was constructed in advance of the remainder of the aqueduct because the Don Pedro Dam, just being completed by the Modesto and Turlock Irrigation District, will back the water of the Tuolumne River above Red Mountain Bar, submerging the siphon crossing to a depth of 73 ft., thus rendering uncertain its future accessibility.

The siphon as installed consists of 776 ft. of riveted butt strap pipe, 9½ ft. in inside diameter, with a plate thickness varying from $\frac{5}{16}$ in. to $\frac{3}{4}$ in. by sixteenths. The pipe is encased in a concrete jacket of 1:2½:5 mix from 18 to 24 in. in thickness and is lined inside with mortar 2¼ in. in thickness which was put in to increase the permanency of the construction.

FIG. 2—CONSTRUCTION WORK IN SECOND COFFERDAM
The two halves of the river channel were cofferdammed successively; this view shows stream diverted over finished portion of siphon, while work is begun on the far side just unwatered.

The pipe was delivered, on a siding of the Hetch Hetchy R.R. immediately above the crossing, in sections, normally 24 ft. long, each section being made up of three 8-ft. courses and weighing from 12 to 16 tons, according to the thickness of the plate.

The pipe was laid in a trench excavated in bedrock across the river channel. The lowest point in the siphon is 367 ft. below the hydraulic gradient and hence will normally operate under that head. The stream flow at the crossing during the period of construction ranged from 400 sec.-ft. to 1,100 sec.-ft.

The first step in the field work was the installation of a standard-gage tramway and trestle across the river just above the line of the pipe, the upper end of the tram being at a siding on the Hetch Hetchy R.R. A derrick was installed at this point for handling the pipe directly from the cars to the tram; this also served for handling concrete materials to the tram from the storage bins constructed adjacent to the spur.

At low water cofferdam frames had been built entirely across the stream bed above and below the pipe line and were well braced and anchored to the bedrock. A transverse partition in the center divided the cofferdam into two halves and by the use of sheathing on first one half and then the other the two halves of the channel were successfully unwatered, the trench was excavated, and the pipe laid in the dry. The cofferdams were quite tight, all leakage being handled by one 6-in. and one 10-in. centrifugal pump. While the trench was being excavated an unusually heavy rainstorm, coming earlier than the normal seasonal rains, caused the stream to rise from about 1,000 sec.-ft. to 11,000 sec.-ft. and washed out a short section of the cofferdam. This was quickly replaced with cribs floated into place, where they were loaded with rock, sunk and faced with sheet piling.

The trench excavation across the channel was handled

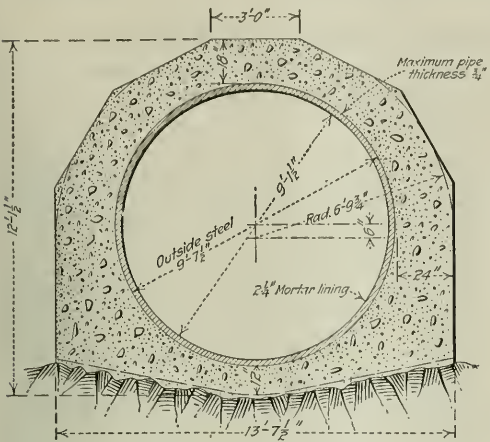


FIG. 4—SECTION OF COVERING AND LINING OF PIPE

by skips and derricks; the pipe was lowered to place from the tram with the aid of skids down which it was rolled in a bight of cable. Each section of the pipe as it was placed in the trench was riveted and lined up on wooden blocks which were immediately thereafter replaced by concrete piers poured in forms constructed of sacks of sand. These sack forms worked out particularly well in this case where the piers were later to be incorporated into the concrete jackets; the rough surface left by the sand bags giving an excellent bond for the concrete.

When enough pipe had been riveted up to reach from mid-stream to a point above high water, bumped test-heads were riveted to each end of the section and a test pressure of 200 lb. per sq.in. was applied and all joints made tight. A small high pressure single plunger pump with a capacity of 40 gal. per minute, driven by a gasoline engine, was used for testing, and for maintaining the pressure in the pipe while the concrete jacket was being poured and allowed to set.

After pipe laying in the first cofferdam had been completed, a concrete partition wall was constructed between the up and downstream faces of the cofferdam, permitting the pipe to extend through the wall. The river was then diverted over the completed section of the pipe and excavation and laying of the pipe were continued on the other side of the river.

The concrete mixer for the work was located above the highest point of the pipe line below the railroad and all concrete for the jackets on that side of the river was placed directly by chutes. The concrete on the opposite side of the river was delivered in concrete dump cars over the tram line, the cars being loaded from a hopper fed by chutes from the mixer.

The pouring of the concrete was generally continuous, except where the work was stopped for testing purposes. Where a construction joint was necessitated the form was bulkheaded with sacks of sand against which the concrete was poured, leaving a rough surface suitable for bonding when the sacks were removed.

The last operation was the placing of the mortar lining inside the pipe. The form for this lining was sheathed with wooden staves as manufactured for wood-stave pipe. These forms were made up in segments held in place by a collapsible frame. The forms were centered inside the pipe by means of small precast concrete blocks about 4 in. square formed with tapering sides so as to key into the lining. Light reinforcing was cast in these blocks with projecting ends to bond into the cement mortar. The mortar used in the lining consisted of one part of cement to 1½ parts of sand and was poured through 2½-in. saddles riveted to the pipe for that purpose at 16-ft. intervals. This mortar was mixed in the concrete mixer and delivered in cars over the tramway.

At the lowest point of the siphon a 12-in. blowoff was installed connecting with a line of 12-in. pipe which was carried up above the level of the reservoir surface. Two valves are installed in this line, one at the upper end and one at the lower level, permitting operation at different reservoir heights. For part of its length this blowoff pipe line is embedded in the concrete jacket of

FIG. 3—SIPHON NEARING COMPLETION, COFFERDAM REMOVED

Track still to be used for delivering cement mortar lining. Concrete wall in center of channel is a permanent feature.

the main siphon and for part of its length is supported on concrete piers.

The work was carried on by city forces on a day labor basis. W. A. Kraner, acting as superintendent, was responsible for plant layout and field installations. The engineering details and design were by L. W. Stocker, assistant engineer, all under the general charge of M. M. O'Shaughnessy, city engineer.

Decline of Typhoid Fever in Maryland

The typhoid death rate in Maryland declined from 42.8 per 100,000 in 1910 to 7.3 in 1922, according to an advance copy of the 1922 report of Abel Wolman, chief engineer, Maryland State Board of Health. Omitting Baltimore, the rate fell from 43.5 to 10.7. The 1920 rates for the whole state and for the state outside Baltimore were 6.9 and 9.1 respectively.

Civil Engineers Have Summer Meeting at Chicago

Technical Sessions Devoted to Discussion of Railway Problems—President's Address Emphasizes Society Co-operation—Protest on Davis Removal Adopted

Engineering News-Record Staff Report

PLENTY of excursions in delightful weather, a large attendance (over 700), a modicum of business and a surfeit of technical papers which effectually prevented discussion characterized the 53rd annual convention of the American Society of Civil Engineers, held at Chicago on July 11-13. That engineers should "go into politics" in the sense of getting acquainted with men and affairs outside of strictly technical lines was suggested by Mayor Dever in his address of welcome. He referred also to the great importance of the engineer and his work in relation to transportation and municipal development. Incidentally he expressed his willingness to accept advice or suggestions from technically competent men and organizations.

President Loweth on Co-operation—Active co-operation between the various engineering societies was advocated as desirable and necessary by C. F. Loweth in his presidential address. It has been said that if this society had lived up to its early opportunities it might now be the one all-embracing engineering society, but Mr. Loweth questioned both the possibility and desirability of such a result. There is already a large degree of co-operation in regard to technical matters, as illustrated by the Engineering Standards Committee and the National Research Council, but there is need for more concerted activity in matters relating to the public service of the profession and to its general welfare. Certain requirements for such co-operation were noted and it was pointed out that the dangers of a super-organization must and can be avoided. That the decisive vote against joining the Federation (which Mr. Loweth did not mention by name) was based on the plan and not the spirit of co-operation is shown by the history of the Society. A review of the development of engineering societies and the American Society of Civil Engineers was included in Mr. Loweth's address. Increase in membership of the Society slackened after the war but is now again reaching the normal rate of growth. Attendance at the annual conventions, however, is not in accord with membership increase and this matter is having the consideration of the officers. Under the new plan of divisions for separate subjects there are now five divisions and Mr. Loweth expects that others will be organized.

Many Papers But No Discussion—Engineers at this convention were subjected to endurance tests in the two morning sessions. At the first session, six papers were presented after the opening ceremonies and at the second session no less than ten papers were crowded into a 3-hour stretch. In order to keep within even these long limits the papers had to be read hurriedly, some in full and others in abstract. There was no opportunity for discussion and it is creditable to the members that so many sat out to the end. With one exception the papers were read by their authors. All the papers were good, but in the aggregate they were too long and too solid. Two or three at each session would have received better attention. Further, if the six papers on Chicago terminals had been compiled into one fairly long paper, with a minimum of statistics but with all the lantern slides used in the separate papers, the subject would have been more interesting and have occupied less time, while the audience would have had a much better comprehension of the subject.

Railroad Transportation—Public phases of the railroad problem were presented in a group of papers on July 11. That the railroads should be freed from political attack and agitation in order that they might carry on their work in the interests of the public and the investors, was urged by C. A. Morse (C., R. I. & P. Ry.) in dealing with "Consolidation of Railroads." In a second paper on this subject Professor Worley (University of Michigan) said the proposal for a score of groups is too drastic; he thought that at first there should be nearly a hundred groups. In reviewing "Federal Valuation of Railroads," E. F. Wendt (Washington, D. C.) pointed out that the value of the property is fundamental to public regulation in such matters as rate making, capitalization, consolidation, joint use of terminals and construction of new lines. He believes that the aggregate value of the railroads as determined by the Interstate Commerce Commission will substantially equal their capitalization.

Transportation as related to national progress was reviewed interestingly by J. G. Sullivan (Winnipeg). Railroad construction has been a great factor in this progress, but if carried to extremes it may be actually detrimental to the public interest. This condition is illustrated in Canada, where railway development has aided settlement and prosperity in a high degree, but where inflated construction under government guarantee for political purposes has now burdened the country with an annual deficit of $60,000,000 to $80,000,000. That investments in railroad securities include those of a great army of small investors (representative of "the public") and are not merely those of "big capital" was pointed out by John W. Kendrick (Chicago). Railroads as arteries of commerce were discussed in a paper by J. R. Bibbins (Washington, D. C.) which was read in his absence.

Railroad Terminals—That terminal facilities were needed badly was the theme of a group of ten papers crowded into the morning session of July 12. After an opening paper by H. R. Safford (C., B. & Q. R.R.) the subject of "Principles of Terminal Station Design" was discussed by Alfred Fellheimer (New York) in relation not only to broad features such as public relations, utilizing air rights and merging of terminals due to consolidation, but also as to traffic considerations and station facilities. Improvement and ultimate unit operation of the complicated freight terminal facilities of St. Louis was advocated by Charles E. Smith (St. Louis) on the basis of the comprehensive report abstracted in *Engineering News-Record* of July 6, 1922, p. 17. In "Street Development in Relation to Railroad Terminals," J. L. Crane, Jr. (Chicago) pointed out that the intensive use of limited city areas has produced more traffic than the streets can properly accommodate.

This difficulty may be overcome in many cases by railway and municipal authorities co-operating in the joint planning of terminals and street systems.

Six papers on the Chicago railroad terminals dealt with specific works and prospects but involved considerable repetition in explaining local conditions. That the new Union Station will be a one-level station in spite of its size was one of the points brought out by J. D'Esposito, chief engineer. Some of the new tracks are already laid and the headhouse is under construction. In regard to the new Illinois Central R.R. terminal works, representing the most extensive of the Chicago projects, D. J. Brumley, chief engineer of terminal improvements, estimated that the electrification will result in speeds as high as 57 m.p.h. on the suburban express runs and that such service will be in operation in three years.

An unusually broad-minded attitude is shown by the city of Chicago in requesting the railroads to co-operate in a study of the improvement of the street layout and complicated terminals adjacent to the south side of the loop district, including three passenger stations. This problem was presented in two papers by R. H. Ford (C., R. I. & P. Ry.) and F. E. Morrow (C., & W. I. R.R.). Projects for rail and water terminals in the Chicago district were described by Major Rufus W. Putnam, U. S. Engineers. Finally the original and adopted designs of the great freight station and warehouse built at Chicago a few years ago by the Pennsylvania R.R. were described by W. L. R. Haines (Pittsburgh).

Business Affairs—Only a few minutes were devoted to a business meeting after the protracted morning session of July 11, the most important action being the adoption of a resolution and statement prepared by the Board of Direction in protest against the summary dismissal of A. P. Davis as Director of the U. S. Reclamation Service. Another resolution expressed the Society's feelings at the murder of John E. Shoemaker in the massacre at Herrin, Ill., while in the discharge of his duties. This resolution also deplored the fact that though this outrage occurred a year ago, the State has been unable to bring the guilty parties to justice. At the closing session a resolution was adopted regarding the death on July 11 of Captain Robert W. Hunt, the noted engineer and metallurgist. In addition to the actions of the Board of Direction noted last week, the board adopted a resolution of protest at the attitude of the municipal authorities of Pittsburgh in intrusting the design of large bridges to architects.

Brief and lightly attended meetings of the highway, sanitary and city-planning divisions were held in the afternoon of July 11, when the power division also held a meeting for the presentation of papers on power development, by W. L. Abbott (Chicago) and on ice problems of hydro-electric plants, by W. T. Walker (Minneapolis).

The sanitary division accepted the invitation of the Sanitary Association of New Jersey to co-operate in working out sewage disposal problems in that state and authorized the appointment of a committee to work for a bill giving engineers in the U. S. Public Health Service equal status with that of the medical officers. The matter came up through a letter from Sol Pincus outlining a course of action and also by reference to the division by the Board of Direction. S. A. Greeley reported ready response from sanitary engineers in contributing for the proposed annual medal for the best contribution on the fundamentals of sanitary engineering. Opinion seemed to favor calling this the Rudolph Hering medal. The highway division discussed proposed activities of the division and the program of the Richmond convention, opinion on the latter being that "bond issue" topics had better be omitted.

Excursions included trips to various local industries and points of interest, and there were two informal dinners followed by dancing. For July 13 two all-day trips were arranged: one on a steamer cruising along the lake front to show the numerous park improvements and industrial developments, the other by rail to Milwaukee to inspect the sewage treatment plant.

Pavement Undermined by Large Sewer Withstands Traffic

Although unsupported for an area 17 ft. wide and 25 ft. long, a 6-in. concrete pavement slab in North Sixth St., Sheboygan, Wis., for an indefinite time withstood heavy traffic which included a 7-ton power flusher carrying 5 tons of water. The pavement was undermined by the sandy material finding its way into an

BREAKING DOWN UNDERMINED UNDAMAGED CONCRETE PAVEMENT TO MAKE SEWER REPAIRS

Cavity 25 ft. long and 17 ft. wide formed by material washing into sewer was not disclosed until sewer became clogged. A 7-ton power flusher used this street for some time before the cavity was discovered.

18-in. sewer 13 ft. below grade. The cavity was about 8 ft. deep when discovered through a clogged sewer.

The paving laid in 1921 was 6 in. thick at the center rather than the usual 8½ in. required by specifications because it was laid over 20-year old macadam which was considered to have a good bearing power. However, C. U. Borley, city engineer, states that the macadam at the center of the street was nearly all removed in grading to subgrade and some doubt was expressed at the time of the sufficiency of using only a 6-in. slab on a 40-ft. street with a 5-in. crown making a decidedly flat arch. As shown in the photograph, a transverse expansion joint cut entirely through the pavement 3 ft. from one end of the cavity.

For the base the mix was 1:3:5 and for the 1¾-in. top it was 1:2:4. The mesh reinforcing was placed near the top of the slab to meet temperature stresses so it had little value when the slab acted as a beam.

In removing the slab to make repairs to the sewer an opening was cut 20 ft. long with sledges and bull points. This narrow opening was then widened with sledges breaking the concrete into small pieces without developing any large cracks or getting out any large pieces.

Chicago City Council Plans Unified Transit System

To Rearrange and Extend Existing Lines—Universal Free Transfers—Few Subways—Interchange with Electrified Suburban Lines

Abstract of the report and recommendations on a physical plan for a unified transportation system for the city of Chicago, made by R. F. Kelker, Jr., chief engineer of the committee on Local Transportation of the City Council of Chicago.

THE PLAN of the local transportation committee of the Chicago City Council to improve the transit situation of the metropolitan district is at variance with most former proposals in that it proposes modification and extension of the existing elevated and surface lines, with the addition of a comparatively small mileage of new subways, rather than a large mileage of new subways and the abandonment of a great deal of the existing systems. It calls for the introduction of universal free transfers between the present surface and elevated lines as a means of giving immediate relief from the surface congestion in the Loop District and of speeding up the passenger movements. The plan also proposes as a future development an interchange between the electrified suburban lines of the trunk railroads and the city rapid transit whereby rapid transit trains can be routed to suburban points and suburban trains can have access to the entire rapid transit system.

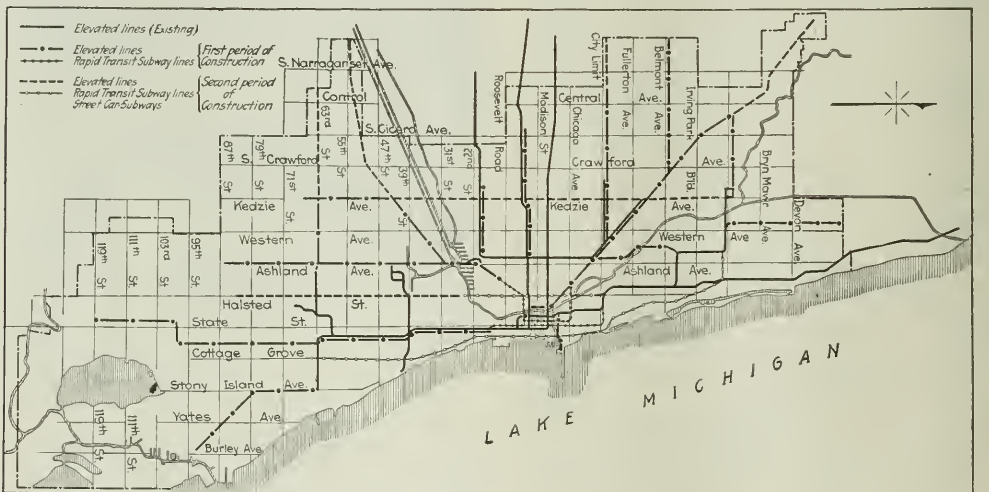
The metropolitan district of Chicago as assumed for the purposes of this report has an area of 275 sq.mi., and a population of approximately 3,000,000. It is estimated that the population will be 5,000,000 in 1950. The district is peculiar in that it is semi-circular in form with the central business district, the normal center of the area, located at the extreme easterly edge and close to Lake Michigan. Obviously then the length of haul is considerably greater than if the area was circular in form. At present the central business district is restricted to the area bounded on the east by the railroads along the shore of Lake Michigan, on the north and west by the industrial district along the Chicago River, and on the south by the railway terminal area. Its growth is practically confined to this area by the fact that with one exception the only rapid transit lines in the city terminate there. The one exception is the stockyards branch.

The present city transportation system is made up of surface lines, elevated lines, and bus lines. The layout of the first two was based on the demand of earlier years, and with the exception of the rehabilitation and extensions made between 1907 and 1911 no changes have been made to meet the demands of the expanding city.

The Chicago Elevated Railways, a voluntary consolidation of the four former elevated companies, comprise the rapid transit system of the city. The combined lines have 162 miles of track but carry only 17 per cent of the revenue passenger traffic. The growth of traffic has not kept pace with the increase in population due to the limited terminal facilities of the central business district and the financial inability of the companies to extend their lines. The reason for not obtaining the maximum capacity is apparent when it is realized that thirteen tracks converge on the Union loop, a double track loop operating in the central business district.

The Chicago Surface Lines, a similar consolidation of four surface railways, comprise 1,060 miles of single track, and carry 71 per cent of the traffic. These railways present a nearly uniform development of trunk and cross-town lines which are intersected by lines on the important radial streets. The limited capacity of the elevated has forced an unusually large proportion of the people to use the surface lines but even so 30 per cent of the lines do not pay the cost of operation. Single fare transfers are used on both elevated and surface lines but the two systems are in competition and do not exchange transfers. Two fares are therefore necessary in order to get the full benefit of the two systems. This condition results in the remarkable length of the average ride on surface lines of 4.2 miles. Bus lines now operate over 23 route-miles and carry 1 per cent of the passengers. The remaining 11 per cent are carried by the suburban lines.

The result of all these conditions is that the maximum number of cars that can now be operated on both the surface and elevated routes which terminate in or pass through the central business district is determined by throats or controlling points in that district. As the present outlets from this congested district are used nearly to their practical limit the capacity of these routes throughout their length is thus fixed by these controlling points. The elimination of such controlling points will



GENERAL PLAN OF THE PRESENT AND PROPOSED RAPID TRANSIT LINES

be accomplished by the development of the plan recommended in this report.

Elements of the Plan—The fundamental elements of the plan are as follows:

(a) Long haul traffic carried on rapid transit lines,
(b) Short haul traffic carried on surface lines serving as feeders to the rapid transit lines,
(c) Transfers between surface and rapid transit lines to facilitate (a) and (b),
(d) Unification of independent systems to eliminate competition and the resulting needless duplication,
(e) Transportation system planned in advance of traffic demands,
(f) Use of existing structures as far as possible to form part of the complete system,
(g) Connection of various outlying commercial centers in such a manner as to provide rapid transit without passing through congested centers.

The fundamental principle of the whole plan is the use of existing facilities as far as possible. The committee justifies this idea by the fact that a former proposal to construct an independent system of subways would cost $550,000,000 more than the proposed system. It also points out that approximately four miles of elevated railway can be constructed at the cost of one mile of subway.

The proposal to build street car subways in the central business district is postponed to the second period of construction as they are expensive and not economical to operate and may be found unnecessary by that time. The proposal to scrap the Union Loop and replace it by subways is also considered unjustified for some years to come.

The key to the solution of the terminal problem is found in providing four tracks through the central business district for North and South Side trains by devoting two tracks of the Union Loop in Van Buren St., Wabash Ave. and Lake St. to the exclusive use of West Side trains. This will be accomplished by the construction of a two-track subway in State St. and in North Ave. from a connection with the South Side Elevated to a connection with the Northwest Elevated, and by the construction of a two-track elevated railway on Wells and Polk St. to a connection with the South Side elevated.

Bus lines are recommended only for use as feeders in outlying districts until the density of traffic along their routes will justify the construction of surface lines.

When the *excess* capacity of the city's urban lines is sufficient to accommodate all or part of the suburban traffic the committee recommends that a study be made to coordinate the unified city system with the electrified suburban railroads. It outlines a plan whereby a connection would be made with such railroads about five miles out from the center of the city, where rapid transit trains and suburban electric trains could interchange, thus making the whole rapid transit system available to the suburban service and reducing the concentration at the railroad terminals. This will make it unnecessary for the railroads to acquire more costly property for additions to their city terminals.

The Comprehensive Plan—The committee recommends that the construction program be divided into two periods as follows: A First Period of Construction, which includes such parts of the plan as are urgently required and can be definitely located at this time; and a Second Period of Construction, which includes the remaining parts of the plan, adjusted to suit the changes that will occur before that time. At the end of the two periods the city will have a complete Unified Transportation System to accommodate the needs of Chicago when its population shall have reached 5,000,000 which is estimated to be about the year 1950. This system is shown for the whole city in Fig. 1. It includes the following divisions:

(a) Rapid transit subways:
  (1) The State Street subway
  (2) The Clark Street subway
  (3) Cottage Grove—Broadway subway
  (4) Halsted Street subway
(b) Elevated Railroads:
  (1) Mid-City trunk line
  (2) Northwest Side lines
  (3) Southwest Side lines
  (4) North Side and South Side lines
  (5) West Side lines
(c) Additional street railways
(d) Street car subways in Washington and Jackson Streets in the central business district.

TABLE I—ESTIMATED COST OF UNIFIED SYSTEM

	First Period	Second Period
Rapid transit subway	$44,330,000	$75,810,000
Elevated railways	71,173,000	30,115,000
Surface railways	13,770,000	8,595,000
Cars	72,750,000	27,600,000
Substations, shops, yards	15,820,000	6,000,000
Street car subways	None	6,870,000
	$217,843,000	$154,990,000
		217,843,000
		$372,833,000

The estimated cost, including cars, yards, substations, and terminals is shown in the accompanying table.

Results Accomplished—Unification of all the existing lines, and the use of single-fare transfers will give some immediate relief and will be of added advantage as the system is expanded. Lack of unification has resulted in 85 per cent of the people riding on the surface lines, the more expensive means of transport, while the elevated lines were not used to advantage.

TABLE II—MILES OF SINGLE TRACK

	Existing Systems	First Period of Construction	Second Period of Construction	Periods of Construction Total	Unified System Total
Rapid transit subways	None	17 6	37.3	54 9	54 9
Elevated railroads	162 0	137 0	67 2	204 2	366 2
Total rapid transit	162 0	154 6	104 5	259 1	421 1
Street car subways	None	None	2.5	2 5	2 5
Street railways	1,060.0	153.0	95.5	248.5	1,308 5
Total mileage	1222 0	307.6	202.5	510.1	1732 1

Transfers and the relocation of surface and elevated stations will make it possible for more people to use the elevated lines for the long part of their ride and will consequently make it possible for 70 per cent of the present number of surface cars now operating in the central district to handle the traffic which will still have to use them.

Other benefits of the unified system will be:

(a) Faster running time, a reduction of the long-haul riders' time from an average of forty-five to twenty-five minutes;
(b) Increased capacity—by eliminating the throats or controlling points of the central business district which are now taxed to capacity, and by adding lines which will make the joint capacity at the end of the first period of construction double the present capacity;
(c) Development of business centers;
(d) Development of residential districts;
(e) Relief of the congestion in the central business district, by the reduction of the number of surface cars, and by making it possible for the district to expand across the Chicago river to the north;
(f) Reduction of operating expenses, as the operating cost per mile on rapid transit lines is only 75 per cent of the cost of surface lines and the unification of the system will shift the bulk of the passenger mileage to the rapid transit lines.

Engineer-Legislators in Canada

Engineers in the federal and provincial legislatures of Canada total 12 out of a total membership of 915. or about 1.3 per cent, according to a count made by *The Canadian Engineer*. In the federal parliament there are two engineers in the senate and three in the house. Of the nine provinces Quebec and British Columbia each has two engineer-legislators; New Brunswick, Ontario and Alberta one each; and the other four provinces none.

Operating Costs on Grinder Used To Make Sand From Basalt

Absence of Sand at Copco Dam Necessitated Grinding Up Rock for Concrete Aggregate —Sand Cost Was $1.10 per Cu.Yd.

By P. O. Crawford
Chief Engineer, California Oregon Power Co.

In the construction of the Copco Dam on the Klamath River in northern California some years ago, the California Oregon Power Co. was unable to locate a deposit of sand near the dam suitable for concrete and finally installed two Williams Universal No. 3 sand grinders. For the first three months black volcanic cinder was put through these without good results. The cinders were moist and clogged the grates, cutting the sand production very low and wearing the bars and hammers excessively. Drying the cinders did not materially improve conditions. However, the same grinders were later used to make sand from a hard basaltic rock, found at the site, which has a specific gravity of about 2.7. This sand was very satisfactory and, owing to the larger percentage of fines, produced a denser concrete than would have been secured with river sand. In view of this success, when it was decided in 1922 to add to the power house and increase the height of the dam, one of the sand grinders was again used with the results cited in the following.

This time the grinder was mounted just below the delivery of the belt conveyor from the gyratory crusher and the supply chute was so arranged that any portion from zero to 100 per cent of the crusher product could be diverted to the grinder. Ordinarily the chute was set so that 40 to 45 per cent of this crusher-run rock, varying in size from dust to 5-in. rock with some larger pieces, went into the grinder. The average size of this material was between 1½- and 2-in. rock.

MECHANICAL ANALYSES OF SAND FROM GRINDER
(Percentage by Weight, Passing Through Each Screen)

Screen Mesh Per Inch	Average of 1917 Tests Per Cent	Average 5 Runs Apr. 8, 1922 Per Cent	Average 4 Runs Apr. 12, 1922 Per Cent	May 10, 1922 Per Cent	May 8, 1922 Per Cent	Average 8 Runs Nov. 22, 1922 Per Cent
4	81.5	....	57.0	89.5	76.2	91.0
10	60.4	70.8	21.1	63.5	66.2	72.5
20	44.5	47.6	12.2	48.5	56.2	50.7
30	36.6	38.6	10.8	39.6	51.7	45.8
50	28.8	31.5	10.2	27.0	48.0	35 4
100	20.8	13.5	3.2	0.5	19.3	23.6

The resulting sand was quite variable due to the wearing of grate bars, hammers and liners and was subject to sudden changes due to the wearing out or breaking of bars, in which cases rocks up to 1 in. in diameter would come through. Trouble was also caused whenever pieces of drills, etc., inadvertently got into the feed. The variation in mechanical analyses is shown in the accompanying table.

Although recognizing the advisability of feeding only small rock through the grinder so as to keep the wear down to a minimum, in this case it was found best to pass part of the fines from the crusher to a ¼-in. mesh revolving screen and to use the portion passing through the screen as sand. These screenings constituted about 25 per cent of the sand used on the job; the remaining 75 per cent was furnished by the grinder.

It should be noted that if the product of a grinder operated in this manner is to be stored in a large sand bunker some means of keeping a constant check on the grinder product before it reaches the bunker should be provided, otherwise in case of worn or broken bars a considerable volume of coarse material might be delivered to the bunker before the variation in the product was discovered.

Provision must also be made for keeping the grinder product dry, otherwise it becomes hard to handle because of the percentage of dust contained. The irregularity of the product and the occasional large pieces made it preferable not to use this sand for finishing work such as floors, etc., although doubtless this would not have been the case with soft rock.

The separation of grate bars as supplied for renewals was ⅛ in. and it was found desirable on this work to increase this opening to ¼ or ⅜ in. by welding lugs to the ends of each bar to serve as spacers. With new liners and hammers the clearance between the ends of hammers and the first grinding plates is about ½ in. This clearance and the space between bars was found to increase rapidly so that a new set of grate bars in the bottom half of the grinder was required every two to two and a half weeks. Any bars not entirely worn out when these renewals were made were placed in the upper half where there was less wear.

The hammer bars in this machine are arranged so that as the outer end wears they may be moved out from the center ½ in. at a time for a total gain of 3 in. In grinding this material it was necessary to move them out one hole about every week and after each two moves it was found best to take the hammers out and have the tips squared off as they wore to a point which resulted in a cutting rather than a crushing blow. When the hammer bars had worn too short for further service two such stubs were welded together to make a single new bar.

In a period of seven months one of these grinders turned out approximately 3,600 cu.yd. of sand operating about 180 nine-hour days at a cost of $3,031 for new parts and $700 for labor on operation of repairs and installation of new parts. This total gives a unit cost of 84 cents per yard for new parts and 19½ cents per yard for labor on repairs and renewals. The total cost of sand secured in this way was put, in round figures, at $1.10 per cu.yd. This figure does not include any quarry cost nor power for the 50-hp. motor used to drive the grinder. It is safe to say, however, that any imported sand of equal quality would have cost at least twice as much as this even with quarry and power costs added.

During this seven-month period there were placed in the grinder 5½ sets of hammers and six sets of grate bars. Approximately 110 man-days were required for these changes and renewals and also for repairs including blacksmith work in welding and dressing hammers.

Low Typhoid Death Rate for England in 1922

The typhoid death rate for England and Wales was 1 per 100,000 in 1922, according to a return issued by the registrar general. With the single exception noted below, and omitting decimals, there was no variation either by seasons or for the total as compared with the urban population. The variation mentioned occurred in the second quarter of 1922, when the rate in the "smaller towns" (20,000 to 50,000 population) was 2 instead of 1 per 100,000. The total mid-year population was estimated as 38,150,000 of which 19,170,420 was in 105 "county boroughs and great towns" and 4,931,620 in 155 "smaller towns."

Air Vibrations Due to Fluttering of Water Sheet Over Dams

Partial Vacuum Between Water Sheet and Face of Dam Produces Waves That Rattle Objects in Nearby Buildings

By Frederic I. Winslow
Division Engineer, Metropolitan Water-Works, Framingham, Mass.

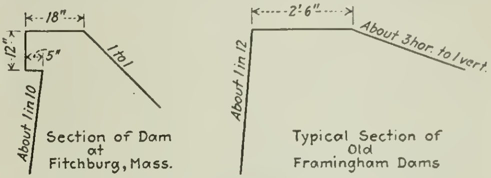
WHAT APPEARS to be a strongly marked case of the comparatively rare phenomenon of vibrations transmitted through the air to a considerable distance occurs about once a year on the Sudbury section of the Metropolitan Water-Works, at Framingham, Mass. The occurrence is noted on two dams, each having a face with a batter of but one in twelve (see sketch). A third dam of similar section but having the sheet of water broken by a continuous rod passing just above the crest of the dam is free from such vibrations. As a result of these vibrations windows rattle, dishes sometimes fall from shelves, and insecure piles of boxes topple over, when the effect is most pronounced, over a mile from the dam. At times the sound effect is similar to that produced by an explosion except that it is more like a series of mild explosions. A like phenomenon has given trouble near Fitchburg and slight vibrations are reported from a few other dams.

As the dams are built on compact sand and no rock is in evidence, the only explanation of the phenomenon is a partial vacuum between the sheet of water and the face of the dam which causes a fluttering which appears to operate on a large scale much as does the diaphragm of a telephone receiver. The sheet of water flowing over the dam and vibrating uniformly, imparts to the atmosphere a series of waves which resemble wave translation in water, or sound waves in the air. Another analogy is the electromagnetic waves produced in wireless telegraphy by a spark discharge which resembles those produced in the atmosphere by an explosion, or the continuous wave produced by an electric arc or the oscillating tube may present a parallel with the waves produced by a fluttering sheet of water.

The dam where the phenomenon is more frequently observed—and this is due to the fact that this dam is used to discharge all the waste from Sudbury River—is 168.67 ft. in length and has a fall of water of about 11 ft. Little vibration is felt until the volume of water passing over the dam amounts to over 300 m.g.d., corresponding to a 6-in. depth of water on the crest. At one time it was attempted to mitigate the effect of the vibrations, as at least one complaint was made of rattling noises at night, by introducing timbers under the sheet of water so that air might freely enter, but this was abandoned.

Several engineers of note in charge of large dams have never had similar vibration experiences and some have never heard of its occurrence anywhere. At Lawrence, Mass., vibrations have been observed when the volume of water was sufficiently large, or when the depth of water is about 1 ft. At Lowell, Mass., the fluttering has been observed when the flashboards have been raised several feet in height and there is 6 in. of water flowing over the dam—generally with a slight breeze at the same time. Vibration has also been observed at several vertical timber dams along the Pawtuxet River in Rhode Island—in every case where there is little or no opportunity for access of air at the ends of the dam—but the vibration has not been so pronounced as to be noticed in the neighborhood.

A more marked case has been reported from Fitchburg, Mass., where it became necessary to devise some method of preventing the trouble. The Fitchburg dam was a small concrete structure (see sketch) on the North Branch of the Nashua River, about 150 ft. long and with a maximum height of 15 ft. The vibrations were at their worst when the water was about 6 in. over the crest, and became less as the depth of flow either increased or decreased. Near this dam, the rattling of windows and general noises in the houses became so marked that the residents threatened legal action, and an engineer was called in to devise a remedy.



SECTIONS OF FRAMINGHAM AND FITCHBURG DAMS

When water flowing over the dams reaches a depth of about 6 in., air vibrations occur which are transmitted for considerable distances, and sometimes rattle windows and dishes in houses. Note almost vertical downstream face of the two dams.

Probably in the cases just mentioned, the lengths of the waves propagated are comparatively long, and these, if occurring at the proper periods, would set material objects in motion and cause them to vibrate in unison with the wave period, in exactly the same manner that a sound wave causes a wire tuned to the proper period to vibrate at that period.

It may not be amiss to refer to a somewhat different variety of movement set up within a water-works system leading to complaints of inability to rest at night owing to noises set up in water pipes in dwellings. Some years ago on the Boston water-works, a complaint of this kind was made, and on investigation it was found that with a hydrant half-opened at night, in order to fill a skating pond at a public park, such a rattling occurred in the meter and pipes in a dwelling about a quarter of a mile away as to demand some relief, which was simple in this case. The tenant of this house happened to be of a sensitive organization, and alone noticed it, as no one else in neighboring houses, even after questioning, appeared to be cognizant of the phenomenon.

Membership of Boston Technical Society

According to the recent report of the executive secretary, the Affiliated Technical Societies of Boston have a total membership of 3,575 as of April 1. However, as there are a number of duplications in the affiliation the total net membership is 3,168. The distribution of members is as follows: Boston Society of Civil Engineers, 932; New England Water-Works Association, 733; Plant Engineers Club, 24; American Institute of Electrical Engineers, 581; American Society of Mechanical Engineers, 913; American Society of Civil Engineers 140; American Institute of Mining and Metallurgical Engineers, 56; Massachusetts Chapter, American Society of Heating and Ventilating Engineers, 35; and Boston Chapter, American Association of Engineers, 161.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Hydrogen Ions

REVIEWED BY HARRY E. JORDAN
Sanitary Engineer, Indianapolis Water Co., Indianapolis, Ind.

THE DETERMINATION OF HYDROGEN IONS—By W. Mansfield Clark, M.A., Ph.D. Baltimore, Md.: Williams & Wilkins Co. Cloth; 6x9 in.; pp. 480; illustrated. $5 in United States, Canada, Mexico and Cuba; $5.50 elsewhere.

The second edition of this book shows no material textual change or addition, but more than nine hundred new references have been added to the eleven hundred appearing in the first edition [which was not noted in these columns—EDITOR]. This in itself is significant of the real importance of the subject matter of the text. Glancing over the Bibliography one realizes anew how wide and active and fruitful is the interest in this subject. The *Journals* of the American Chemical Society, of Biological Chemistry, of Bacteriology, as well as the more practical *Journal* of the American Water Works Association, rarely issue a number in which there does not appear an article based upon studies involving hydrogen ions.

The text is formidable, not in size, rather in its conciseness and strict adherence to the presentation of the scientific facts. An able critic of the first edition regretted that a few brief chapters of simplified theories were not added; many users of the text have regretted that Clark did not add a simple statement on the use of the potentiometer and on the care of electrodes. Those who know Clark realize that he will not deviate one iota from the more purely scientific and theoretical basis by any concession to the practical side. Fortunately there now exists in the literature enough information, simply stated, to guide the somewhat faltering approach, let us say, of the chemist who, instructed in the primitive empiricism of qualitative and quantitative analysis twenty years ago, finds it not easy to keep abreast of the science in its present-day form, admixed as it is with physics and mathematics.

In the field of sanitary engineering the determination of hydrogen ions has had a tremendous influence—not the least important of which has been the mental stimulus to the engineers themselves. It has done more to furnish tools for investigation and rational study of problems of sanitation than anything, perhaps, since the first plate count of bacteria was made. Naturally, there have been a few ill considered applications of these data to certain projects—in one notable case retarding the construction of a much needed water purification plant.

While the applied theories are yielding valuable information in studies of iron removal, softening, and coagulation processes, it appears that no material change in purification structures will develop. As to methods of correctly preparing water for filtration, every day in the year, as well as prevention of red water troubles in distribution systems, knowledge of Clark's text and the allied literature is of great value.

The usefulness of the next edition could be increased by expanding the Bibliography to a series of brief abstracts of the references cited, as has been done in other books. Although this would mean a lot of drudgery on the part of the author it would vastly increase the service qualities of the enlarged book.

Valuable Researches on Ventilation

VENTILATION: Report of the New York State Commission on Ventilation Appointed by the Governor of the State of New York at the Request of the New York Association for Improving the Condition of the Poor and Supported by the Milbank Memorial Fund, C.-E. A. Winslow, Chairman. New York: E. P. Dutton & Co. Cloth; 7x10 in.; pp. 620; 134 line cuts and halftones. $15.

Keep cool. This is the fundamental conclusion of this report as regards ideal conditions of ventilation. Next in order of importance is keep dry and don't worry much about over-dryness—reference here being made to relative humidity. Forget carbon dioxide *per se;* forget also in large degree organic and other impurities in air except when these go to extremes and even then regard these chiefly as having an unfavorable effect upon appetite and inclination to work. Such, in brief, are the main conclusions drawn from the interesting historical review of ventilation theory up to the date of the experiments forming Part 1 of this book and from studies on the effect of various air conditions conducted by the New York State Commission on Ventilation.

That window ventilation is the best method for school rooms is the main conclusion drawn from the many experimental and other data given in the 400 pages of Part 2 of the volume. That is, having established the main desiderata for ventilation in general, the commission devoted the major part of the rest of its studies to a consideration of how a supply of cool air, with reasonably frequent changes, can best be secured for school rooms. The Commission summed up its conclusions on this point as follows:

"In general, therefore, we are forced to conclude that window ventilation with ample direct radiation, window deflectors, and adequate gravity exhaust, seems the most generally promising method for the ventilation of a class room where local conditions permit its use." The conclusion just quoted is based principally upon studies of the sort of ventilation outlined compared with plenum and fan ventilation. Some attention is given to fan exhaust, on which the Commission has this to say: "Such data as we have obtained are not particularly promising along this line." It should be understood that these main conclusions are qualified in various ways by the more detailed discussion given in the report, and stress should be laid upon the fact that so far as window ventilation is concerned its application here is limited almost wholly to school rooms.

The New York State Commission on Ventilation was appointed some eight or nine years ago by the Governor of New York and under the other conditions stated in the heading to this notice. It serves without expense to the state.

The opening chapter of the report is a most excellent and interesting review of the historical development of knowledge in regard to the physiological influences of ventilation, compressed within a very few pages. Those who cannot read French and German will be annoyed, to say the least, by the fact that relatively extensive citations in these languages are given without translation and sometimes without any summary. Another source of annoyance—and this extends throughout the whole of the text of the volume—is the long measure employed, the lines being 5½ in. long and therefore difficult to read.

The division of the report into two main parts has already been indicated. It has also been intimated that each part contains many detailed data. These consist of minute descriptions of the experimental work conducted and the apparatus used together with tabular logs. Further details are given in an appendix.

The conclusions drawn by the Commission in favor of window ventilation of school rooms were very promptly and vigorously challenged at the annual meeting of the American Society of Heating and Ventilating Engineers at Chicago in May, and the president of the society was authorized to appoint a committee to consider the report and submit recommendations regarding it at the next annual meeting. (A brief summary of the discussion may be found in *The Heating and Ventilating Magazine* for June.) It was urged during this discussion that (quoting from the magazine just named) "the Commission had exhausted its funds before completing its work and that the story might have been very different if the plans, as originally outlined, of testing school buildings under a wide variety of conditions, had been carried out." It should be noted that one of the members of the Commission, D. D. Kimball, New York City, is a member of the society.

An important point not yet mentioned regarding the conclusions of the discussion is that observations over some weeks of time showed 18 per cent more absences due to respiratory illness and 70 per cent more respiratory illness among children in the "warmer fan-ventilated rooms" than in the window-ventilated rooms, even though the latter had less per capita floor space than the former.

The report as a whole is a most valuable piece of work and will repay study. Good summaries are given at the end of each chapter. These will enable anyone who cannot read so voluminous a report in detail to get the main results and conclusions in a short time.

An Engineer's Brief for a Stable Dollar

EVERYBODY'S MONEY: What It Is, What It Does and What Should Be Done with It—By Ernest McCullough. New York: G. P. Putnam's Sons. Cloth; 6x8 in.; pp. 175; two plates of line cuts. $1.75.

After writing a considerable number of books on engineering and closely allied subjects, and after war and post-war experience of the evils of inflation and deflation, Mr. McCullough has attempted what may perhaps be best and most briefly described as a popular exposition of Prof. Irving Fisher's plan for Stabilizing the Dollar—recently set forth by the latter in a book bearing the title just quoted and also embodied in a congressional bill. The Fisher plan proposes basing the amount of gold in a standard dollar on a price index, the index to be computed six times a year and the number of grains in a dollar and also the number of dollars in the treasury to be changed accordingly.

To lead up to his final chapter on The Natural Standard of Value, the author reviews briefly, with many apt illustrations, both homely and statistical, the following main topics: Prices and value, money—metal, paper and bank—foreign exchange, war inflation, the business cycle and the price index. A point urged repeatedly throughout is that the voters of the country should gain a knowledge of the fundamentals of the subject and then take the whole matter of stabilizing money out of the hands of the politicians and the speculators, insofar as both classes are to their own profit making use of instability and proffered remedies. That is, Mr. McCullough would have the voters see to it that their representatives in Congress enact legislation for the Fisher plan, or some other plan that would substitute a stable for a "dancing dollar."

The vital importance of the subject and the brevity and clarity of the treatment make the volume deserve a wide reading while the fact that the author is an engineer should give it particular interest to members of the engineering profession.

New Treatise on City Pavements

CITY PAVEMENTS—By F. S. Besson, Major, Corps of Engineers, U. S. Army; Assistant Engineer Commission, District of Columbia. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 421; 199 line cuts and halftones $5.

A quite different line of approach to a discussion of city pavements has to be pursued today than was followed in the older familiar treatises on pavements. Paving materials and pavement construction are still important factors, but the problem of paving a city has been made much more complex by questions of street-system planning, zoning of streets, and weight and volume of traffic. This changed situation is exemplified well in the most recent of treatises on city pavements by Major Besson. Of the 400 pages 100 discuss organization, records, contract practice, street systems, pavement selection, and detail design. It is in these first 100 pages that the engineer old in the service of city street departments will find his greatest inspiration.

Of the three other major divisions of the book one is devoted to bituminous pavements and one to block pavements and the third to concrete, which is the base for both bituminous and block surfaces. In each of these three divisions the plan of presentation, in from four to seven chapters, is (1) materials and tests; (2) design of mixtures; (3) construction plants and methods. Generally the requirements of the American Society for Testing Materials in respect to materials and tests are followed by the author. In discussing concrete mixtures the modern theories of proportioning by fineness modulus and surface area are given along with the methods by voids and proportioning by tables. This chapter on the design of concrete mixtures and that on the design of bituminous mixtures are among the most useful portions of the volume.

Altogether, however, the city paving engineer will get most of value from the sections on administration and management and on planning and design. Major Besson favors a military organization in street administration and emphasizes the use of plans and records. These include topographic, highway-plan and work-progress maps; street, alley and measurement sheets; maps, cost and traffic records. Contracts are fully discussed and

the chapters on street systems, selection of pavements and street and pavement design are notable contributions to the information available to the street and pavement engineer.

Highway Motor Transportation

MOTOR TRANSPORTATION OF MERCHANDISE AND PASSENGERS—By Percival White, Research Engineer; Formerly Manufacturer of Projecta Cars, London, England; Director of Development, Aluminum Manufacturers, Inc., Cleveland, Ohio; and Ordnance Expert, War Department; M. Am. Soc. M. E., Soc. Automotive E., etc. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 486; illustrated, $4.

Highway engineers have need of a general treatise on motor transportation, which it has been the purpose of the author of this to produce, rather than of manuals discussing in more detail single phases of the subject. No engineer of highways is today in a position to plan broadly and to design efficiently without a general knowledge of traffic, of the vehicles which act on the highways and are reacted on, and of transport relations and development, but he does not want details which concern only the automotive engineer or the bus-line manager. Naturally the text is directed more particularly to the manager of motor transportation than to the highway engineer, but even in the discussion of transport problems. specifically, as vehicle design and maintenance, operating organization, routing and scheduling traffic, accounting and insurance, the treatment has, because of the extent of the subject, to be confined to presenting general principles and conclusions which hold interest to the highway engineer.

In presenting his discussion the author aids the reader by an introductory chapter in which are described the outstanding aspects of motor transport which are considered in detail in the succeeding chapters, and by outlines heading each chapter. Both were found by the reviewer a distinct aid in visualizing the plan and contents of the volume and in co-ordinating his ideas later in the more careful reading of the several chapters.

Of the twenty-seven chapters, five relate to the design and maintenance of vehicles, eleven to such fields of freight and passenger service as express haulage, bus operation, etc., and the others to general questions of administration, operation and accounting. Highway engineers will be particularly interested in the chapters on the truck and the railroad, on truck legislation, and on insurance. It is, however, as a general picture of highway motor transportation which the highway engineer needs to visualize that the volume offers most of value.

Trade Associations Explained

TRADE ASSOCIATION ACTIVITIES—Prepared by L. E. Warford and Richard A. May Under the Direction of Julius Klein, Director, Bureau of Foreign and Domestic Commerce. Washington: Superintendent of Documents. Paper; 6x9 in.; pp. 368. 50c.

Much has been heard about the trade association in the past few years. Owing to the inquisitive notice of them taken by the Department of Justice and the condemnatory mention several of them have had by the United States courts, they cannot be said to be very much in favor at the present time. It is a fact, though, as Secretary Hoover says in the preface to this government report on such associations, that their "constructive purposes unfortunately have been confused with the minority of activities which have been used as a cloak for action against the public interest."

The report is, therefore, a welcome corrective. It is intended, according to Mr. Hoover, "to present a picture of the organization, administration and operations of trade associations with a view to meeting the need for public information on the subject and, further, in order that a business facility which is economically useful, when properly conducted, may not suffer discrimination by reason of misapprehensions regarding its purposes and accomplishments." It contains, in addition to the introduction, which outlines the problems and the activities of trade associations, chapters written by various specialists on statistics, legislative activities, standardization, accounting, trade disputes and ethics, employee and public relations, insurance, public relations, traffic and transportation and research. There are, in addition, chapters explanatory of the functions of the government in assisting trade and a suggested form of organization for associations. Appendices contain some historical notes and a directory of such associations as now exist.

The book is the result of an investigation undertaken jointly by the Bureau of the Census, Bureau of Foreign and Domestic Commerce and the Bureau of Standards. It was guided and supervised by a committee headed by F. M. Feiker. Among the other members of the committee were: E. W. McCullough, Chamber of Commerce of the United States; S. L. Nicholson, Electrical Manufacturers' Council; Alfred Reeves, National Automobile Chamber of Commerce; and Nathan B. Williams, National Association of Manufacturers. L. E. Warford was secretary of the committee.

Pioneer British Regional Planning Work

THE DONCASTER REGIONAL PLANNING SCHEME: Report Prepared for the Joint Committee by Patrick Abercrombie, University of Liverpool, and T. H. Johnson, Doncaster, Together with an Appendix on Coal Subsidence by Joseph Humble, Doncaster. London: Hodder & Stoughton, Ltd., for the University Press of Liverpool. Paper; 10 x 12 in.; pp. 93; plates of half tones and maps and colored folding maps. 10s. net.

City planners in America and elsewhere who have been engaged of late in promotional or actual regional planning work will find this report interesting and suggestive. It deals with a part of England that only of late has begun to change from a rural area with Doncaster as its center and a few scattered hamlets and villages to what promises to be a hustling mining and manufacturing district. Doncaster and possibly some of the smaller places have not only begun town planning but have also had the vision and initiative to take up regional planning as well.

Doncaster and other local authorities in the new coalfields district near Sheffield and Leeds, England, on being convened by the Ministry of Health in January, 1920, to consider industrial development in that section, formed a joint town-planning committee composed finally of representatives of nine local government areas. This committee, with the clerks and the surveyors of the several communities, and with the aid of the specialists named above, have produced what Prof. Abercrombie in his Introduction describes as the "first regional planning scheme to be prepared," presumably meaning in England. Reference is made to the South Wales Regional Survey noticed in these columns, Nov. 16, 1922, p. 850, as a demonstration of the need of a plan.

Zoning along unique lines following topography and taking into account land subsidence and other problems incident to a colliery region is a notable feature of the

regional planning scheme. The committee outlines a plan, having as its "general aim" a dozen "self contained and well-defined towns" with Doncaster as the "capital town" and with the intervening areas given up to "agricultural land, small holdings, allotments and playing fields." Three zones are proposed: (1) Industrial, comprising certain low-lying lands; (2) agricultural or industrial, with prohibition of new dwellings "except what are absolutely essential for local agricultural purposes, this zone to comprise land below the 25-30-ft. contour, the exact line to vary with local conditions; (3) a neutral zone, above the 25-30-ft. contour, usable for either housing, commerce or clean industry . . . well-balanced communities being planned as the type of suitable local development becomes apparent." Maximum building heights of 76 ft. for all but the industrial zone are proposed, but with no part of any building projecting "above a line drawn from the center of the street in front at angle of 56 deg. with the horizontal."

Other subjects covered by the report are preservation of certain villages, places of natural beauty and of ruins; road widenings and extensions, including much-needed ring roads, and the fixing of building lines; better railway facilities as regards local traffic (the district already has a notable system of through railway lines, as it has also through highways); improvements of the three waterways of the district; also the provision of civic centers and of regional parks.

The suggestions for regional parks show a timidity that seems to be only partly excused by uncertainty as to the location and needs of future development and the general lack of areas which thrust themselves forward for being set aside because of their eminent fitness as parks and reservations.

From the viewpoint of present-day knowledge of the origin and control of diphtheria one sentence in the report seems inexcusable. In this sentence it is stated that a health survey of the Doncaster region "would probably show that in certain villages in the flood lands such terrible diseases as diphtheria may be said to be endemic." This is incidental and immaterial, so far the main purposes of the report are concerned, but the appearance and usefulness of the many regional plan inserts is damaged by failure to letter the originals for reproduction. The result is that without a magnifying glass most of the lettering on these maps cannot be read. The same is true of the names of minor places on the large colored folding maps at the back of the report.

Finally, the Doncaster regional plan is a commendable piece of work. The report will repay study by city and regional planners everywhere.

Publications Received

Notes on Pamphlets and Reports

Excellent Papers by Leading Highway Engineers are given appropriate dress in the well-edited and handsomely-printed Proceedings of the 1923 convention of the American Road Builders Association. Too commonly the technical society report is a poor example of book-making with little if any editing beyond the clerical process of assembling the material in order of presentation at the convention and correcting the most obvious errors of the convention stenographer. It is in being the direct opposite of these things that this report deserves study by association secretaries and publication committees. It is edited as a high-class technical journal or a scientific book is edited and typography and illustrations are co-ordinate elements of the editorial plan. It is bound and printed in the manner of the better-class engineering books. It is a credit to the growing organization which publishes it.

Rarely Does a Technical Society publish its convention proceedings within less than two months of the date of its meeting, as has the National Conference on City Planning this year. The meeting closed on May 2; the *Proceedings* were out by June 20. (Flavell Shurtleff, secretary, 130 E. 22nd St., New York City; $2.25.)

Nearly a Million Trade Union Members (actually 861,893) are covered in the eleventh annual bulletin of the Bureau of Labor Statistics on Union Scale of Wages and Hours of Labor, May 15, 1922. Figures are given for 66 of the chief cities of the United States, with comparative figures for May 15, 1921, and with summaries by trades going back to 1907. In view of the importance of this and related labor and industrial problems it is a pity that these figures are a year old on publication.

It Pays to Give Vacations With Pay to both office and factory employees according to conclusions drawn from data given in "Employee Vacation Plans." Reports from many manufacturing, commercial, financial and other concerns are briefed separately and 121 vacation plans for (1) executive and office forces and (2) factory employees are summarized in two small tables. (Boston, Mass.: Bloomfield & Bloomfield, Consultants in Industrial Relations; $1.50.)

Airways and Landing Facilities are the subject of a 112-p. illustrated pamphlet recently prepared by the Office of Chief of Air Service, Washington, D. C. While the information is primarily for pilots of air craft some portions of the text are of interest to engineers, particularly those relating to the location, size and construction of air terminals and landing fields. The circular contains a list, by states, of landing facilities throughout the country.

The Populations of the 542 incorporated cities of Kansas and the officials of 514 of the cities, together with lists of the 11 cities having managers and the 46 cities under commission government are given in Bulletin 41 of the League of Kansas Municipalities. (Lawrence, Kan.; $1.)

Public Utility Rates for 542 Kansas Cities, as of Jan. 1, 1923, contains quite a bit of other information regarding 255 municipally- and 6 privately-owned waterworks; 237 public and 179 private electric plants; 7 public and 109 private gas works and 590 telephone stations. (Lawrence, Kan.: League of Kansas Municipalities; $2.50.)

Rehabilitation of the New England Railroads and the operation of them as a regional system is proposed by report of the Joint New England Railroad Committee to the Governors of the New England states, as preferable to consolidation with one or more of the large eastern systems. An abstract of this report appears elsewhere in this issue.

Iron and Steel Statistics, 1919-21, for the British Empire and Foreign Countries and copper statistics likewise are available in pamphlet form. (London: His Majesty's Stationary Office; 1½s. and 3s. net.)

A Spot Map of the 312 Cities in the United States and Canada known to have city managers is a feature of the 1923 Year Book of the City Manager's Association (Lawrence, Kan.: John G. Stutz, secretary; 50c.).

Vestnik Pro Vodni Hospodavstvi (Review of Water Economy) is the name of a periodical issued by the government of Czechoslovakia. Similar publications from other countries are desired by the editor, Ing. Josef Vrba, secretary, Ministry of Education and private professor at the Czech School of Technology, Prague.

Statistics of Income for the calendar year 1921 have just been issued by the Commissioner of Internal Revenue

(Washington, D. C.) as a preliminary pamphlet report devoted to personal income tax returns alone. It has some very interesting information regarding distribution of income by classes and localities.

A MONOGRAPH ON EXPLOSIVES designed to meet the lack of a comprehensive work on the subject has been issued by the Bureau of Mines. The authors are C. A. Taylor and W. H. Rinkenbach and the title is Explosives: Their Materials, Constitution, and Analysis. (Washington, D. C.; pp. 185; one copy free; additional copies 20c. from Superintendent of Documents.

RECONNAISSANCE AND SIGNAL BUILDING, by Jasper S. Bilby, Signalman, U. S. Coast & Geodetic Survey, supplies "information on a subject not fully treated in any previous manual of the U.S.C. & G.S." (30c. from Superintendent of Documents, Washington, D. C.)

CONFERENCES ON SEWAGE TREATMENT have been held annually for four years at Iowa State College, Ames, Iowa, under the auspices of the Engineering Extension Department. Among the six papers read at the 1922 conference and now available as a department bulletin, are The Role of Bacteria in Sewage Purification, by Prof. Max Levine, and The Activated-Sludge Process, by Prof. Edward Bartow.

OUR LUMBER PRODUCTION DECLINE is strikingly shown in the Lumber Cut of the United States, 1870-1920, by R. V. Reynolds, Forest Examiner, and Albert H. Pierson, Statistician, in Forest Products, U. S. Forest Service (pp. 63; illustrated). The cut for 1920 was 27 per cent below the peak production of 1907, and 2.2 per cent below the 1919 cut.

ZONING IS RECEIVING SO MUCH ATTENTION just now as to make two new pamphlets on the subject welcome. In Present Attitude of Courts Toward Zoning, Edward M. Bassett, Counsel, Zoning Committee, New York City, presents a review that would be useful wherever zoning ordinances are being framed or in litigation. Regional Zoning, by Robert Whitten, city planner, Cleveland, Ohio, reviews the extension of zoning to whole districts. (National Conference on City Planning, 130 E. 22nd St., New York City.)

New Books and Revised Editions

ACOUSTICS OF BUILDINGS: Including Acoustics of Auditoriums and Soundproofing of Rooms—By F. R. Watson, Professor of Experimental Physics, University of Illinois. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. 155; 72 line cuts and halftones. $3.

CARATTISTICHE COSTRUTTIVE DELLE TURBINE IDRAULICHE Negl' Impianti Attuati—By Ing. Guido Gambardella. Milan, Italy: Antonio Vallardi. Paper; pp. 133; 17 line cuts.

According to the author's preface, this is not a textbook but rather an attempt to connect recent theory with current practice, showing the relation of recent studies and laboratory tests to methods of construction and installation in use in Europe and America. It is intended to be a guide for students as to the theories now actually put into practice; and for manufacturers in selecting the type of turbine best suited to their needs.

CROWELL'S DICTIONARY OF BUSINESS AND FINANCE—New York: Thomas Y. Crowell Co. Cloth; 6x9 in.; pp. 605. $3; postage extra.

Definitions, mostly short, of thousands of words and expressions current in business and finance and associated law.

FOUNDATIONS, ABUTMENTS AND FOOTINGS—Compiled by a Staff of Specialists; Editors-in-Chief; George A. Hool, S.B., Consulting Engineer, Professor of Structural Engineering, University of Wisconsin, and W. S. Kinne, Professor of Structural Engineering, University of Wisconsin, Assisted by Horace S. Baker, S.B., Chief Engineer, Frank D. Chase, Inc., Chicago. New York and London: McGraw-Hill Co., Inc. Cloth; 6x9 in.; pp. 414; illustrated. $4.

PRACTICAL RAILWAY MAINTENANCE—By Charles Weiss, C.E. New York and London: McGraw-Hill Co. Cloth; 6x9 in.; pp. 349; illustrations and tables. $3.50.

THE DESIGN OF STEAM BOILERS AND PRESSURE VESSELS—By George B. Haven, S.B., Professor of Machine Design, Massachusetts Institute of Technology, and George W. Swett, S.B., Associate Professor of Machine Design, Massachusetts Institute of Technology. Second Edition, Revised. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Limited. Cloth; 6x9 in.; pp. 435; 206 illustrations. $4.

Nineteen pages of text and six illustrations have been added to the present edition. There is a new chapter on "the logical design of a water-tube boiler." The first edition was favorably reviewed by William H. Boehm, of the Fidelity & Casualty Co., in *Engineering News*, June 15, 1916, p. 1135.

Bronx River Bridge Abutment Held by Girder Brackets

By ARTHUR G. HAYDEN
Senior Assistant Engineer, Bronx Parkway Commission, Bronxville, N. Y.

THE May 31 issue of *Engineering News-Record* reports on p. 971 the use of brackets on a deck plate-girder bridge of 34-ft. span near Vienna, Austria, to prevent the overturning of yielding abutments. It may be interesting to know that the same device was used on a Bronx Parkway bridge two years before the Austrian example.

Development of the parkway necessitated moving the channel of the Bronx River in the vicinity of the New York Central R.R. station at Mount Vernon, N. Y., westward about 60 ft. Sherwood Ave. Bridge crosses

GIRDER BRACKET TO HOLD ABUTMENT

the river at this point, and the bridge was moved west to span the new channel. The old east abutment was abandoned and the old west abutment was used as the east abutment (Abutment B) of the relocated bridge, a new west abutment being built. The new river channel was excavated back of Abutment B, and the old channel filled in front of it.

It is thus seen that the direction of the earth thrust on the abutment was reversed, and the abutment was not safe for this condition. The resultant pressure line, including the bridge reaction, came near the edge of the base. Addition to the abutment to increase its stability would have been expensive and unsightly. Therefore the scheme was devised of supporting the abutment against overturning by means of brackets attached to the bottom flanges of the girders.

The brackets were adjusted with slight clearance at high temperature, so as to avoid temperature stresses in the girders due to expansion. Thus, no load will be imposed on the girders unless the abutment actually yields. If this does occur, the abutment will be braced against the new west abutment by means of the brackets at either end of the girders. Calculation shows that the maximum possible load from the brackets might reverse the dead- and live-load stresses in the girders near end of span, but would not exceed safe limits.

Sherwood Ave. Bridge is a four-girder bridge of 55-ft. span with concrete floor, and carries a 32-ft. roadway and two 7½-ft. sidewalks.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Building Height Restriction

Sir—In your issue of July 12, 1923, p. 45, you attempt to discuss "Building Height Uncertainties." Evidently the writer of the editorial has been Rip Van Winkling in municipal affairs for several years past.

He admits that "half a dozen cities have concerned themselves with the question in recent months." Ten times that number would be more accurate. Any city or village that takes up the question of zoning in a comprehensive way must consider height regulation. There are now 145 municipalities of all sizes in this country that have adopted zoning ordinances and nearly that many others have zoning under consideration.

It is hard for a New Yorker to believe, but in that vast unknown territory stretching west from the Hudson River there are quite a number of people. They are not all Indians, either. About a thousand miles west of the metropolis there is a place called Chicago that is nearly half as big as New York. Thirty years ago that village started to regulate the height of its buildings and is still doing it.

"Nowhere, however, has substantial reasoning been brought to bear on the problem. So far as can be judged, esthetic notions are leading factors in the discussion." Rot! If you are to write more for the edification of those interested in municipal problems, you should read up. As a starter on "Heights" read "Studies on Building Height Limitations in Large Cities," by The Chicago Real Estate Board.

A. H. C. Shaw,
Engineer, City Planning Commission.
Columbus, Ohio, July 14, 1923.

Backfilling to Avoid Settlement

Sir—It has been the practice of contractors, corporations, and plumbers, who have occasion to open streets, to place the backfill in such a manner as to cause a mound of earth over the opening, which after a few rains generally sinks into a deep depression, leaving holes in paved streets, which remain in bad condition for a long period of time, causing great inconvenience in the use of the highway, breaking automobile springs and causing accidents.

In order to avoid these conditions, the following procedure, which has been followed by the Office of the President of Manhattan of the City of New York for the past eight years, is recommended.

It is reasonable and advisable to hold the one who makes the opening responsible for its backfilling in such a manner as to avoid settlement. This is the basis of the system proposed. It is accomplished by requiring the contractor, plumber, or corporation who makes an opening to guarantee that there shall occur no settlement in the refilled opening for six months after backfilling. In contracts with the city sufficient money is held back for six months to cover the cost of repaving if it should become necessary. Corporations are required to furnish bonds, and are charged twice in case the repaving of the filled opening becomes necessary within six months. Plumbers are required to deposit a sum equal to twice the estimated cost of repaving. This money is held for six months, and if the filled area is required to be repaved a second time, the work is done by the city and charged against the plumber. If, however, his fill has been made so well that no settlement occurs after six months, he is refunded the balance of his deposit.

Each permittee who opens a street has a financial interest in backfilling in such a manner as to avoid settlement. Eight years' experience in the Borough of Manhattan has demonstrated that by this simple means the backfill is generally done with proper care, and a great saving to permittee and the public generally is effected.

When it becomes necessary to open a public street, application is made at the office of the President of the Borough or the Public Works Office of a city for a permit. An application blank is furnished which contains a statement of the conditions under which the permit is granted, and clearly sets forth the conditions with reference to backfill and double payment therefor. Separate forms are used for corporations and for general permits.

Upon filing the application the permittee is required to make a deposit of twice the estimated cost of paving the opening. This has been estimated in Manhattan as follows:

Opening for water in sheet asphalts	16 sq.yd. @ $5 00	$1 for permit	$81.00
Opening for sewer in sheet asphalts	24 sq.yd. @ 5 00	1 for permit	121.00
Opening for water in wood block	16 sq.yd. @ 6.00	1 for permit	97 00
Opening for sewer in wood block	24 sq.yd. @ 6 .00	1 for permit	145.00
Opening for water in granite on concrete..	16 sq.yd. @ 3.60	1 for permit	58 60
Opening for sewer in granite on concrete.. .. .	24 sq.yd. @ 3.60	1 for permit	87 40
Opening for water in granite on sand	16 sq.yd. @ 1.00	1 for permit	17.00
Opening for sewer in granite on sand	24 sq.yd. @ 1.00	1 for permit	25 00
Opening for water in macadam	16 sq.yd. @ 2 00	1 for permit	33.00
Opening for sewer in macadam.....	24 sq.yd. @ 2 00	1 for permit	49 00

At the time the permit is issued, a report is made up on a special form.

To introduce this system into any other municipality the area will be divided into inspection districts. In Manhattan the districts are such that each inspector is enabled to cover every street in his district at least once a week. A portion of the permit report goes to the district inspector, and the remainder is filed at the office as a tickler. The form contains a page for a preliminary report, and one for a final report, which is made six months after the pavement has been first replaced. Upon this report is based the refund to the permittee. The conditions agreed to by the permittee require that the pavement be replaced within 64 hours after notice by the inspector that the backfill has been completed. In highway contracts that provide for maintenance, a clause is included which provides that cuts must be refilled by the contractor at a stated price within 64 hours after notice by the Commissioner of Public Works of the Borough. When the pavement is replaced by the contractor under the maintenance clause, the report of the area is made by the district inspector, and the permittee is charged with the contract price, plus the cost of the inspection. Where the replacement is made by the city force, record of the actual cost is noted and turned in by the inspector on special forms provided. In these reports the quantities of material used, the labor, and the area repaved is recorded, and forms the basis for the charge against the permittee in a ledger account which is kept in a daily permit ledger which is arranged according to the permit numbers, and gives the exact charges and credits against the permit until entirely satisfied after each six months' replacement. This ledger shows the cost of the original replacement, and any additional costs for an additional replacement, as well as the sum deposited by the permittee. The balance due the permittee is also recorded, and the sum he is allowed to liquidate by application to the Comptroller upon certification of the Commissioner of Public Works that the account is ready for liquidation, having passed final inspection, is the balance shown upon this ledger.

By the tickler system, at the expiration of six months the inspector is notified to report upon the condition of the opening which report is made upon a special form.

The application of this system depends upon frequent and efficient inspection, without which it would fail. It is believed, however, to be as good a system as can be recommended, if strictly enforced, and is applicable to any city where the one who makes a street opening is required to pay the cost of repaving the opening.

Louis B. Manheimer,
Assistant Engineer, City Planning Bureau,
Borough of Queens, City of New York
Long Island City, N. Y.,
July 1, 1923.

How to Get Apprentices

Sir—Your editorial "Who Restricts Apprentices?" in the issue of July 12, 1923, p. 45, is very much to the point. It directly touches a point familiar to all interested in building work from its many angles. The condition in New York certainly must be typical of the general condition throughout the country.

It is not possible for one man to find or fix a cure for the existing condition. However, if a sufficient number of people throughout the country would think about this condition and then act, first by publishing their opinions, then by following their publications by co-operative action, some definite results could be obtained. For instance, in our local territory, and we serve in and throughout Maryland, parts of Pennsylvania and West Virginia, the lack of apprentices in the various trades cannot be blamed entirely upon unions or contractors or that portion of the younger generation from which apprentices are usually drawn, but all are responsible. It would be foolish to claim that union rules control the number of apprentices when there are not sufficient apprentices to fill the vacancies which are at present in existence.

Take the situation in our own city of Cumberland, there are no apprentices available for the bricklayers' trade, we know of no apprentices in the plasterers' trades, and so it goes throughout all of the various building trades. It would be foolish to blame the lack of apprentices on the contractors of this city because there is sufficient co-operation between contractors and the various unions to insure completion of any job and incidentally to insure placing of any available apprentices. Also the contractors would be cutting their own throats if they did not endeavor to bring prospective apprentices to the notice of the various unions.

It will be recognized as a fact that the young people of the present age are more interested in dancing and white-collar jobs, so-called, than they are in such work as bricklaying or any other mechanical trade. In every college there are students trying to be lawyers, architects, or other professional students who could better be plumbers, bricklayers or mechanics. If every college were fitted with a mechanics or trades department a portion at least of these students who find they are fitted for a mechanical line or discover their ambition while students could very readily take up their choice of studies in the college in which they are entered. Then, too, the proper incentive of a large percentage would be put before them at a time when it would do the most good. Many young men who start out in life experience several changes of vocation in the first four years of business life. This, of course, does not hurt them but gives a valuable knowledge of men and conditions. It only delays the individual in the finding of a proper and suitable vocation for which he is most suited. This thought was confirmed by a recent editorial in your paper wherein it was stated that a large number of men were going back to or into the trades.

It seems, therefore, to be up to all concerned to encourage the mechanically inclined to choose a trade at an early day in life. If all of the boys graduating from technical or mechanical, engineering or architectural, courses would serve from three to four years in any one of the building trades before taking up their engineering vocation, the need for apprentices would constantly be met and these young men would then have a practical and efficient foundation for their chosen vocation in their respective professions.

The answer to "Why is a student?" is probably that said student desires or has the ambition to get above the other fellows and so studies for a number of years to get himself there by the quickest road, but the true student is a life student and therefore four years spent in practical work in any trade would not be a handicap, and incidentally the average mechanic now commands more during his apprenticeship than the average engineer in the first year of his career. The worthy apprentice will eventually rise above the trade, especially those who have been through a higher college and obtained a degree, and all of them will be more efficient and capable for the experience gained during their apprenticeship.

J. B. Brower, Jr.,
Architect.
Cumberland, Md., July 14, 1923.

High Cost of Detours

Sir—High cost of detours in constructing roads in Wisconsin is analyzed in an impressive manner by N. M. Isabella in your issue of June 21, p. 1088. The subject is one to which very inadequate attention has thus far been given and it is to be hoped that Mr. Isabella's presentation and your editorial comment will go far toward giving the subject its proper place in the economics of road construction.

Mr. Isabella's estimates are quite conservative; in fact too conservative. He makes no estimate as to the cost of maintaining detours in passable condition or as to the increased cost of operating the motor vehicle over detours due to bad grades and unsatisfactory road surfaces. These items would undoubtedly swell the total considerably to say nothing of the time loss and annoyance to users.

In suggesting the methods of reducing the penalty imposed upon the traveling public Mr. Isabella entirely omits the one mathematically certain method of reducing the detour period, namely, that of changing the type of construction from portland cement concrete to a type which does not have to be shut off from traffic while it is curing. As stated by Mr. Isabella fourteen days are required for this curing process in Wisconsin and in some other states as high as twenty-one days are required for this purpose. Asphaltic concrete on the other hand may be thrown open to traffic upon its completion. Fourteen days cut from the 81.6 days average mentioned by Mr. Isabella would result in a saving of $630,000 and if there is any merit to my statement that additional costs are involved in the maintenance of the detours, in the increased operating cost of the motor vehicle and in the lost time by the road users it may reasonably be stated that the substitution of asphaltic concrete pavements would result in a saving of $1,000,000 in the item of detours alone. What is true of Wisconsin is true of any other state and it must be quite evident that the detour penalty we are placing upon our traffic throughout the United States runs far up into the millions of dollars.

If the asphaltic concrete type of pavement were experimental I should not make the suggestion that it be considered. It is a matter of service record that this type of pavement has been in use for upwards of forty years. In the City of Visalia, California, is a pavement of this type laid in 1894 which has cost nothing for maintenance and is now in excellent condition. Millions of yards of this type have been laid on the Pacific Coast and while it has not been extensively used in the East, remarkable results have been obtained where it has been laid. In Erie, Pennsylvania, a section which had been down over thirty years and which was in good condition was recently taken up on account of changes in underground service.

Because of its flexibility and its water-resistant quality the asphaltic concrete pavement is seldom laid to a total of more than 6 in. The usual thickness is 5 in. made up of 3-in. base and 2-in. asphaltic concrete top or 3½-in. asphaltic concrete base and 1½-in. sheet asphalt top. Where the subgrade is of a water holding soil it is customary to lay a course of 3 or 4 in. of broken stone. This would be desirable on some of Wisconsin's roads but on the whole it should be possible to adapt this admirable type to the Wisconsin program with little increase in the construction costs.

Apart, however, from the merits of the asphaltic or portland cement concrete types of pavement it can scarcely be contested that the item of detour costs should certainly be taken into account in the selection of a type of pavement rather than to be considered after it is too late to weigh it as an economic factor in the selection of type.

I make the foregoing suggestion not in a spirit of criticism of the portland cement concrete type of pavement but because I believe the highway engineering profession and the tax-paying public will profit by a discussion which will bring out the economics involved in this phase of road construction.

J. E. Pennybacker,
Secretary, Asphalt Association.
New York, July 3.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The Public Service Corp. of Quebec has announced that the name of the Quebec Railway, Light, Heat & Power Co. will be changed to the Quebec Power Co., and its capital increased from $3,000,000 to $10,000,000. No information is at present available as to why this increase in capital is being made.

Judgment of $161,187.31 to the C. S. Lambie Co., engineering and contracting firm, Denver, Colo., has been granted as money due on contract for the large reinforced-concrete building erected by Lambie for the L. R. Steel Co., the company going into the hands of a receiver about the same time that the building was completed.

A preliminary permit and license to develop 360,000 hp. on the Susquehanna River near Conowingo, Md., has been granted to the Susquehanna Power Co. by the Federal Power Commission. The preliminary permit gives the company priority over other interests which might seek rights to develop this power. If the final permit is approved the development, which calls for an expenditure of approximately $30,000,000, will be started at once.

The Milwaukee Harbor-Rail Committee was organized by the Milwaukee Harbor Commisson on the recommendation of the Milwaukee chapter of the American Association of Engineers, not at the request of the Milwaukee Society of Engineers as stated in *Engineering News-Record* May 31, 1923. J. A. B. Tompkins, representing the Harbor Commission as its consulting engineer, is chairman of the committee.

The Hudson & Manhattan Railroad Co., has declared its first half-yearly dividend of 2½ per cent on its preferred stock. This railroad which operates two tubes under the Hudson River between New York and New Jersey was constructed at an average cost of $3,500,000 a mile. Recent large increases in the passenger traffic and an increase in fares granted by the Interstate Commerce Commission are responsible for this improvement in the railroad's financial condition.

To Help Relieve Traffic Conditions in New York City the parked strips in the center of Park Ave. are to be narrowed from 56 to 20 ft. by taking 18 ft. off each side. The narrowing will extend for the eleven blocks from 46th to 57th St. An appropriation of $1,661,000 for the work was made by the Board of Estimate the latter part of June. The high cost is said to be due to the necessity of carrying supports for the roadway to the track level of the New York Central some 40 ft. below. The sub-surface work will be done by the railway.

Pinchot Vetoes Engineers' License Law Repeal Bill

On July 12 Governor Pinchot of Pennsylvania vetoed the bill passed by tho recent session of the Pennsylvania Legislature repealing the engineers' registration and license law.

R. H. Keays Is Chief Engineer of Moffat Tunnel Commission

R. H. Keays has been appointed chief engineer of the Moffat Tunnel Commission; and Major L. D. Blauvelt, state highway chief engineer of Colorado, has been added to the consulting board of the Commission, the other members of which being D. W. Brunton, J. V. Davies, and J. Waldo Smith.

Mr. Keays was assistant general superintendent for the Ulen Contracting Corp. on construction of the Shandaken Tunnel for the Catskill water supply of New York City. He was born in 1874 and is a civil engineer graduate of Cornell University. He spent several years in Porto Rico and Cuba and was, in 1900, in direct charge of the design of the sewer and water systems of Havana. Previous to that he was an instructor in mechanics and hydraulics at Cornell University and engineer on field work on Hydraulic surveys and sewer systems in New York State.

Hirst-Potts Hearing on Trenton Sewage Works July 24

The charges brought against Clyde Potts, an engineer-member of the New Jersey Board of Health, by H. Jerome Hirst, of the Direct-Oxidation Disposal Corp., alleging that Mr. Potts held up the Trenton sewage-works plans because he was refused stock in the company, will be heard by the Board at Trenton, July 24, at 10:30 a.m., daylight-saving time.

Order Restraining Shopmen in Strikes Made Permanent

A sweeping temporary restraining order, affecting 400,000 railroad employees and officers of the shop crafts unions, has been made permanent by the final decree by Judge Wilkerson of the Federal District Court in Chicago. "The significance of the order," says Attorney General Daugherty, "is not its application to the present shopmen's strike, which theoretically is still in existence, but in its effect on future strikes as a matter of precedence. It not only enjoins the strikers from interfering with railroad properties, but also enjoins them from interfering with the railroads' business, from picketing, from parades and meetings, letters, telegrams, telephone messages or any other acts that would interfere with or incite against the operation of the railroads."

Am. Soc. C. E. Protests Removal of A. P. Davis

Convention Adopts Resolutions Against Converting Reclamation Service Into Political Machine

In protest against the summary dismissal of A. P. Davis from the position of director of the U. S. Reclamation Service, the American Society of Civil Engineers at its annual convention in Chicago, July 11, adopted by unanimous vote the following resolution and statement prepared by the Board of Direction.

"Whereas, the director, formerly chief engineer, of the U. S. Reclamation Service, has recently been summarily dismissed by the Secretary of the Interior, apparently without a hearing, after a connection with this Service since its organization over twenty years ago—this Service being a Bureau charged with the construction and operation of engineering works, and

"Whereas, this summary dismissal of the head of a technical bureau, apparently without a hearing, may be made the precedent for other similar removals when prompted by political expediency; and because the engineering profession is deeply concerned in the wise and efficient direction of public works,

"Resolved, That the Board of Direction of the American Society of Civil Engineers approves the action of its executive committee in appointing a special committee to collect additional facts and report further upon this matter."

The Board submitted for the information of the annual convention the following statement:

"The Reclamation Service has had an honorable and a creditable career of over twenty years. Its conduct during that period has been under the constant surveillance of the officers of the national administration, of members of congress and of the residents of the numerous communities in which the projects have been constructed.

"The nature of its operations is such as to arouse the watchful care of those who are to be served and the active opposition of those whose interests might run counter.

Scandals Lacking

"Throughout this long period there has been no scandal and no sustained charge of lack of faithful loyalty to public interests. The works erected and the precedents established serve as worthy examples for our own country and have been used as a guide in such developments in other lands. The personnel of the Service has been remarkably loyal, conscientious and devoted to a high standard of public service. The dismissed director has been either chief engineer or director since the establishment of the work in 1902, and was at least entitled to a written statement of reasons for dismissal as provided in civil service regulations, and as required in proper administrative practice.

"The reported reason of better business administration advanced for the replacement of the Director by a successor under the new title of Commissioner, appears to be a pretext which is refuted by the long and honorable business record of the Director dismissed, in comparison with such record as we can obtain of the appointee selected to succeed him. The implication that engineers are not competent business administrators is refuted by numerous engineers who today are conducting as executives, many of the great railroad systems, public utilities and industrial enterprises of this and other countries, and the U. S. Reclamation Service is peculiarly an engineering enterprise.

"The Board fears that any pretext of better administration could only be regarded as a perversion of the proper precepts of a rightful economy to suit the needs of an ever present political situation.

"The Board deplores the action taken by the Secretary of the Interior, for the following reasons:

1. That it will work irreparable injury to the public service in the breakdown of morale and confidence of public employees.

2. That it is an injustice to a man who has given forty-one years of faithful and valuable service to the Government of the United States.

3. That arbitrary methods of removal are not creditable to a popular government based upon equality and fair dealing.

4. That the change now inaugurated bears evidence of an attack upon a worthy and highly creditable branch of the government service to serve political needs.

5. That the conversion of the Reclamation Service into a political machine would result in the withdrawal of public confidence and national financial support with the resultant injurious effect upon the development of the West."

Alabama Power Co. to Build 132,000-Hp. Plant

The new hydro-electric development which the Alabama Power Co. has announced it will build at Cherokee Bluffs on the Tallapoosa River at a cost of about $10,000,000 will, with the exception of the Muscle Shoals development, be the largest hydro-electric plant in the South. Its ultimate capacity will be 132,000 hp. The initial installation will be two 44,000-hp. units. A dam 800 ft. long, 120 ft. high, and containing 200,000 cu.yd. of concrete will form a reservoir covering 22,500 acres and holding about 25,000,000,000 cu.ft. of water.

Twenty-five miles of railroad are to be built to give access to the site.

New York Has New Transit Bureau

As a check on the state-controlled Transit Commission the Board of Estimate of New York City has appointed a transit bureau consisting of the dock commissioner as chairman, the president of the Board of Aldermen and the chief engineer of the Board of Estimate.

The new bureau is to handle all negotiations between the city and the Transit Commission.

Robert W. Hunt Dead

Robert Woolston Hunt, head and founder of the nationally known inspection firm bearing his name, died July 11, just one day after the Board of Direction of the American Society of Civil Engineers had made him an honorary member of the Society. Captain Hunt was born Dec. 9, 1838, in Fallsington, Pa., and spent several years learning the practical side of iron making in the rolling mills of John Burnish & Co., Pottsville, Pa. Later he took a course in analytical chemistry in the laboratory of Booth, Garret & Blair, upon the completion of which he entered the employ of the Cambria Iron Co., Johnstown, Pa., and for them in 1860, established the first laboratory in America as a direct part of an iron or steel organization.

In 1861 he entered the U. S. Military Service and was in command of Camp Curtain at Harrisburg, Pa., with the rank of captain. Upon being mustered out of service he returned to the employ of the Cambria Iron Co. at Wyandotte, Mich., where experiments with the new Bessemer process of making steel were being conducted. He was in charge of the experimental works in 1865, and so continued for a year, when the Cambria Company called him back to Johnstown to take charge of their steel business. It was at this mill later, and largely under Mr. Hunt's direction, that the first commercial order for steel rails ever made in America was rolled.

With Bessemer Works

Later he assisted in designing and building the Bessemer works at the Cambria plant, and in 1873 moved to Troy, N. Y., becoming superintendent of the Bessemer works of John A. Griswold & Co. and in 1875 he became general superintendent of the Albany & Rensselaer Iron & Steel Co. During those years of active connection with steel rail manufacture, he almost completely rebuilt the various works of this company, and also patented many details of iron and steel metallurgical processes and machinery, including, in conjunction with others, the first automatic rail mill tables.

In 1888 he removed to Chicago and established the bureau of inspection, tests and consultation, now known as the Robert W. Hunt Co.

Mr. Hunt was twice president of the American Institute of Mining and Metallurgical Engineers; past president of the American Society of Mechanical Engineers; past president of the American Society for Testing Materials and past president of the Western Society of Engineers. He was also a member of various other technical societies both in this country and Europe.

In 1912 he was awarded the John Fritz Medal (for his contributions to the early development of the Bessemer process) and in June of this year he was given the Washington Award of the Western Society of Engineers in recognition of his achievement. He was for many years a trustee of the Rensselear Polytechnic Institute, and in 1916 received from it the honorary degree of Doctor of Engineering.

Turner Reports on New York Suburban Traffic

Some important features of the suburban traffic problem of New York City and environs are dealt with in the preliminary report on the Metropolitan Transit Plan submitted to the New York City Transit Commission by D. L. Turner, the consulting engineer of that commission. Mr. Turner's study is still in its early stages and no attempt has been made to answer any of the pressing questions of the suburban traffic problem. Some general conclusions are, however, considered practical at this time and are therefore included in his preliminary statement.

The report outlines the area covered in the study, roughly the parts of New York, New Jersey, and Connecticut within a 50-mile radius of the City Hall, estimates its future population, and gives a summary of the present traffic flowing into New York, and a review of the conditions surrounding the passenger service as regards the number of trains per hour during rush hours and the requirements for handling these trains if they were operated in subways in Manhattan.

The report closes with a statement of the following general conclusions: (1) that ten years hence it will be impossible to accommodate the 600,000,000 or more suburban passengers per year with the facilities that now exist; (2) that it will be impossible to take care of this traffic on the city transit lines, for it will be as much as the city can do to obtain facilities for the traffic originating within its limits; (3) that it will be impossible to inject the suburban traffic into the city transit lines by extending them into the territory now served in part by these suburban lines, for under such conditions the trains would be filled to capacity before they reached the city limits; (4) that in order to accommodate this suburban business it will be necessary either to provide additional terminals for accommodating it or to shunt it all past the existing terminals and provide separate and independent collecting and distributing systems traversing central Manhattan, for the exclusive use of the suburbanites now served by the steam railroads; (5) that the second of the two alternatives mentioned above is the proper basis on which to develop the metropolitan transit plan, while adoption of the first alternative would only tend to increase the congestion on the city transit lines, thereby throttling those facilities.

Public Works and Highway Bodies Separated in California

The California Highway Commission was divorced from the Department of Public Works and the state engineer was made head of the latter department by a bill passed by the recent California legislature and immediately signed by the Governor. This action restores the departments involved to independent operation as they were before the passage of the law in 1921 that combined all engineering functions of the state under the Public Works Department and made the state highway engineer head of that department. A report of the combination appeared in *Engineering News-Record* July 28, 1921, p. 167.

Engineering News of the Railroads

Capital Expenditures of the Pennsylvania system for enlargements and improvements in 1922 were restricted to immediate operating necessities, but these expenditures on roadway and structures amounted to $5,272,483. The annual report states that "much larger expenditures must be made in 1923." The improvements include line revision from Lemoyne to Shippensburg, Pa.; rearrangement of terminal facilities and track elevation at Pittsburgh; classification yard at Sharpsburg; delivery yard at Kearney, N. J.; elimination of grade crossings at Cornwells; shop and engine terminal facilities at Enola, Altoona, Pitcairn and Hagerstown; pier, grain elevator and freight yard at Baltimore; second track and revision of line and grade on Cleveland & Pittsburgh line; construction of low-grade line from Kenwood to Rochester, and track elevation at Indianapolis, Ind.

Completion of Negotiations as to the disposal of the Morris Canal is noted in the annual report of the Lehigh Valley R.R. In March, 1923, the railroad company transferred to the State of New Jersey the ownership of the Morris Canal & Banking Co. and cancelled its lease of the canal property made in 1871. The agreement with the State permanently established the railway company's title to the "Big Basin" property in Jersey City, on the Hudson River, an important terminal site upon which are piers and other facilities. In addition the company retains the canal right of way through Jersey City and Bayonne, reaching a growing industrial section, and part of the canal right of way at Phillipsburg; but it is relieved of taxes and maintenance of canal property for which it had no use. This means a saving of approximately $300,000 annually. To secure these favorable terms the company relinquished the balance of the canal right of way, the "Little Basin" on the Hudson River, the water rights of the canal company, and agreed to pay the State $875,000 in five annual installments.

The Chicago, Indianapolis & Louisville Ry. started work on its track elevation at Indianapolis last year and will continue it during 1923. This will necessitate the construction of a new freighthouse, with team facilities at the street level and tracks and platforms on the upper floor.

The Buffalo, Rochester & Pittsburgh Ry. in 1922 reinstated its policy of general improvement, which had been in abeyance for some years, and will continue the work through the present year. This work includes strengthening steel bridges, replacing timber bridges and trestles with permanent structures and improving the track with heavier rails and stone ballast. The improvements carried out in 1922 included $170,000 for sidings and yards extensions, $26,500 for bridges, $135,280 for rails and ballast, $53,237 for a coal handling plant at Rikers, Pa., $44,340 for shop machinery and tools and $15,014 for the Brown St. subway at Rochester.

The Delaware, Lackawanna & Western R.R. annual report states that a reduced expenditure for additions and betterments in 1922 is "due to the fact that previous liberal expenditures of this character were for construction of such a permanent value that it was not found necessary to make as great expenditures for these purposes as were required in preceding years."

Improvement Work Now in Progress on the Louisville & Nashville R.R. and expected to be completed in 1924 includes 15.48 miles of second track between Hazard and Lennut, Ky. (with three tunnels paralleling existing tunnels); second track and reduction of grade from Bailey's to Wallsend, Ky., 16.63 miles; and new bridge over the Great Rigolets Pass on the Gulf Coast. New yard facilities at Ravenna, Ky., are expected to be completed in 1923.

The Chicago, Rock Island & Pacific Ry.'s most important item of new work is the double-tracking between Topeka and Herington, 70 miles, about half of which will be completed in 1923. A large capital expenditure will be required by the decision to use oil fuel in Arkansas and Louisiana, but it is stated that the saving in cost of oil as compared with coal will make this a productive expenditure. Studies are being made to convert other divisions to the use of oil. Additions and betterments in 1922 totaled $2,590,533 for road and $10,764,747 for equipment.

The Texas & Pacific Ry. Is Carrying out a program of strengthening embankments and 811 miles were widened to standard width during 1922. Stretches of line were raised and waterways increased 50 per cent on account of floods in the Trinity River valley, while owing to the floods in the lower Mississippi valley during May and June, 1922, a large part of the maintenance forces were engaged in raising and strengthening the levees.

The Chicago Great Western Ry. Reports that it will ultimately acquire the Mason City & Fort Dodge R.R., having made a settlement with the bondholders. The Chicago Great Western Ry. can now go forward with many capital improvements which are needed by the Fort Dodge line but for which there was no provision in the former lease.

Preliminary Work For a New double-track bridge over the Mississippi River, to replace the present bridge at Fort Madison, Iowa, is noted in the annual report of the Atchison, Topeka & Santa Fe Ry. The cost is estimated at $4,000,000. The report states that this new double-track bridge "is imperatively required by the density of the traffic over the Chicago-Kansas City line and the heavy power necessary to haul it economically." Soundings and preliminary studies for the location of the bridge are now under way.

The Kansas City Southern Ry. Co. Has Been Denied permission to abandon 1.5 miles of its railway into Independence, Mo.

A Steel Side-Wheel Car Transfer Steamer is being built for the New Orleans, Texas & Mexico Ry. for transferring cars across the Mississippi River at Baton Rouge, La. This vessel is 340 ft. long and 91½ ft. wide over the guards, with three tracks, giving a capacity of eleven large passenger cars or twenty freight cars. The steamer, which is to be put in service this summer, was built by the Dravo Contracting Co., Pittsburgh, Pa., at a cost of about $255,000.

The Baltimore & Ohio Has Applied to the I.C.C. for authority to abandon 9.3 miles of the Bedford, Md., Branch, claiming that the traffic does not justify the heavy maintenance charges, and for authority to sell 1.5 miles of its line in Bedford to the C. I. & L. Ry. Co.

The Oregon Short Line R.R. Co. Has Applied to the I.C.C. for authority to construct a railroad from Rogerson, Twin Falls County, Idaho, to Wells, Elko County, Nevada, a distance of 98 miles, in order to provide an additional outlet to the highly developed irrigated districts of Southern Idaho.

Authority Has Been Granted to the Southern Pacific R.R. by the I.C.C. to construct a branch line in Kern County, Calif., from Magunden to a point near Arvin, a distance of 17.64 miles. Construction is to begin before July 1, 1923 and be completed by Dec. 31, 1923.

The First Electrically-Operated Train on the Chilean State Railways recently made a successful trip from Santiago to Tiltil and return, a distance of 24 miles. President Alessandri of Chile was at the controller and the American ambassador was a passenger on the train. The order for the equipment for this railway was placed with the Westinghouse Electric & Mfg. Co. in 1921. The total mileage to be electrified is 144.

The Norfolk & Western Ry. lists 130-lb. rails on 115 miles of track and 100-lb. rails on 1,516 miles, of which 70.5 and 221.4 miles were laid in 1922.

Creosoted Ties and 136-lb. Rails are noted in the annual report of the Lehigh Valley R.R. Continued use of treated ties has reduced materially the number of annual renewals, and only 245,848 ties had to be placed during 1922. At the end of the year the railway had 5,953,827 creosoted ties, or more than 64 per cent of the total number, while 415 miles of track were laid with 136-lb. rails.

Valuation on the Erie R.R. Is Practically completed and the annual report of the company states that the Bureau of Valuation, Interstate Commerce Commission, has finished for informal review the engineering reports of physical improvements. These reports are being reviewed. Land reports upon the entire system were expected within a few months. The field work was practically finished by the end of 1922 and the entire work about 85 per cent completed. The cost of Federal valuation at the end of 1922 was $1,143,492, of which $745,487 was charged to operating expenses, the remaining $398,005 having been assumed by the U. S. Railroad Administration during the period of Federal control.

A Reduction of 102 Miles in the distance between Toronto and Winnipeg by the Canadian National Railways is being effected by the construction of the 29½-mile Long Lake cut-off, north of Lake Superior, connecting the two main lines of the former Canadian Northern Ry. and National Transcontinental Ry. The contract for grading, bridges and culverts was let in December, and work is reported as progressing favorably. The new line has economic advantages in addition to reducing the mileage.

Random Lines

Thanks for the Ad

Simeon Strunsky, the genial and erudite editor of the New York *Evening Post*, has been traveling into New York over the Long Island Ry. and after the custom of all good editors he has been looking out of the car windows for copy. In consequence, the engineer is indebted to him for the following appreciation:

The deluded archæologist will write the history of America from the ruins of the Woolworth Tower and the history of Forest Hills from the pink concrete arches of that over-powering railroad station. No one ever excavates market gardens or wheat fields or olive groves. The engineer and the mason hold a corner on history.

The engineer, the mason and the concrete mixer deserve the posthumous credit they are in for, and especially the engineer. He is about the only man who can lift himself by his bootstraps; that is to say, he is the only man who can keep traffic going along an old railroad while he is building a new one. In the region of trans-Jamaica the engineer and the contractor are now engaged in laying new trackage, elevating and depressing roadbeds, throwing lines of shining new railway ties across the ruins of promising park "developments"—and all the time managing to get commuters all into Pennsylvania Terminal and back to their homes almost on schedule; almost, though not quite. The engineer runs his trains over apparently precarious sand piles and around the most casual corners, and the switches grind, and the train halts here and spurts there, and outside the window low-grade Mediterraneans and Alpines in sweat-soaked undershirts dig, and shovel, and heave, and drag, and you get home almost in time—almost, though not quite—and some day there will be a fine new four-track railroad built under your flying wheels.

Perhaps that is what people mean when they want the engineers to tackle the job of world reconstruction. If anybody can somehow manage to keep the old world going while building a new one under its feet it ought to be the engineers.

* * *

A French scientist, returning home from a visit to New York, says that stray electric currents there are undoubtedly affecting the nerve and brain capacity of New Yorkers. There are plenty of Americans who will admit that New Yorkers have nerve, but brains—well, the French were always a polite people.

* * *

The Discussion Was Limited

Everyone who was at Chicago last week seems to agree that the American Society of Civil Engineers' meeting there was a success. And yet—the technical discussion consisted of the presentation of six papers in 2½ hours and ten papers in 3 hours. According to one member, the audience only opened its mouth to yawn.

City of Baltimore Reorganizes Highways Department

The Highways Department of the City of Baltimore has been reorganized under the direction of Bernard L. Crozier, recently appointed highways engineer. Eighteen positions have been abolished and two created, meaning a reduction of $26,100 in salaries annually. The post of assistant highways engineer, with a salary of $3,800, is created. It will combine the work of the bridge engineer, department engineer and division engineer of highways. J. Wilson Richardson, bridge engineer, has been appointed to the position. Steuart Purcell, recently appointed chief engineer of Baltimore, formerly filled the position of division engineer of highways. Thomas J. O'Connell was department engineer.

Highway Engineering Fellowships Offered by Michigan

The University of Michigan Graduate School offers again this year according to an announcement by Arthur H. Blanchard, professor of highway engineering and highway transport, the following fellowships: Roy D. Chapin Fellowship in High Transport, Roy D. Chapin Fellowship in Highway Engineering, and Detroit Edison Fellowships in Highway Engineering. Of these, two will be awarded not later than Sept. 10 and two not later than Nov. 1, to holders of Bachelor's degrees from college or university. Each Fellowship carries an allowance of $300 with no tuition to pay, and leads to the degree of Master of Science or Master of Science in Engineering.

Main Reservoir on Hetch Hetchy Project Fills in Three Weeks

THE siphon spillways in O'Shaughnessy Dam on San Francisco's Hetch H tchy water supply project began to spill on May 25, three weeks after closure of the valves in the dam. The eighteen siphon spillways each have a capacity of 1,000 sec.-ft. and are built with a 3-in. difference between the throat levels of successive siphons. Thus the capacity of the spillway as a whole will increase as the reservoir level rises. The crest of the dam is at El. 3726½ and the present reservoir level is at El. 3721, at which height the reservoir capacity is 65,000,000,000 gal.

New Phase of Work on Plan for New York and Environs

By Oct. 1 the Committee on the Plan of New York and Its Environs expects to have completed its various preliminary surveys and to begin active planning work. Thomas Adams, the British town planning expert, who has been chairman of the Advisory Planning Group of the committee since Jan. 1, will become general director of plans and surveys on Oct. 1, when Frederic P. Keppel, who has been acting as executive secretary, will retire to become president of the Carnegie Corporation. Frederic A. Delano, formerly president of the Wabash R.R., has already succeeded Charles D. Norton, deceased, as chairman of the committee. Nelson P. Lewis, formerly chief engineer of the New York City Board of Estimate, and other staff members, will continue with the committee.

Rail Committee Against Outside Control of New England Roads

On railroad consolidation as it affects New England the Joint New England Railroad Committee has presented a report to the governors of the six states which is adverse to any consolidation which will turn the railroads of that section over to one of the large trunk lines having its principal interests outside of New England. The committee suggests that New England should run its own roads and with this idea in view it proposes a rehabilitation of the Boston & Maine and the New Haven, state help by the remission of taxes and a guarantee of certain charges, federal aid by a reduction of interest rates, and a sort of trusteeship by men appointed in quotas by the several states. If consolidation with a trunk road is made necessary by legislation or other conditions then the committee recommends that the consolidation be made with the Pennsylvania system.

Colorado River Action May Follow Flaming Gorge Permit Issuance

By granting a preliminary permit to the Utah Power and Light Co. covering its Flaming Gorge project on Green River, the Federal Power Commission has inserted the thin edge of the wedge which is expected to lead to action on the Colorado River projects. Regardless of what Arizona may do with regard to the ratification of the Colorado River compact, it is believed that the Commission will award this fall the Girand license, covering the large development proposed at Diamond Creek. It is believed also that the upstream states could not insist successfully that the Arizona project be held up when they have urged the granting of the Flaming Gorge permit. Prominent officials of both Utah and Colorado now are urging the granting of that permit.

The load of the Utah Power and Light Co. has been increasing at such a rate that a steam auxiliary must be put into operation in the near future. Unless the Flaming Gorge development is allowed to proceed as rapidly as possible, it will be necessary to construct additional steam units. It is to avoid this latter situation that so much pressure has been brought to permit the company to proceed with its foundation explorations at Flaming Gorge.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 15-17.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga.; Nov. 12 to 16.

The American Society of Agricultural Engineers will hold its annual meeting in Chicago Nov. 8-10. Principle discussions will include farm power and equipment and farm structures, rural electrification and reclamation, and the problems of teaching and extension and research work. The society's secretary is Richard Olney, St. Joseph, Mich.

The Engineers Club of Baltimore has elected the following officers: president, Earl Stimson; first vice-president, Henry G. Perring; second vice-president, G. J. Requardt, and treasurer, Robert B. Rifenberick.

Personal Notes

F. H. ROOD has been appointed engineer of tests of the Pittsburgh, Pa., Testing Laboratory, with headquarters in Pittsburgh. Mr. Rood is a civil engineer graduate of Syracuse University. For many years he was engineer of tests of the New York state highway commission, for three years he was assistant engineer of tests of the Pittsburgh Testing Laboratory, and for two years a research engineer with the U. S. Bureau of Public Roads.

C. W. CREEKBAUM, recently appointed project engineer on construction for the Florida State Road Department, was formerly county highway engineer of Scioto County, Ohio, and prior to that was assistant city engineer of Portsmouth, Ohio.

A. MCGILLIVRAY, highway commissioner of Manitoba, was elected chairman of the Manitoba branch of the Canadian Institute of Engineers, at the recent annual meeting of the organization.

CARL T. POMEROY, of Melrose Highlands, Mass., for the past nine years health inspector for the North Shore District of the Massachusetts Department of Labor and Industries, became health officer of Montclair, N. J., on July 1, succeeding H. B. Larner, whose services ended Dec. 31 last. Mr. Pomeroy received a C.P.H. from the School of Public Health of Harvard and the M.I.T. a year ago. He was graduated from Bates College with the degree of A.B. in 1909 and soon afterwards was assistant health officer and bacteriologist at Plainfield, N. J., and then held a similar position at Summit, N. J., each for a short time.

JAMES L. TIGHE, Holyoke, Mass., who for twelve years served as city engineer of Holyoke and since then has been in private practice as a consulting engineer, has been appointed a member of the Public Health Council of the state of Massachusetts.

LEE POWELL, recently of Harris & Powell, highway contractors, has been appointed city engineer of Tyler, Tex., succeeding Sam H. Bothwell, who resigned to become city manager of Longview, Tex. Mr. Powell is a graduate of the engineering college of the University of Texas.

WILLIAM EISENBERG, general contractor, Woodbine and Vineland, N. J., announces the removal of his Vineland office to Camden, N. J.

JOHN DUBUIS and C. M. REDFIELD announce the opening of an office in Bend, Oregon, under the firm name, Dubuis & Redfield, consulting engineers, and will give special attention to irrigation, drainage, water supply, sewerage and hydro-electric work.

ROBERT MCCONNELLY, of Fort Wayne, Ind., has been appointed city engineer of Appleton, Wis., succeeding O. F. Weissgerber, resigned.

P. J. FREEMAN, formerly engineer of tests with the Pittsburgh Testing Laboratory, announces the opening of offices for general consulting engineering at 311 Ross St., Pittsburgh, Pa. He has already been retained by the Standard Inspection Co. to supervise their testing of materials.

DAVID L. STRUTHERS, who has been highway engineer for Gaston County, N. C., with headquarters at Gastonia, has resigned and has been appointed city manager of Gastonia, N. C.

CLEVELAND B. COE has been elected commissioner of public works of Johnson City, Tenn. He is a graduate of Hobart College, was a student at Carnegie Institute of Technology, served as lieutenant of field artillery with the 32nd Division, and since the war has been in private practice in Johnson City.

J. R. ELLIS, assistant chief engineer for the Utah State Road Commission, has resigned to become assistant engineer of the Union Pacific R.R. on construction of the 7-mile line from Park City to the Park-Utah mine.

M. M. LEIGHTON has been appointed chief of the Illinois State Geological Survey, with office at Urbana, Ill., succeeding F. W. DeWolf who resigned recently.

PAUL HAMILTON, engineer of track and roadway on the Cleveland, Cincinnati, Chicago & St. Louis Ry., has been appointed assistant chief engineer, with office at Cincinnati, Ohio, to succeed Hadley Baldwin, who has been promoted.

L. D. SNYDER, civil engineer, who has been a superintendent of construction and specialist in concrete roads and bridges for the George T. Wilhelm Co., contracting engineers, Cedar Rapids, Iowa, has been made general superintendent of construction. He was formerly county engineer at Humboldt, Iowa.

F. E. WEYMOUTH has been appointed a member of the committee to report on the Columbia Basin and Umatilla Irrigation Projects for the U. S. Reclamation Service. The committee now consists of Francis M. Goodwin, Assistant Secretary of the Interior; David W. Davis, Commissioner of Reclamation; and Mr. Weymouth.

ERIC FLEMING, until recently assistant city engineer of New Brunswick, N. J., under Asher Atkinson, city engineer, has resigned to join the architectural and structural division of the Electric Bond and Share Co., New York City.

PAUL C. GISIGER, formerly designer for the Southern Power Co., has accepted a similar position with the Fargo Engineering Co., Fargo, N. D.

C. L. CRANDALL has been appointed assistant engineer in charge of surveys for the New York and New Jersey Bridge and Tunnel Commissioners in work on the vehicular tunnel, having served in similar capacity with the Transit Commission of New York City.

ROSS W. TAYLOR has changed from field engineer with A. W. Kutsche & Co., Detroit, Mich., to a similar position with the Otis Steel Co., Cleveland, Ohio.

H. R. SMITH, formerly mayor and city engineer of Belton, Texas, has been made county engineer of Wise County, Texas.

H. D. ROBINSON and D. B. STEINMAN, consulting engineers, have been retained by the West Penn Railways Co. to make an investigation of the suspension bridge across the Ohio River at Steubenville, Ohio, of which a stiffening truss failed under a heavy load as reported in *Engineering News-Record* on May 31. Robinson and Steinman are engaged in making an inspection, re-calculation, re-adjustment, and strengthening of the structure for the increased loads it has to carry.

Obituary

SIDNEY B. CADY, Bloomfield, N. J., for thirty years an assistant engineer in the Bureau of Highways, New York City, and later town engineer of Bloomfield, died July 13 at the age of 70. He was a native of Vermont and a graduate of Middlebury College and of Dartmouth.

CHARLES T. TAYLOR, secretary and treasurer of the William Cramp & Sons Ship and Engine Building Co., Philadelphia, Pa., died in that city recently.

WILLIAM DALY, railway contractor, died in Outremont, Province of Quebec, recently at the age of 74 years. He was born in Newton Upper Falls, Mass., and went to Montreal in 1872. He was engaged on the aqueduct intake enlargement, the Lachine Canal, Wellington Basin, and later served the Canadian Pacific Ry. for several years as superintendent of construction.

JAMES T. MCCARTHY, 33 years old, a civil engineer in the employ of the Baltimore & Ohio R.R., died on July 7 at his home in Baltimore. During the war he served as a lieutenant in the Second Engineers.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Additional Mixer Standards Approved by Committee

Many Details Simplified as Result of Conference Between Makers and Users

FOURTEEN provisions for the standardization of concrete mixers were approved by the Joint Committee on Construction Equipment in session with members of the Associated General Contractors and representatives of mixer manufacturers at a meeting held in Chicago, June 27-29. These provisions cover a reduction in the number of types manufactured, the furnishing of auxiliary equipment, standard capacities and ratings and many other points of mutual interest to the manufacturer and the user of equipment. In *Engineering News-Record's* report of the meeting, in its issue of July 5, p. 36, details of about half of the approved measures were given; the remaining points are covered in the paragraphs below:

The recommendations of the Joint Committee, which now go to the Associated General Contractors for approval, deal only with the horizontal non-tilting drum type of mixer. It was recognized that the work of standardizing tilting mixers involved problems peculiar to these types which could only be determined after full consideration of the various points in conjunction with the manufacturers of tilting machines. Another meeting of the Joint Committee is scheduled for this week.

Standards to be A.G.C.

Upon recommendation of the manufacturers present at the Chicago meeting it was agreed that the standards adopted should be designated as A.G.C. Standards pending the establishment of contact with the American Engineering Standards Committee and the adoption of American standards. At the request of manufacturers, also, the Joint Committee approved the use of a standard name-plate to be later designed by manufacturers, giving the standard rating of the machine and its capacity for various proportions of mix, with a statement that the machine conforms with standard A.G.C. requirements. As a means of securing general adoption of the recommended standards the manufacturers requested that the right to use the name-plate be obtained from the Associated General Contractors and that the name-plate be purchased through the Joint Committee on Construction Equipment from a company to be designated later.

Portions of the committee's approved report not covered in the issue of this journal referred to in the opening paragraph follow:

For the three standard sizes of paving mixer approved the Joint Committee has prepared Table I, showing the number of sacks of cement per batch.

For three of the four standard sizes of building mixer, Table II shows the sacks of cement per batch.

Building Mixers

(a) Extension power loaders shall be eliminated.

(b) Mixers shall be equipped with tanks of sufficient size to deliver the indicated quantities of water per batch as follows: 7-S, 12 gal.; 14-S, 22 gal.; 21-S, 32 gal.; 28-S, 42 gal.; 7-E, 12 gal.; 12-E, 22 gal.; 21-E, 32 gal. Tanks shall withstand a working pressure of 150 lb. per square inch. One tank shall be standard.

Water supply connections shall be furnished as follows: 7-S, ¾-in. garden hose nipple; 14-S, 1¼-in. standard iron pipe connection; 28-S, 2-in. standard iron pipe connection; 7-E, 1¼-in.; and 12-E and 21-E, 2-in. standard iron pipe connection.

TABLE I—PAVING MIXERS

Mix	Number of Sacks in Batch 7-E	12-E	21-E
1-1½-3	2	3	6
1-1½-3½	2	3	6
1-2-3	2	3	6
1-2-3½	1	3	5
1-2-4	1	3	5
1-2½-5	1	2	4
1-3-6	1	2	3

TABLE II—BUILDING MIXERS

Mix	Number of Sacks in Batch 7-S	14-S	28-S
1-2-4	1	3	6
1-3-6	1	2	4

(c) Discharge control on one side only shall be standard, but may be furnished on both sides as an extra.

(d) Skips shall be made with closed ends.

(e) Standardization of wheels shall be referred to the Concrete Mixer Association for further investigation and report.

(f) Power discharge shall be eliminated as standard but the manufacturers may furnish same on 28-S and 56-S mixers as an extra.

Paving Mixers

(a) Only full caterpillar tread or four wheels shall be used on 12-E and 21-E machines, and four wheels only on 7-E machines.

(b) Maximum width of skip 4 ft. from end shall be 100 in.

(c) Power steering control shall be used in full caterpillar and hand steering on four-wheel machines.

(d) Hand power boom swing only shall be used.

(e) Maximum speed of travel of mixer shall be 1½ miles per hour and minimum ½ mile per hour.

(f) The batch transfer derrick shall have a reach of 14 ft. from center line of machine as standard.

(g) Engine tools only shall be furnished on the 7-S mixer. On the 14-S, the 21-S, the 28-S, and on all paving mixers the manufacturer shall furnish all necessary special tools and a kit of standard tools to be agreed upon by the Manufacturers' Committee.

(h) An auxiliary hoisting drum may be furnished only on the 7-S as special equipment.

Miscellaneous Recommendations

Shafts and Gearing — The sizes of shafts, keys, keyways, gears, and the composition of gears shall be referred to the American Society of Mechanical Engineers for recommendation as to procedure in standardization.

Standardization of Power—The question of standardization of power with reference to requirements for different machines shall be referred to the A.S.M.E. for advice as to proper procedure.

Safety Devices—All working parts shall be guarded in accordance with the requirements of state laws. Paving mixers shall be provided with safety devices to protect men when the skip is being lowered.

Standardization of Names of Parts—The nomenclature of the Concrete Mixer Association, with additions recommended by the Manufacturers' Committee above named, to bring this nomenclature up to date, shall be adopted as standard.

Name Plate—A name plate giving the standard rating of the machine, its capacity for different portions of mix and such other data as may be later determined, shall be affixed to each machine. A committee of three manufacturers shall pass upon the plate and manufacturers shall obtain the right to use this plate from the A.G.C. It is recommended that pending adoption of American Standards, the plate state that the machine meets the standard A.G.C. requirements as approved by the Joint Committee of manufacturers and contractors.

Lubrication, Bearings and Anti-Rust Paint—The manufacturers shall fully, effectively and honestly set forth in their printed matter, information on the principles of lubrication, care and composition of bearings and material and the use of anti-rust paint as used in their machines.

Composition of Committee

The Joint Committee on Construction Equipment is headed by C. E. Bement, chairman, Novo Engine Co., Lansing Mich., and includes the following members representing manufacturers:

H. B. Bushnell, Western Wheeled Scraper Co., Aurora, Ill.; Phillip Koehring, Koehring Co., Milwaukee; F. H. King, Marion Steam Shovel Co., Marion, Ohio; H. H. Baker, Sterling Wheelbarrow Co., Milwaukee; H. W. Howard, General Motors Truck Co., Pontiac, Mich.; C. D. MacArthur, Blaw-Knox Co., Pittsburgh, Pa.

Representatives of the users of equipment on the committee are:

H. V. Coes, American Society of Mechanical Engineers; Stanley D. Moore, Moore-Young Construction Co., Waterloo, Iowa; W. A. Rogers, Bates & Rogers Construction Co., Chicago; A. P. Greensfelder, Fruin-Colnon Contracting Co., St. Louis, Mo.; W. D. Hill, Samuel Gamble Co., Carnegie, Pa.; Frederick L. Cranford, Frederick L. Cranford Co., Brooklyn, N. Y.; W. A. Walbridge, Walbridge-Aldinger Co., Detroit; Frederick Ward, Ward & Tully, Brooklyn, N. Y.; R. C. Marshall, Jr., Associated General Contractors, Washington, D. C.; Ward P. Christie, secretary, 1038 Munsey Building, Washington, D. C.

Reduce Brick Varieties to Two Standard Sizes

Washington Correspondence

One standard size for common brick and one for face brick were adopted formally at a general conference of manufacturers, distributors and representatives of large consumers held at the Division of Simplified Practices of the Department of Commerce, Washington, D. C., June 21.

The size determined upon for common brick and textured face brick was 8 x 2¼ x 3¾ in.; that determined upon for smooth face brick was 8 x 2¼ x 3⅞ in. Tolerances and variations in size due to shrinkage while being burned, different clays and other factors, will be allowed, the permissible tolerances to be studied by the American Society for Testing Materials in connection with the American Face Brick Association and the Common Brick Manufacturers Association of America. The final report of these organizations will assist in deciding the standard tolerance and variation which will apply to the approximate standards.

By adopting these two standard sizes, the conference eliminated at least 38 rough brick and 35 smooth brick varieties. A survey of 167 plants producing rough brick and of 141 plants producing smooth brick in 1922 showed that from 80 to 90 per cent of the total output conforms to the standard sizes adopted by the conference. The final conference followed a preliminary meeting held May 11, where elimination of excess sizes was discussed.

Motor Vehicle Production

Production of motor vehicles during May, based on figures received by the Bureau of the Census in co-operation with the National Automobile Chamber of Commerce and covering approximately 90 passenger-car and 80 truck manufacturers each month, are shown in the accompanying table. It will be noted that the May figures for trucks are almost double those for the same month last year.

AUTOMOBILE PRODUCTION
(Number of Machines)

	Passenger Cars		Trucks	
	1923	1922	1923	1922
Jan.	223,706	81,693	19,398	9,416
Feb.	254,650	109,171	*21,817	13,195
March	*319,638	152,959	*34,681	19,761
April	*344,474	197,216	*37,527	22,342
May	350,180	232,431	42,983	23,788

* Revised.

Use of Mechanical Loaders for Snow Work Increases

An increased use of mechanical loaders of the elevating bucket type for snow removal work in cities is shown by the sales records of the Barber-Greene Co., Aurora, Illinois. To date, cities and street railway companies have purchased exclusively for snow work 22 Barber-Greene loaders. Chicago is the largest user with four machines. Next, with two machines each, are the cities of Philadelphia and Providence, in addition to three street railways, including the Third Ave., New York, the Boston Elevated and the Springfield (Mass.) Street Railway. Owners of one loader include the cities of New York, Pittsburgh, Springfield (Mass.), Albany and Schenectady as well as the street railway companies of Worcester, Mass., Albany and Ottawa, Canada.

Standards Committee Considers C.-I. Gas Pipe Specifications

The American Gas Association has submitted for the approval of the American Engineering Standards Committee three specifications for cast-iron pipe and special castings which, it is said, are in general use for underground gas pipes throughout the United States. The Standards Committee has appointed a large and representative special committee to consider the application for the approval of these specifications, and sponsorship for future revisions under the regular procedure involving the organization of a representative sectional committee to consider and develop any changes required. The following are the members of this special committee and the organizations they represent:

S. G. Flagg, Jr., chairman, American Society of Mechanical Engineers; F. A. Barbour, American Water Works Association; E. A. Barrier, Fire Protection Group on A.E.S.C.; W. Forstall, American Gas Association; A. H. Hall, Gas Group on the A.E.S.C., and American Gas Association; W. G. Hammerstrom, chief engineer, Lynchburg Foundry Co., Lynchburg, Va.; H. Kely Associated General Contractors of America; N. F. S. Russell, U. S. Cast Iron Pipe & Foundry Co.; R. Toensfelt, American Society for Municipal Improvements; W. Wood, president, R. D. Wood & Co.; C. D. Young, American Society for Testing Materials; F. A. McInnes, New England Water Works Association; F. F. Schauer, Natural Gas Association of America; A. W. Claussen, Underwriters' Laboratories; and J. C. Meloon, National Automatic Sprinkler Association.

Sales Managers Organize

The National Association of Sales Managers was organized in Atlantic City, N. J., June 7-8, during the convention of the Associated Advertising Clubs of the World. The officers elected were: President, C. F. Abbott, Pictorial Clubs, Inc., New York; vice-presidents, G. W. Hopkins, Columbia Graphophone Co., New York; L. C. Rockhill, Goodyear Tire & Rubber Co., Akron, Ohio, and Martin J. Wolf, Bussmann Mfg. Co., St. Louis; treasurer, A. E. Pitcher, E. I. duPont de Nemours & Co., Arlington, N. J.

Business Notes

Asher Fireproofing Co. will open Cleveland offices in the B. F. Keith building, July 1, under the immediate charge of Kirby Smith, who recently resigned as a commander in the U. S. Navy to become a member of the executive staff in the Asher company. During his service with the Civil Engineer Corps of the Navy, Commander Smith was engaged largely in concrete construction work. In addition to being a graduate of the U. S. Naval Academy, Commander Smith holds a diploma from the Rensselaer Polytechnic Institute.

International Clay Products Co., Philadelphia, manufacturer of vitrified clay conduits, has changed its name to the Clermont Clay Products Co., following a reorganization of the old company.

Orton & Steinbrenner Co., Chicago, manufacturers of locomotive cranes, dipper shovels and grab buckets announces a reorganization of the company and the election of the following officers: P. A. Orton, president and general manager; E. B. Ayers, vice-president; Herbert Mertz, secretary and sales manager; Harry Shaffer, treasurer and purchasing agent; G. L. Niederst, chief engineer; Alex Orton, works manager. No change in the management, control or policy has been made, nor is any contemplated. The reorganization is occasioned only by the resignation of H. G. Steinbrenner as president and the disposal of his interest in the company.

Connecticut Blower Corp., Hartford, Conn., has been incorporated under the laws of Delaware, with capital of $250,000. The officers are: M. E. Keeney, president; C. H. Keeney, treasurer; C. E. Keeney, secretary. The company has taken over the International Blower Co. and the Hartford Sheet Metal Works. The products manufactured and installed include blowers and exhaust fans, blower systems of all kinds, dust-collecting systems, exhaust systems and ventilating systems. The plant of the International Blower Co. will be utilized until fall, at which time a larger plant will be occupied.

Equipment and Materials

Tractor Mounting for Elevating Bucket Loader

A mobile, self-feeding bucket loader mounted on a standard Fordson tractor is the latest product of the N. P. Nelson Iron Works, Brooklyn, N. Y. It is designed for quick moves from one loading point to another, particularly in the case of road contractors who wish to buy only one loader for handling sand, gravel or crushed stone.

Two features of this equipment are emphasized by the manufacturer.

(1) Instead of crawling in under the elevator, where he cannot see what he is doing or digging, and surrounded by chains and sprockets, the operator now stands on a platform at the side of the machine, with all controls in easy reach and with an unobstructed view of the entire digging and loading operation.

(2) By connecting the elevator directly to the engine, instead of to the usual power take-off, the elevator with its toothed digging spiral runs full speed, while the tractor may be inched

backwards into the pile. The spirals level a 6-ft. cut and material once started in motion keeps moving continuously until picked up by the elevator buckets, which are fitted with digging teeth. An overload release gives the operator ample warning of boulders or undiggable material.

The capacity of the machine is 40 yds. per hour of material 2 in. and under that a man can shovel without the use of a pick. A governor is installed to control the fuel consumption to the actual requirements. The power take-off remains available should the owner require its use for operating other machinery, while the entire loader attachment can be readily removed and the tractor used for other purposes. A swivel or turning spout is attached to the loader, permitting discharge sideways into truck. Clearance of 8 ft. 6 in. is given under the discharge chute.

All-Steel Crane Scale Has Capacity of 10,000 Lb.

For use on crane booms in weighing, sorting or grading operations where weights up to 10,000 lb. are handled, the special heavy-duty scale illustrated herewith has been developed by John Chatillon & Sons, New York. In addition to determining the weight of objects handled, the scale is useful in preventing crane overloads and accidents. It is of all-steel construction and its action depends upon four extra heavy, specially tested springs, oil-tempered after coiling. The dial is 15 in. in diameter, clearly etched and easily read. Scales of this type, the manufacturers report, are being used in many industries where overloads on traveling cranes, cables, and other forms of hoisting apparatus might prove disastrous.

Exhibit Shows Durability of Copper and Brass Pipe

The varied uses and durable qualities of copper and brass pipe and fittings were featured in an exhibit by the Copper and Brass Research Association, New York, at the annual meeting last month in Atlantic City, N. J., of the National Association of Master Plumbers. An outline of the history of piping was presented in a panel of oil paintings, starting with the wooden trough and ending with brass pipes. A fragment of copper pipe 5,400 years old, from Egypt, was secured from the museum in Berlin and displayed at Atlantic City. About half a hundred different brass plumbing fixtures were connected up into a "family tree" as shown in the accompanying illustration. Emphasis was given in the exhibit to the rust-resisting qualities of brass pipe and the increased flow of water possible through a clean pipe as compared with a rusted pipe.

Publications from the Construction Industry

Caterpillar Tractors — HOLT MANUFACTURING CO., INC., Peoria, Ill., features its caterpillar tractors in a recently published 40-p. illustrated booklet. The information is largely in the form of pictures illustrating the varied uses of the company's tractors, particularly in road construction and logging. Complete specifications are given for the 10-ton, 5-ton, and 2-ton caterpillar tractors.

Centrifugal Pumps — DE LAVAL STEAM TURBINE CO., Trenton, N. J., has issued a 20-p. illustrated pamphlet on its multi-stage centrifugal pumps. After a brief discussion of the principal parts of the equipment, including casing, impellers, shafts and bearings, the text describes manufacturing methods and materials and the testing of pumps before they leave the factory.

Steel Windows for Schools—TRUSCON STEEL CO., Detroit, in its 28-p. pamphlet "Daylighting Schools," illustrates the uses of a large number of types of its window equipment. Detail drawings and photographs of typical installations are preceded by a treatise on school architecture, with particular reference to windows, by John J. Donovan.

Blueprinting Machinery—C. F. PEASE CO., Chicago, describes and illustrates its new printing machinery and drafting room accessories in a 64-p. illustrated catalog. The apparatus featured includes blueprinting, washing and drying equipment, and high power arc lamps. Several pages are given over to drawing instruments, filing cabinets for tracings and prints, drafting tables and tools.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Heavy Freight Traffic Reported by the Railroads

Freight traffic in May was the heaviest for that month in the history of the railroads, according to reports just received from the carriers by the Bureau of Railway Economics, Washington, D. C. It amounted to 39,597,582,000 net ton-miles, an increase of 2.7 per cent over the same month in 1917 when the previous record for that month of the year was made. It also was an increase of 41.7 per cent over May last year, when, however, the miners' strike resulted in a curtailment of coal shipments. Because of this strike last year, freight traffic in May this year in the Eastern district showed an increase of more than 57 per cent over last year, while there was an increase of 24 per cent in the Southern district. The Western district reported an increase of nearly 28 per cent.

Substantial progress is being made by the railroads in carrying out the program adopted by the carriers in April, calling for a speeding up in the movement and the heavier loading of freight cars. The daily average movement per freight car in May was 28.6 miles. Except in May, 1917 when an average of 29 miles was attained, this average has never been excelled in any month before and only once equalled, that one time being in the fall of 1920. The average of 28.6 miles was an increase of 0.6 mile over the average for April.

Every increase of one mile in the average movement of a freight car, it is pointed out, is equivalent to the addition of 100,000 freight cars to the country's transportation facilities.

The program adopted by the railroads calls for a daily average movement per car of 30 miles and for the loading of all freight cars to maximum capacity in an effort to bring the average loading to 30 tons per car for the entire country.

Further Slump in Lumber Movement

The nation's lumber movement for the week ending July 7, as reflected by reports from 392 of the larger commercial mills of the country shows a marked decline from revised reports for the preceding week from 408 mills. Production fell off about one-third, shipments about the same, and orders declined by a sixth, but as compared with this time last year the movement as a whole is substantially larger. The declines in production and shipments are chiefly due to the summer letup and closing of mills for customary semi-annual repairs.

For all the reporting mills shipments were 92 per cent and orders 85 per cent of production; the corresponding figures for Southern Pine mills alone being 93 and 77, and for the West Coast mills 124 and 126. Grouping by themselves the 347 mills with an established normal production, actual production for the week was 74 per cent of normal, and shipments 72 and orders 66 per cent thereof.

The following figures give the summary of the lumber movement for the week ending July 7, the corresponding week of 1922 and the preceding week of 1923:

	Week Ending July 7	Corresponping Week 1922	Preceding Week 1923 (Revised)
Mills	392	366	408
Production, ft.	188,046,983	164,510,776	284,487,287
Shipments, ft.	173,451,837	161,756,252	256,060,910
Orders, ft.	160,497,639	160,665,513	192,972.469

Municipal Bond Sales in June

As a result of the sale of two very large state bond issues the aggregate of state and municipal bonds placed during June, according to the monthly review of the *Commercial and Financial Chronicle*, New York, was swelled to the figure of $156,366,800, the largest total reached in any month of June, always notable for bond disposals of exceptional extent.

Fewer municipalities issued obligations last month than in June, 1922. The number of municipalities in the United States issuing permanent bonds and the number of separate issues made during June, 1923, were 390 and 550 respectively. This contrasts with 394 and 571 for May, 1923, and 560 and 762 for June, 1922.

Of the fifty-odd representative bond issues included in the tabulation on this page 3 sold at par, 46 above par, and 3 below par. The yields ranged from 4.11 to 5.97 and the rate of interest from 4¼ to 6 per cent.

The large major bond issues last month were for payment of bonuses to war veterans—$25,000,000 in Kansas and $22,000,000 in Iowa. Nevertheless, the aggregate of state and municipal bonds that have come on the market during the first six months of 1923 falls considerably short of that for the first half year of 1922, being $571,803,563 as against $655,086,150.

Prominent bond issues during the month for public works or other forms of construction included $6,720,000 5½s. for the Moffat tunnel in Colorado; $5,000,000 4s. for the Chicago Sanitary District; $5,000,000 4½s. for road and bridge work in New Jersey; $2,750,000 for roads and hospital in Hennepin County, Minn.; $2,500,000 for public building construction in St. Louis, Mo.

REPRESENTATIVE PUBLIC BOND SALES DURING JUNE AND JULY, 1923

State	Purpose	Amount	Rate Per Cent	Sold for	Basis	Dated	Maturity	Purchased By
Colorado	Roads	1,500,000	5	100.61	4.95	June 1, 1923	1934–36	International Trust Co., Denver
County								
Beaufort, N. C.	Roads	150,000	5	100.28	4.97	1923	1929–53	Geo. H. Burr & Co., Chicago
Erie, Ohio	Water impv't.	124,000	5½	100.00	5.50	March 1, 1923	1925–34	State Industrial Commission
Jefferson, Wis.	Roads	600,000	5	104.03	4.58	1923	1933–39	Second Ward Securities Co., Milwaukee
Lucas, Ohio	Roads	542,658*	5	100.27	4.94	1923	1924–32	R. M. Grant & Co., Chicago
Montgomery, Ohio	Sewer	228,000	5½	104.93	4.95	1923	1926–45	Federal Securities Corp., Chicago
Pike, Ind.	Roads	30,000	5	102.66	4.45	May 15, 1923	1924–33	First National Bank, Winslow, Ind
Shelby, Tenn.	School and market	975,000	4¾	100.08	4.74	June 1, 1923	1933–57	Harris Trust & Savings Bank, Chicago
Charlotte, Fla.	Roads	200,000	6	100.37	5.97	Jan. 1, 1923	1929–52	G. B. Sawyers Co., Jacksonville, Fla.
Hennepin, Minn.	Hospital	750,000	4¾	101.61	4.57	July 1, 1923	1928–42	Bankers Trust Co., New York and others
Person, N. C.	Roads	15,000	5	100.16	4.99	May 1, 1923	1929–43	L. S. Rosenthal Co., Cincinnati
Randolph, Ind.	Roads	118,700	5	100.61	4.88	May 15, 1923	1924–33	Merchants National Bank, Muncie, Ind
Atlantic City, N. J.	Building	136,000	5	102.95	4.65	July 1, 1923	1925–43	Bankers Trust Co., Atlantic City, N. J.
Broward, Fla.	Roads	200,000	6	102.58	5.76	Jan. 1, 1923	1932–46	Lauderdale State Bank
Burlington, N. J.	Roads	221,000	5	101.85	4.61	Aug. 1, 1923	1924–33	M. M. Freeman & Co., Phila.
Cayuga, N. Y.	Court house	150,000	4½	100.31	4.38	May 1, 1923	1924–28	Lamport, Barker & Jennings, New York
Hardin, Ohio	Roads	34,000	5½	100.11	5.47	June 1, 1923	1924–32	Sidney, Spitzer & Co., Toledo
Lake, Ohio	Sewer	170,000	5	100.31	4.96	April 1, 1923	1925–42	Richards, Parish & Lamson, Cincinnati
Lucas, Ohio	Road	296,111	6	103.51	5.21	July 2, 1923	1924–32	Syndicate, Sidney Spitzer & Co., Toledo, and others
Los Angeles, Cal.	Pub. impv't.	1,250,000	5	103.17	4.68	July 1, 1923	1928–47	Bank of Italy, San Francisco
Township								
Independence, Pa.	School	51,000	4¼	100.19	4.21	May 1, 1923	1926–30	E. H. Rollins & Sons, Phila.
Municipality								
Ansonia, Conn.	Municip. impv't.	200,000	4½	102.26	4.23	June 15, 1923	1924–43	Thompson, Fenn & Co., Hartford, Conn.
Conrad, Ia.	School	150,000	4¾	100.70	4.70	June 1, 1923	1928–43	Ringheim, Wheelock & Co., Des Moines, Ia.
Geneva, N. Y.	School	480,000	4¼	100.45	4.22	June 1, 1923	1926–63	Harris, Forbes & Co., New York and others
Green Bay, Wis.	School	600,000	4½	102.10	4.25	July 1, 1923	1924–43	First Trust & Savings Bank, Chicago
Greenville, S. C.	School	240,000	5	100.81	4.92	July 1, 1923	1924–47	A. M. Law & Co., Spartanburg, S. C.
Manchester, N. H.	Bridge	300,000	4	97.07	4.12	May 1, 1923	1924–43	P. F. Cusick & Co., New York
Memphis, Tenn.	Municip. impv't.	1,527,000	4½–5	100.08	4.78	July 1, 1923	1926–63	Syndicate, Bankers Trust Co., New York and others
Miami Beach, Fla.	Pub. impv't.	220,000	5¾	99.55	5.81	April 1, 1923	1925–43	First National Bank of Miami, Fla.
Milwaukee, Wis.	Pub. impv't.	4,390,000	4½	100.63	4.43	July 1, 1922	1923–42	Syndicate, Wells-Dickey Co., Minneapolis, and others
Perth Amboy, N. J.	School	248,000	4¾	101.12	4.66	July 1, 1923	1925–63	First National Bank, Perth Amboy, N. J.
Seattle, Wash.	Port impv't.	100,000	5	99.64	5.03	June 1, 1923	1924–65	Bond, Goodwin & Tucker, Seattle
Spring Lake, N. J.	Streets	80,000	5	101.05	4.87	Feb. 1, 1923	1924–43	Boland & Preim, New York
Troy, N. Y.	Pub. impv't.	276,000	4¼	100.88	4.15	July 1, 1923	1924–43	Geo. B. Gibbons & Co., New York
Wauwatosa, Wis.	Sewer	30,000	5	102.67	4.71	June 15, 1923	1924–43	Harris Trust & Savings Bank, Chicago
West Orange, N. J.	Sewer and street	83,000	4½	100.10	4.49	June 1, 1923	1925–43	H. L. Allen & Co., New York
Williamsport, Pa.	Sewer	100,000	4¼	101.07	4.19	July 1, 1923	1953	Stroud & Co., Phila.
Akron, Ohio	Water, grade elim.	1,075,000	4¾	100.91	4.67	July 1, 1923	1924–52	Grau, Todd & Co., Cincinnati
Blanchester, Ohio	School	75,000	5½	103.66	5.10	June 21, 1923	1924–47	Detroit Trust Co., Detroit
Cleveland, Ohio	School	700,000	4½	100.00	4.50	July 1, 1923	1924–43	Syndicate, Eldredge & Co.
Denver, Colo.	Moffat Tunnel	6,720,000	5½	103.20	5.33	1923	1943–63	R. M. Grant & Co.
Greenfield, Mass.	Street and water	120,000	4¼	101.15	4.11	July 1, 1923	1924–43	First National Bank, Greenfield, Mass.
Greensboro, N. C.	Streets	1,000,000	5	100.00	5.00	Jan. 1, 1923	1925–44	Syndicate, Kauffman-Smith-Emert & Co. and others
Greensboro, N. C.	Water	300,000	5	100.08	4.99	Jan. 1, 1923	1925–64	Syndicate, Kauffman-Smith-Emert & Co., and others
High Point, N. C.	Pub. impv't.	834,000	5¼	100.10	5.24	April 1, 1923	1932–48	Commercial National Bank, High Point, N. C.
Monticelo, Ind.	Water	25,000	5	101.50	4.76	June 1, 1923	1925–36	Union Trust Co., Indianapolis
Norfolk, Va.	Water	410,000	5	104.64	4.71	May 1, 1922	1952	Syndicate, Kissel, Kinnicutt & Co., and others, N. Y.
Oneonta, N. Y.	Water	217,000	4½	100.19	4.46	June 15, 1923	1924–33	Union National Corp., New York
Washington, Cal.	School	150,000	5	101.68	4.82	June 15, 1923	1924–48	Blyth, Witter & Co.
Blasdell, N. Y.	Sewer	39,719	4¾	101.28	4.64	July 1, 1923	1928–52	Farson Son & Co., New York
Lima, Ohio	Paving	566,300	5½	100.82	5.33	April 1, 1923	1924–32	Prudden & Co., Toledo
St. Louis, Mo.	Pub. impv't.	2,500,000	4½	101.17	4.38	July 1, 1923	1928–43	Syndicate, Geo. H. Burr & Co., New York and others
San Diego, Cal.	Pub. impv't.	920,000	5	100.10	4.99	July 1, 1923	1924–63	Bank of Italy, San Francisco

*Ten issues.

Cement Production Ahead of Last Year's Output

Portland cement production in the United States during June, based on figures issued by the Department of the Interior and prepared under the direction of Ernest F. Burchard, of the U. S. Geological Survey, from reports of producers, amounted to 12,382,000 bbl., as compared with 11,245,000 bbl. for June, 1922. The shipments for June of this year and last year were, respectively, 13,307,000 and 13,470,000 bbl., and stocks were respectively 9,219,000 and 10,718,000 for the same period.

For the first six months of this year the production of portland cement was 62,320,000 bbl. a gain of 15,402,000 bbl. over the same period of 1922.

Indianapolis Profits By Asphalt Price War

A "war" between asphalt street paving contractors has caused prices for asphalt paving quoted to the Indianapolis board of public works to drop sharply in the last few weeks until the price of $2.30 a square yard was reached on one project, the lowest quotation on asphalt street paving since 1916, according to John L. Elliott, city civil engineer.

At the first of the season, the prices for asphalt paving started around $3.20 a square yard. Later the price hovered about $3.00, and about three weeks ago a sharp drop to about $2.60 was noted. Thie was followed by the $2.30 offer.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 29 to 41, are the following:

Hotel, Cleveland, O., to Crafts Construction Co., $3,000,000.

College buildings, Greenville, N. C., to J. E. Beaman Construction Co., Raleigh, $1,025,000.

Bank and office building, Boston, Mass., to A. C. Whitney, $1,000,000.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 29 to 41, are the following:

Factory, Sweetwater, Tex., for United States Gypsum Co., $1,000,000.

Cement plant, Macon, Ga., for Clinchfield Portland Cement Co., Kingsport, Tenn., $1,000,000.

Hospital, Nashville, Tenn., for Vanderbilt University, $2,000,000.

Cement plant, Jefferson City, Mo., for State Highway Commission, $2,000,000 to $2,500,000.

High school, Hartford, Conn., for Board of Contr. and Supply, $1,500,000.

Jetty, New Orleans, La., for U. S. Engineer, $1,300,000.

Railways Continue Record Loading of Revenue Freight

Despite the fact that loading of revenue freight for the week which ended on June 30, according to the Car Service Division of the American Railway Association, totaled 1,021,770 cars, the greatest number for any one week in the history, the railroads of the United States had on June 30 a total of 63,636 surplus freight cars in good repair. This is in contrast with the situation that existed during the week of Oct. 14, 1920, when 1,018,539 freight cars were loaded, the best previous loading record, at which time there was a car shortage of 69,517 cars.

Despite the fact that the loading of revenue freight for the month of June has averaged more than 1,000,000 cars a week, the greatest in history for this time of year, there was an actual increase during the month of June of 31,193 in the number of surplus freight cars. Despite this heavy traffic no car shortage has existed.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the the issue of July 5; the next, on Aug. 2.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.30	—$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.25
Structural rivets, 100 lb.	4.40	5.00	—4.90	3.75	4.25	5.40	5.00	4.75	6.00
Reinforcing bars, $\frac{3}{4}$ in. up, 100 lb.	3.54	4.25	3.80	—3.20	3.45	3.85	3.50	4.10	4.00
Steel pipe, black, $2\frac{1}{2}$ to 6 in. lap, discount	44%	52%	45%	47%	53-5%	36%	35.2@47.6%	40%	32.76
Cast-iron pipe, 6 in. and over, ton	62.30	58.00	63.00	60.20	60.50	69.00	62.00	70.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.80	2.85	2.25	2.20	2.50	2.84	2.63	2.90	2.25
Gravel, $\frac{3}{4}$ in., cu.yd.	2.25	1.90	2.25	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	1.95	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, $\frac{3}{4}$ in., cu.yd.	1.75	2.00	2.50	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	63.00	42.00	+52.75	58.50	—42.50@ 44.75	—47.00	41.00	31.00	70.00
Lime, finishing, hydrated, ton	18.20	23.50	22.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	2.35	1.50	1.50	2.70	2.10	2.80	10.00
Common brick, delivered, 1,000	23.50@24.60	14.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.109	.115	.0724	.0816	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1573	.109	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	—1.10	1.20	—1.30	1.28	—1.18	1.34	—1.23	.86	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	$.82\frac{1}{2}$	.55	.35@.50	.50	$.50@.62\frac{1}{2}$	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, $93\frac{3}{4}$c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size $5\frac{1}{2}$ x 8 x $11\frac{1}{2}$. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.32). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; $2\frac{1}{2}$-in., $32.76; 6-in., $108.

Changes Since Last Week

While prices of certain basic materials have shown a downward trend during the last two months, increased labor costs have offset any gains realized by the buyer. Lumber has dropped materially; premiums charged for quick steel deliveries have disappeared from the market, and such materials as lead and linseed oil have declined with the decrease in demand. Brick, however, has advanced owing to scarcity, while cement has remained fairly firm throughout the entire country. The general tendency of the present market, therefore, appears to be toward stabilization at present levels rather than an actual decline.

Pig-iron prices have gradually fallen off, owing to unsettled market conditions and slowness of buying. A fair-sized volume, however, of new steel plate inquiries, for tank and car construction, marks the beginning of the third quarter.

While pig-iron, coke and scrap are lower, there has been no deviation from the $2.50 base on plates and shapes. Reinforcing bars are still $2.40 per 100 lb., f.o.b. mill. A fair volume of new demand for structurals has also developed, with a slight slowing down in production, owing to labor shortage and weather conditions.

Steel shapes dropped 10c. and structural rivets 5c. per 100 lb. in Dallas, while reinforcing bars declined $12\frac{1}{2}$c. in Chicago warehouses during the week. Pine timbers rose 50c. in Dallas and Douglas fir declined $1 per M. ft. in Denver. Linseed oil dropped 1c. in San Francisco, 2c. in Dallas, 3c. in New York and 6c. per gal in Minneapolis.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor
FRANK C. WIGHT, Managing Editor

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Toward Society Co-operation

WHILE President Loweth of the American Society of Civil Engineers was expressing only his own views on a matter of society policy when he discussed co-operation at the Chicago meeting, it may well be assumed that his views are the result of a careful analysis of the trend of membership opinion, which should govern the intentions of the committee of the society now studying this most important question. As a prospectus with obvious limitations his remarks contain a few excellent basic principles. The most important of these is the statement that the chief function in co-operation should be to bring about concerted action of various organizations rather than to attempt to speak for them. If the committee of the American Society of Civil Engineers can propose a scheme acceptable to the other engineering societies by which this end will be achieved, society co-operation in the best sense will soon become a fact. It is absurd to think that the whole great and diversified engineering profession can speak as one voice. The thing which needs to be done is so to co-ordinate the thinking of the various important societies that they can readily get together their opinions, whether similar or diversified, and unless those opinions are too diametrically opposed can achieve some degree of compromise which, expressed through the separate voices of the different societies, will come to the public ear with the additional force of diversification and distribution. Details of organization of such a system are very great, and will doubtless be subject to considerable criticism even after they have been worked out by the committee itself, but the principle laid down by the president might well govern the committee in the study of its problems.

Aiding Water-Waste Prevention

CHICAGO water-waste continues, but no longer without official cognizance or attention. Both mayor and commissioner of public works are using in public speeches words, phrases and arguments framed by engineers, mostly from a brief submitted to them by the Western Society of Engineers. In making up the brief the public affairs committee of that organization had in mind just such use and in consequence the conclusions of the brief were short, illustrative, comparative and calculated to appeal as seriously as possible to the councilmanic constituency. Laying stress on savings was not considered as having anywhere near the pulling value as the startling information that 75 per cent of the city had a decidedly inadequate service in the summer when it is most needed. In the last analysis the citizen wants service—he does not get it in Chicago and never will so long as the pumps must deliver into a sieve-like system. The newspapers have given columns of space to the waste-prevention campaign, nearly every item bearing the earmarks of the society's report. If Chicago ever does stop wasting water the members of the society's public affairs committee may well feel repaid for their noon-hour conferences, where were discussed the pros and cons of political appeals to a strictly engineering administrative policy.

Crude Figures Misleading

PRESIDENT HARDING'S note of alarm over our mounting state and municipal expenses and debts, sounded in a recent speech at Salt Lake City, was unfortunately based on bare totals and percentages. Had the President made no allowance for any factor entering into the increase except the decreased purchasing power of the dollar, he might have been astounded at the result and been forced to commend instead of blame our cities if not our states for their moderation during the seven trying years since 1914. If in addition he had taken into account population growth since 1914, higher capital costs, and increased operating charges due to run-down plants through deferred repair and renewals, and other factors the whole tenor of this part of his address would have needed marked change. Crude bulk statistics, used without qualification, are always likely to mislead, but seldom are they so gravely misleading as in the discussion of state and city expenses and debts sent reverberating over the country by the President.

California Starts Subgrade Survey

IN THE light of the Pittsburg test-road experience with adobe subgrade construction, it is noteworthy that the California road department has begun a field survey of road foundations. Until now all the systematized records available on foundation materials and structure have come from experimental roads and while they are important there is always present the reflection that in some degree laboratory conditions instead of the comparatively unregulated methods of actual field construction are represented in the results. From all reports, however, the California survey will have particular reference to the character of the foundation soil. It is to be hoped that there will go with this soil sampling the best determination possible in each case of the method of preparing the subgrade and of drainage conditions. A soil survey, useful as it will be, is certain to be only a fraction as useful as it would be if co-ordinated with information on construction methods and drainage. The stable subgrade secured with adobe soil on the Pittsburg test road was the result of the method of construction and not due, it would appear, to any unusual character of the material. A soil analyses alone would have shown presumably nothing of the real reason for the success of the foundation. In any event we need to know all that is possible of subgrade structure and drainage in relation to road durability and the soil survey furnishes an opportunity conveniently to secure such knowledge.

Express-Train Service

A STRIKING feature of the new Chicago rapid transit plan summarized last week on p. 104 is the absence of any general provision for express-train service such as is now operated on most of New York City subways and elevated lines. It is obvious from the fact that the proposed subways and elevated lines are almost entirely double-track structures that an express service is not contemplated. It may be that the committee made a study of the needs of the city in regard to an express service on some or all of the lines and that the idea was abandoned as not justifying the additional expenditure required to three-track or four-track the new line. Or it may be that with the proposed unification of the surface lines with the elevated and sub-surface lines the committee considers that stations can be put at express intervals. If so, the practical workings of such an arrangement will be of great interest to all cities now struggling to provide adequate rapid-transit facilities. Its possibilities for providing immediate relief of the transit situation in New York are enormous. The present four-track subways could, during rush hours, be converted into subways with two lines of express service in the direction of maximum traffic. In this case the people would have to be diverted to the surface lines for the last few blocks of their journey. But if this is not contemplated, if the new plan calls for stations at the usual interval of about one-third of a mile, it does not seem that it will be adequate for a city of the extent of Chicago. Relative distances are not so unlike in New York and Chicago that New York's experience in the use of express trains cannot be taken as a criterion. The benefits which New York derives in an increasing degree as traffic increases amply justify the expense of express service; similar benefits are to be expected in Chicago's rapid transit.

Bridge Design and Good Taste

AN ARTICLE which appeared last week in a magazine of opinion denounces the design for the Hudson River suspension bridge at Bear Mountain as ugly, and proceeds to deplore the defacing of a beautiful landscape by such a bridge. One can hardly take exception to this as a setting forth of the author's likes and dislikes, assuming that they are worthy of being brought to general attention. There is no disputing over tastes. But the author is on less sure ground when, after admitting that he is not competent to say what kind of bridge should be built, he continues, "I think I have enough esthetic sense to say that the design is, on the face of it, hopelessly incompetent." Here we have not a statement of likes or dislikes but an arbitrary dictum. It is extravagant enough to be its own answer.

A word, however, on the question of ugly suspension bridges. Beauty is an elusive matter to discuss, but the case in hand is simplified in respect to the important element of esthetic precedent. Not a great number of suspension bridges has been built in the entire world, so far, and there is no agreement of precedent on proportions, or trussing, or other phases of the design. In this virgin field the one certain fact is that the best suspension bridge is the one that is most efficient *as a suspension bridge*, and which gives expression to its functioning most truly and directly. And truth, we have it on the best authority, is beauty. Whether the line of the cables shall remain above the truss or not, whether the truss must have parallel chords—or, for that matter, whether the towers are to be stone or steel or vertical or inclined toward stream or bank—may be judged by the criterion of how the efficiency of the structure is made greatest, that is by how truly it performs its desired function. We are not compelled to defer to dogmas of taste established by the building of certain bridges some centuries ago, which, famous through hundreds of years, now set the norm of good taste. The suspension-bridge engineer, happily, need not even in highland scenery vindicate his skill in efficient design by building baronial castles in imitation of venerable ruins of a former efficient adaptation to purpose.

So for many years, as at present, the planning of suspension bridges will be a free art, in which the keen analysis of truly efficient construction will tell what is true beauty of form. The art will not have to go through such struggles against fancied doctrines as involved the builder of truss bridges when he undertook to show that straight lines might serve the world better than the beauty of the arch. Nor will it, we hope, become subordinate to copy book esthetics as did those early builders of plate girders who felt obliged to mask the "ugliness" of their web rivets by appliquéd rosettes.

And finally, the oft-repeated cant about defacing Nature's beauty with ugly works of man is worth a few moments' reflection. This matter is one of sharply dissonant opinions. An extreme note is sounded in the article above quoted, when the author asks that a bridge shall "contribute to the beauty of the Hudson" rather than mar it. Many among those who feel the beauty of a landscape will resent the suggestion that a bridge—however beautiful in itself, however ornamented—can contribute to the beauty of the Hudson. Others again, and we think their number will also prove to be many, will deny that a bridge makes the beauty of such a landscape either greater or less; in their view, the landscape remains as beautiful as before, except where concealed by the bridge. The numerous phases of the question are even more in dispute than the question of the inherent beauty of the bridge. Yet it is brought to the front whenever it is necessary to decide (for example) between stone and steel, or girder and arch. On one occasion it will be claimed that steel construction is always ugly and only stone will do; or again, that a hilly landscape with its curving lines demands curved lines also in a bridge. Thus arguments without base or reference point recur and recur, and while dispute concerns itself with harmony the virtues of contrast rarely receive a thought.

At all times, we believe, it will remain an involved and delicate question, quite too delicate to serve as foundation for such rash and bald conclusions as those expressed in the article quoted. When minimum disturbance of the pre-existing landscape with human construction is most satisfying it will be obviously desirable to make a bridge unobtrusive; when it is best that a structure should not insistently claim the center of the picture, a quiet and consistent outline will commend itself. A few such considerations may be set down; but in its larger aspect the question of harmony with Nature will always remain one of good taste—a quality of fully as much value to the bridge engineer as to the architect.

Some Problems in Rail Consolidation

IN THE proposed consolidation of practically all the railways of the United States to form a limited number of large groups or systems, as provided by the Transportation Act of 1920, the railways face a problem which seems likely to rank only second to the valuation problem in point of difficulties and complications involved. This problem is of interest to the engineer from its probable influence upon railway engineering in particular as well as upon railway affairs in general, His main work will come after the final establishment of the several groups. Then it will be his duty to revise and improve physical conditions and operating facilities on various weaker links in new traffic routes which will need to be developed. Nevertheless there are some engineering and traffic complications involved in consolidation which will bear emphasis.

Under the provision for continuing competition in the transportation act, consolidation must provide systems of interlocking and overlapping arrangement, and not merely separate systems serving different geographical districts. The law is permissive merely, although compulsory powers were included in the original draft, but because it was evident that private initiative alone could never reach the stage of devising or agreeing upon a national grouping of the railways, provision was made for suggestive arrangement of systems by the Interstate Commerce Commission.

A tentative series of nineteen groups has been drawn up by the commission as a basis, their lengths ranging from 3,000 to 22,000 miles, and public hearings have been held for the presentation of the views and objections of railway executives, state commissions, commercial organizations and other varied interests. It is unfortunate that the majority of the arguments have indicated destructive criticism, narrow-gage ideas, lack of foresight, and vision restricted by local or selfish factors. The broad question of consolidation in regard to public welfare and national commerce has been visualized only by a few of the many speakers. Few seem to realize that consolidation is not a paper theory but is a very practical and pressing probability.

According to a report prepared by a committee of the National Industrial Conference Board, the railway executives in general favor the principle of consolidation and regard its application as inevitable. Naturally a railroad strong in financial position, earning power, traffic capacity or physical condition might object to having weaker or less favorable roads annexed to it in a consolidated system. But on the other hand a strong company left alone and surrounded by larger competitors might lose much of the financial and strategic factors of its present individual strength. One special difficulty, perhaps, will be in securing harmony when one present road or system is to be partitioned between two of the new groups to insure effective routes and groups.

The final adoption of a series of groups by the Interstate Commerce Commission does not guarantee financial success or operating efficiency for the several groups. Possibly it is not fully realized what great responsibility will thus rest eventually on the shoulders of the commission. It is true that some of the difficulties may prove less serious than expected and may be smoothed away, but new and unexpected difficulties are likely to arise. It is true also that the law provides for changes subject to the final grouping. Such changes could be made only slowly and after much deliberation, so that they could hardly be relied upon as a means of avoiding or rectifying serious financial or operating difficulties resulting from errors in grouping.

One feature of consolidation in which the engineer is particularly interested is that of the relative physical condition of lines put together to form a group or operating system. With the aid of a good railway map it is not difficult to select logical groups and logical routes within a group. But the map does not show physical conditions. Take certain proposals for linking up through routes between South Atlantic ports and the Great Lakes. In one of these it was proposed to combine two competing lines which are nearly parallel for part of their length, so as to form a duplicate line of heavy traffic or alternative lines in case of accidental blocking of either one line. The lines are physically connected at certain points and the arrangement appears favorable. But it developed that these connections are not well adapted for through service and that considerable new construction would be required at heavy cost to make such a plan workable.

In another case, an east-and-west trunk line was to be given a northward connection to a lake port. But the trunk line objected that this link had such excessive curvature and grades, combined with light construction, that it could not handle the intended traffic except after costly and extensive improvements. Furthermore, a very similar but not directly parallel lake connection of another trunk line is well adapted for the economic handling of heavy traffic. As a result the latter group would have a distinct advantage in handling lake traffic. This situation at once suggests the question of how the less favorable lines are to be handled and how some kind of balance is to be contrived.

New traffic routes are likely to become logical and available in the consolidated systems, but may be composed in part of lines which at present are of a secondary character. It is probable, therefore, that a considerable amount of improvement work will be required in each group to perfect new routes, and to improve operating conditions. Extensive changes in terminals, yards and other facilities may also be foreseen.

While the main problem is the grouping of the railroads throughout the body of the country, a secondary problem is presented by the semi-isolated sections of the country. Thus in regard to the New England railways there is a question whether they should be consolidated to form a single group with gateway connections to trunk lines of adjacent systems, or whether they should be divided among such trunk lines in order to form New England extensions of the latter. Under the law the grouping is required to retain competition as far as practicable. But in the first case the competition would be that of trunk lines for the traffic of the New England group, while in the second case it would be between the different lines in New England.

In conclusion it may be said that the movement is going forward steadily and that actual consolidation may be regarded as imminent. If the objectors would see the handwriting on the wall they might realize that their interests lie in co-operation rather than in controversy. To the engineer and the railroad operating officer there may be visions of a much greater, more effective and more economic railway system than that which is now composed of numerous separate individual railways, large and small.

Highway Progress and Problems in the Mid-South

South Carolina	North Carolina
Virginia	West Virginia
Kentucky	Tennessee
Missouri	

Seven Southern States Contemplate Road Expenditures Approaching a Billion Dollars — Automobile License Fees and Gasoline Taxes Will Provide the Money—Editorial Review Based on Studies in the Field

In a few years the banner of quantity production of improved roads will pass to the states lying immediately south of the Mason and Dixon Line and including Missouri. To meet this change there must be a large development of all the agencies of highway building. Engineering organizations must be enlarged, materials production increased, equipment service extended and contractors trained in modern road building. All this necessitates a long look ahead and constructive planning by engineers, contractors, manufacturers and materials producers. It is to help in this planning that the following studies of highway progress and problems in the South were undertaken.

The broad outlook has been assumed in these studies. Technique of design and construction is not discussed; it shows no notable variations from good practice in the older road building states of the North. Instead, the attempt is made to visualize the broad fundamental problems of finance, administration, popular education and traffic development. To get these wide aspects a month of intensive work in the field and some 3,000 miles of travel have been required. The interviews and conferences have not been with road department officials alone but have included bankers, leading merchants, commercial organizations, highway associations and prominent engineers and contractors. Even the viewpoint of the man in the hotel lobby and the smoking car has not been despised. Naturally all there is to learn has not been grasped and only the high points of what was learned are indicated. They, however, seem to present a chart of highway development which can be examined to advantage by all who look to road building as a continuing business for their employment and profit.

Group Problems Summarized

THE WAVE of large mileages in highway construction is moving southward. In the zone of states embracing the Carolinas, the two Virginias, Tennessee, Kentucky, Missouri and Kansas, only Kansas registers an ebb in the flood. Seven states are planning or proceeding with construction programs surpassing in the amount of money involved all but those of a few states. In the next five years the great records of mileages under construction will be made not by Pennsylvania, Illinois, Wisconsin, Michigan and other northern states but by those mid-southern states which have hitherto counted small in the active production of modern roads. Already in North Carolina and Missouri more miles of highway are under contract than in any of the states previously known as leaders in new construction.

Perhaps the best measure of this sweep of highway development toward the South is the expenditure which is being contemplated. In three states, highway bonds have been authorized in the following amounts: North Carolina $65,000,000, West Virginia $50,000,000 and Missouri $60,000,000. In four states legislation has been inaugurated for highway bond issues in amounts as follows: South Carolina $60,000,000, Virginia $50,000,000, Kentucky $50,000,000 and Tennessee $75,000,000. The aggregate is the enormous amount of $410,000,000. For 1923-24 the federal-aid allotment to these seven states is something over $9,000,000. Assuming a construction period of ten years, continuing federal aid, normal county and township road building and the amount of bonds named, the expenditure for roads will amount to something over $600,000,000, without considering the growth of ten years in traffic and income.

Admittedly this estimate possesses the uncertainty that four of the bond issues are not yet legally authorized. However, in each state empowering legislation barely failed to pass the legislature last winter because opinion had not crystallized on the preferable method of financing. In no state of the four was public sentiment against comprehensive improvement or averse to heavy expenditures for such improvement. In brief, the most intelligent observers of the trend of thought in highway matters in each state express confidence that at another session of the legislature, if bonds are not authorized, some adequate means of financing an equivalent public roads development will be provided.

There is clearly enough a situation, under the circumstances outlined, which concerns engineers, contractors and manufacturers deeply in a business way and which affects largely the construction-economic direction of public works policies. To present this situation particularly as it interests the engineer, contractor and manufacturer and incidentally in its broader economic aspects, an editorial survey has been made on the ground, from which certain conclusions may be formulated.

Each state of the group has its special problem. In North Carolina, West Virginia and Missouri, the three states whose systems are financed, the problems are progressive construction of improved roads and current maintenance. Virginia has a problem in methods of financing. In South Carolina a lagging disposition adequately to finance road improvement has to be overcome by education. Education again is the problem in Tennessee, but here in road administration policies. Kentucky has a complicated problem in recovering from county control. Virtually all of these problems exist to some extent in each state; together they constitute the group problem of the mid-southern states.

Area and Population—In round figures the group has

an area of 300,000 square miles and a population of 16,000,000. The average population per square mile in no state of the group varies more than five persons from the group average population of 53 per square mile. In the seven mileage-producing states contiguous at the north and including Michigan the area is nearly the same and the population is twice as great.

The two outstanding characteristics of highway development in the mid-southern group of states are:

1. Highway improvement has for its purpose, more than in the North, the development of territory and creation of traffic.

2. For each dollar spent in road improvement there is a greater charge than in the North on each individual and each unit of property value.

In undertaking the expenditures which have been indicated these states are therefore evidencing an appreciation of transportation value and a boldness in investing for its attainment which are not surpassed in the older road building states of the North. This should be set down, it would seem, as the *first fundamental group characteristic* in highway development of the mid-southern states.

Present Status of Highways—These states have no systems of modern roads. They all have improved roads in isolated stretches leading out from centers of population but no considerable mileage of connected and correlated roads. In a measure these statements should be modified in respect to North Carolina and West Virginia, which for two years have been actively building modern roads and are approaching completed systems, but they accurately represent the conditions in these two states at the beginning of construction two years ago. Creation of state road systems virtually from the beginning—for the nucleuses of existing improved roads is scarcely important—is the *second fundamental characteristic* of the group.

Production of a maximum mileage of road usable throughout the year except for a few weeks of the worst weather is the essential road development task. This is well understood by the state highway officials and appears to be sensed in a considerable and increasing measure by business and industrial leaders. It is planned to be secured in two principal ways:

1. Progressive construction, or rapid construction first of permanent grade temporarily surfaced, to be improved later, as traffic develops, by paving.

2. Intensive maintenance, established over the entire system so as to give highway service, prior to construction, in every part of the state.

At present North Carolina is the high exemplar of these practices, but Missouri is following closely and the beginning is apparent in the other states. It is a fair conclusion that the *third fundamental group characteristic* is progressive construction and immediate full-mileage maintenance.

Topographic Conditions—Five states of the group—the two Carolinas, Virginia, Tennessee and Kentucky, are remarkably similar in general topography. In the three seaboard states there is a low coastal plain rising to a higher plateau known as the Piedmont region, and in the west a rugged mountain section. Tennessee and Kentucky have their mountains in the east and from them a rolling plateau sweeps west and gradually descends to the Mississippi River. In these states the highest development is in the plateau region, except for a few important coast and river cities. West Virginia is uniformly mountainous with no marked regional divisions of topography. Missouri is hilly upland, with a marked mountainous district of the Ozarks and an equally pronounced river bottom area in the southeast.

It follows from these topographic conditions that there is an outstanding group problem of regional planning of highways. This problem shows several phases of which two attract most attention. One is the varying engineering task of mountain construction involving heavy earth and rock excavation; upland construction in industrial and agricultural country where traffic introduces a surfacing problem, and low-land construction complicated by stream crossings and overflow conditions. These are tangible difficulties, which is not true of the difficulties of the other phase of the regional planning problem, namely, sectional jealousy growing out of the provincialism of previous county control of all highway enterprise. It is fair, then, to call the *fourth fundamental group characteristic*, a problem in regional planning.

Financing and Public Sentiment—It is this lingering idea of county rights which has obstructed state financing, although in general the main reasons for delay are: (1) Doubt whether such large expenditures can be afforded and (2) debate whether a bond issue or a pay-as-you-go policy is the sounder method. Public sentiment in practically every state of the group favors improvement on an extensive scale, but it is undetermined as to the wisest method of financing. Everywhere, unfortunately, discussion is tinged with partisanship, which is forgetting the economic and business question in the determination to win personal victory. This situation, however, is largely incidental and may be overlooked in the certainty, which observation indicates, that education is crystallizing public opinion. A public going to school in highway affairs is almost the first impression one gets of the present situation in the border-line states of the South.

Turning to the proposed plans of financing, whether an issue of bonds or a pay-as-you-go method is considered, resort to a general tax is nowhere being advocated. Indeed great effort is being expended to kill any suspicion that general taxes will be increased by intensive road building. The money is to come from automobile license fees and gasoline taxes, and such other taxes as now exist. Six states of the group, all except Missouri, now impose a tax on gasoline: 3c. in South Carolina, North Carolina and Virginia; 2c. in West Virginia and Tennessee, and 1c. in Kentucky, an average rate of 2½c. a gallon, which is well above the average rate for the country. The *fifth fundamental group characteristic* is then, that the automobile is to be made to pay for road improvement.

Road Types—There is no group characteristic in road types except that maximum immediate construction of permanent grade surfaced with selected local soil is contemplated. Paved roads are of all the types common elsewhere except that Kentucky rock asphalt has greater use in these mid-southern states.

Recapitulation—The elements which feature the highway problem in these seven states as a group are: (1) Construction primarily to develop territory and create traffic; (2) Provision of immediate highway service by full-system maintenance and quantity production of permanent grade temporarily surfaced; (3) Regional

planning required by the distinct mountain, upland and bottom land sections of each state; (4) Development of financing plans without general property taxation; and (5) Public education in highway economics and administration.

The Two Carolinas

THE TWO Carolinas are far apart in their progress in road improvement. North Carolina ranks perhaps as the most advanced state of the South. In system development West Virginia will probably challenge this claim and Missouri certainly is running ahead in mileage under contract. South Carolina has not been in a position to do what the other states have accomplished. It has limited funds which have to be widely distributed according to county allotment so that both system development and intensive construction have been impossible.

In population and area the Carolinas are quite different. They are closely similar topographically. Both have the coastal plain, the Piedmont uplands and the mountain region, each having its characteristic development and all together presenting the problem in regional road planning which is a group characteristic of the seven mid-southern states. They are alike too in having extended areas of "top-soil," which is one of the most valuable of the natural road surfacing materials. Altogether the problems of the physical development of roads are similar in the two states.

South Carolina

Mobilizing for Highway Development

South Carolina is a state making ready for the period of intensive road improvement which it knows is approaching. Evidence of this appears in economic studies and formulation of plans by the state highway commission and in the inauguration of definite legislation for a bond issue and for centralizing authority in the state and carrying this legislation over to a succeeding regular session, thus protracting the period of discussion preceding action.

With a very determined public opinion that more definite highway development is required, there is no definite popular thought on ways and means. This is more true of questions of finance and administration than of those of amount, location and type of road. There are, among those who are looked to for formative planning, factions favoring (1) centralized state administration, (2) complete county administration and (3) joint state and county administration. Both a bond issue and the pay-as-you-go plan of financing have their advocates. Taking their cues from their leaders, the run of persons uphold this or that plan as may happen.

Of the bills put before the Legislature last winter, one called for a referendum on a $60,000,000 bond issue to be financed by increased automobile license fees and a gasoline tax, and one specified a state highway system to be constructed and maintained without regard to county boundaries. Both bills were passed by the senate and after consideration in the house were carried over to the next session. It is a fair presumption that the postponement was wise, since a bond issue would be certain to be defeated by popular vote with the people in their present undetermined state of mind, and that an interim period of thought and discussion will help to formulate and stabilize public opinion.

Meanwhile the engineers of the highway commission are formulating tentative engineering and economic policies. As a starting point three classes of public roads are being considered:

1. Those connecting the farm and market which are or ought to be, it is thought, of sufficient local interest to be paid for wholly out of local funds.

2. Those connecting every market of consequence in the state directly with the next larger markets so as to get a connected system of inter-market roads. These roads, it is considered, are of interest to the entire state, and should be paid for at least in large part by the state.

3. Those roads connecting the principal centers of this state with the principal centers of other states. These are of national significance and ought to be paid for at least in part by the nation.

With 52,000 miles of public roads it is estimated that between 8 and 9 per cent, or from 4,000 to 4,500

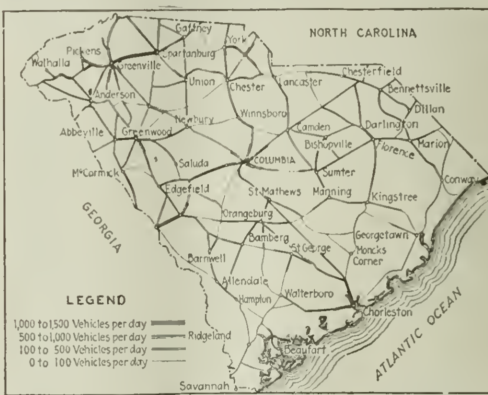


FIG. 1—APPROXIMATE DISTRIBUTION OF HIGHWAY TRAFFIC IN SOUTH CAROLINA

miles, will eventually have to be included in the state system "if all centers where farm products are marketed in sizeable quantities are to be connected adequately." The present system, as of Jan. 1, 1923, includes 3,519 miles. Type of improvement and its cost have been carefully considered.

Tests made by the department engineers indicate savings up to 50 per cent in gasoline consumption between operating a motor vehicle on fair earth roads and on pavement. Between average unimproved earth roads and the better sand-clay and top-soil roads the saving may run as high as 30 to 40 per cent. Assuming that sand-clay roads cost $5,000 and paved roads $30,000 a mile, Charles H. Moorefield, state highway engineer, speculates on the problem as follows:

"If only 1c. per vehicle-mile is saved, 100 vehicles per day would mean a saving of $360 per mile per year, which would pay 5 per cent interest on $5,000 and leave over $100 per year to help with the maintenance. One thousand vehicles per day would mean a saving of $3,600 per mile per year and would justify any sort of pavement. The actual saving, in cost of operation, of course, would be much more than 1c. per mile as between an average unimproved earth road and a good sand-clay road, particularly if the latter is well maintained. In fact it is estimated, from such information as is had, that the average cost of operating a Ford automobile is approximately 10c. per mile for the unimproved roads in good weather, 6.5c. per

mile for well maintained sand-clay, top-soil and gravel roads, in any ordinary weather, and for a paved road, about 5.5 to 6c. per mile. For other makes of automobiles the relative difference in cost of operation is about the same.

"If these figures are accepted as showing the relative operation costs and the construction cost is estimated as already mentioned, it is apparent that in general 50 vehicles per day would justify a sand-clay or top-soil surfacing with an expenditure of $300 or $400 per mile per year for maintenance, and between 500 and 1,000 vehicles per day would justify a pavement.

"From such traffic counts (see Fig. 1) as have been made, there are about 1,200 miles in the present state highway system where the traffic has already reached or is approaching the point where hard-surfacing becomes economical and of this about 200 miles have already been paved. Every mile of the remaining system not already improved can unquestionably be improved economically as sand-clay, top-soil, or gravel roads. There are about 2,000 miles of such roads already and at least 2,000 miles in addition are necessary to complete the systems."

As a construction program to meet the minimum highway requirements of the state the following has been laid down:

1. Two thousand miles of sand-clay, top-soil and gravel, to be completed in three years, at an average cost of $6,000 per mile, allowing for some gravel to be transported by rail, or a total for this item of $12,000,000.

2. One thousand miles of pavement to be completed in 6 or 7 years at an average cost of $28,000 per mile, or a total for this item of $28,000,000.

3. Major bridge projects to be built as the sand-clay system develops, or within 3 years, at a total cost of about $5,000,000.

This adds up to a minimum construction program of about $45,000,000 during 7 years. About $1,500,000 per year would be needed for maintenance in addition to the funds for construction.

Two fundamental thoughts stand out in this speculative planning; one is progressive construction and the other is the use of top-soil surfacing. In North Carolina both practices have been perfected to a degree which makes their adoption logical in a state having so much the same conditions as South Carolina.

North Carolina

Constructing Roads Progressively

Intensive highway development is in progress in North Carolina. Construction with the bond issue money began in April, 1921. On Jan. 1, 1923, there had been completed on the state system 137 miles of paved road and 676 miles of graded and surfaced road. There were under contract at that date 850 miles of paved road and 931 miles of graded and surfaced road. The plans for 1923 contemplate putting 800 miles of road under contract, about half had been let on May 1. So many activities are involved in a program of this size that a general review would largely defeat any good purpose.

North Carolina stands out in highway affairs for its efficient administration, its plan of progressive construction and its full-system maintenance irrespective of condition of improvement.

There is complete state administration of both construction and maintenance. The chart Fig. 2 shows the organization adopted. It is not merely in its powers and its mechanism, however, that administration exhibits its quality. An excellent personnel has been secured and a team morale developed which are pushing through one of the most remarkable of the many notable state highway programs of the time.

Progressive construction has been expanded so often in the last year or two that little remains to be said of its theory or practice. In North Carolina it has been developed as an official plan more purposefully perhaps than in any other state. As described by Charles M. Upham, state highway engineer:

"The North Carolina method of progressive type construction is to grade the road, using the same standards for line and grade that are used in hard surface construction. Only one standard of drainage structures is used, regardless of whether the road is merely graded or is to be covered with a hard surface. This construction of

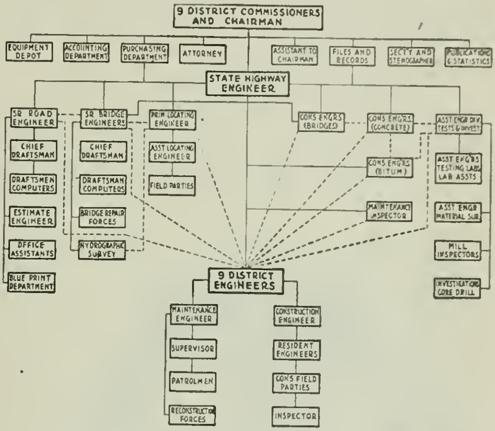


FIG. 2—NORTH CAROLINA HIGHWAY COMMISSION ORGANIZATION CHART

graded road will care for the light traffic which generally exists in all newly developed localities. This graded road is at all times maintained and when the increased traffic creates a high cost of maintenance, then it is time to construct the next higher type of road surface. The next step in the progressive type road is to cover the graded road with a selected soil material such as sand-clay, top-soil or gravel. This material is generally of higher bearing value than the natural soil and is a material which is less affected by moisture and, therefore, more suitable for use as a road surface. This selected surface material is maintained as a subgrade highway until such time as the maintenance cost becomes excessive and the increased traffic indicates that a hard surface roadway is necessary.

"The cost of grading and of the drainage structures generally constitutes about one-sixth of the ultimate cost of a hard surface road. To add a selected soil surface adds very little to the cost of this construction. Consequently about six times as much road, with a selected soil surface, may be constructed for the money that would be spent for the immediate construction of hard surface roads. This makes it possible for transportation to be benefited to a much greater extent and the state to develop at six points rather than at one. It will be noted that the construction of the selected soil surface is an addition to the graded road, and no previous step in the grading or construction of drainage structures has been lost or thrown away in the construction of this selected soil surface road."

Quick extension of road service to the people, which is one of the fundamental objects of progressive construction, was again a fundamental thought in planning full-system maintenance and putting practically all state roads under intensive maintenance whether improved

or not. In the matter of the working out of the theory of immediate full-system maintenance without respect to the progress of construction, Frank Page, chairman of the North Carolina Highway Commission, says:

"It has been demonstrated by North Carolina's assuming control of a large mileage of highways for improvement and by the establishment of immediate intensive maintenance that the public at once realizes something is being done. The adoption of the combination patrol and gang system of maintenance, employing motor trucks and tractors for all operations, demonstrated to every section of the state that results were being accomplished every day. The same standard of work and uniformity of practice was maintained throughout the entire state, and, combined with the tremendous extent of the operations, gave immediate and better service to traffic and satisfied an impatient and jealous public which did not expect to see the results realized in so short a time."

A New Method of Testing Hardness

A HARDNESS test differing quite radically from existing tests based upon scratching or penetration of a ball or a sharp point has been worked out by Edward G. Herbert, Ltd., of Manchester, England. An instrument called the Herbert pendulum hardness tester

HARDNESS TESTER APPLIED TO A CUTTER

is being built and sold by them for the purpose of the new tests. As indicated in the view herewith, the instrument consists of a bow-shaped weight, adapted to swing as a pendulum on a point support provided at the center of the bow. At this support the bearing is a 1-mm. ball of either ruby or hardened steel. On top of the bow is mounted a spirit level.

With this instrument two kinds of test are possible. What appears to be the preferred test of the makers is called the time test. In this, the instrument, placed with its bearing point on the surface to be tested, is given a very gentle impulse so as to oscillate on its support; the time, in seconds, of ten complete oscillations is taken as the hardness number. From a statement by the makers, an empirical relationship between the hardness figure found in this time test and the Brinell hardness number has been established by tests, as follows: For time-test numbers T below 33⅓, the Brinell number is $0.3\,T^2$, while for time-test numbers over 33⅓, the Brinell number is $10\,T$. The time of ten oscillations on glass is 100, so that the time-test hardness number for glass is 100. This is with a length of pendulum (height from bearing surface of ball to center of gravity) of 0.1 mm.

A test of another kind may be carried out by tilting the instrument to one side until the level bubble is at zero on the scale, and then releasing it. The reading of the level bubble at the end of the first swing is taken as the hardness number. In the case of glass this figure is 97, while annealed carbon steel gives 41, soft cast brass 4, and lead 0.

In the photograph herewith the instrument is shown applied to a cutter whose hardness is to be tested. The cutter is held in a ball-and-socket adjustable vise which is built by the makers for use with the instrument.

Streets of Canterbury in the Days of Henry VIII and Elizabeth

FOR the benefit of Canterbury pilgrims and residents after the days of Chaucer, or in the reigns of Henry VIII and Elizabeth, street lighting, watering, and cleaning at private expense, and scavenging at public expense, were ordered in the following terms, according to excerpts from Bunce's manuscript abridgement of the minutes of the Courts of Burghmote, cited by P. H. Warwick, city surveyor and engineer, in a paper on "Roads of Canterbury, Ancient and Modern," read before a district meeting of the Municipal and County Engineers and published recently in London *Surveyor*:

Street Lighting—Twentieth of November, 55th Henry 8th. From henceforth during Winter every dark night the Aldermen and Common Council and every Inn holder shall severally find one candle will light at their doors on pain of forfeiting 6d., and the other inhabitants are to do in like fashion upon reasonable request under the same pain, and if any lanthorn shall be stolen the offender shall be set on the Pillory by the discretion of the Mayor. The candles are to be lighted at 6 o'clock, continue till burnt out.

Street Cleaning—Sixth November, 35th Henry 8th. The inhabitants of the city are from henceforth to keep clean their pavements belonging to their houses on every Friday or Saturday, and are to carry away the Dung from the pavements to a common place theretofore ordained called the Black Dyke, and no persons are to lay any Dung under their walls on pain of 2d., one half to the Chamber and the other half to the Officer assigned on. The penalty is to be levied by distress.

Street Watering—Fourteenth July, 32nd of Elizabeth. In course of the hot weather every inhabitant of the city is to water the street adjoining his house on pain of 3d.; to be levied by distress.

First Scavengers—Eleventh March, 42nd of Elizabeth. The Mayor and Aldermen are to provide a Scavenger or Scavengers for cleaning of the streets, who shall be paid their wages by a taxation on the inhabitants.

Water Costs More Than Doubled at Reading

The cost of supply water at Reading, Pa., increased from $15.62 per million gallons in 1913-14 (April to April) to $32.82 in 1921, according to the latest published report of Emil Nuebling, chief engineer of waterworks. The figures given include all maintenance, but no capital charges. Pumping costs increased from $5.97 to $15.50 per million gallons. The revenue per million gallons was $48.41 in 1913-14 and $45.13 in 1921.

Flood Relief Plans for Red River of the North

Interstate Relations Complicate $6,000,000 Plans for Detention Lake and Improving 400 Miles of Winding Channel

PREVENTION of overflow from a sinuous river channel and drainage of flood waters from the adjacent lands are the main points of a project for the protection of the valley of the Red River of the North, where increasing settlement makes the periodical flooding increasingly serious. Some form of interstate organization will be necessary for carrying out and supervising the project effectively, since Lake Traverse, at the head of the river, forms part of the boundary between Minnesota and South Dakota, while the river forms the boundary between Minnesota and North Dakota. Channel improvement being one of the main features in the project, maintenance of the channel in its improved condition will be essential to success and will be one of the problems for solution by whatever supervisory body is organized.

This flood control and drainage problem has been the subject of an extended investigation by the U. S. Department of Agriculture, under the direction of S. H. McCrory, chief of the division of agricultural engineering. The accompanying review of the situation is prepared from a report by P. T. Simons, senior drainage engineer, and Forest V. King, drainage engineer, who have been in charge of the investigation. A preliminary report, dealing with the special features involved at Lake Traverse and the upper end of the valley, was summarized in *Engineering News-Record* of July 29, 1920, p. 225.

The Red River of the North heads practically in Lake Traverse on the western line of Minnesota and flows north to the Canadian boundary, continuing to the city of Winnipeg and discharging into Lake Winnipeg. The problem of the Canadian portion of the river was discussed in *Engineering News-Record*, April 20, 1922, p. 657. The river is fed by numerous tributaries and its drainage area and the main streams are shown in Fig. 1. The south end of Lake Traverse is closed by a low and narrow divide, separating it from Big Stone Lake, which is at the head of the Minnesota River flowing southeast to the Mississippi (see *Engineering News-Record*, July 28, 1921, p. 140).

Although the course of the Red River is due north its channel is so extremely winding that its length from the Lake Traverse outlet to the Canadian line is 456 miles, or about double the straight line distance. This typical condition is shown in Fig. 2. For the first sixty miles the stream is known as the Bois de Sioux River, the Red River proper beginning with the junction of the Bois de Sioux and Otter Tail rivers near Wahpeton, N. D

Red River Valley—A plain 15 to 30 miles wide flanked by steeply rising ground forms the drainage area of the river, with 35,895 square miles south of the Canadian line. Owing to natural drainage there is comparatively little swamp land in the plain, except along the Bois de Sioux River. Not more than 10 per cent of the drainage area is forested and about 80 per cent of the prairie and cleared land is under cultivation, the remainder being mainly grazing land and town sites. The soil is largely clay and loam.

In this broad and nearly level valley the flood water has very little current and the depth is not great even with a heavy overflow. But it causes damage to property, interferes with transportation and agricultural work and may result in greatly reduced crop yields. The river has an irregular flow and protracted periods of low water. Its fall is slight, the elevations of the ground surface on the banks being 980 ft. above sea level at Lake Traverse, 963 ft. at Wahpeton, 900 ft. at Fargo, 830 ft. at Grand Forks and 789 ft. at the Canadian line. The channel capacity is about 2,000 and 4,000 sec.-ft. just above and below Breckenridge, 6,000 ft. below the Dakota Wild Rice River, 12,000 ft. below the Sheyenne River, 15,000 below the Buffalo River and 25,000 sec.-ft. below the Red Lake River.

Rainfall and Runoff—Annual precipitation during the 38-year period including 1919 for the 25,755 square miles above Grand Forks has ranged from 12.21 in. in 1910 to 27.76 in. in 1916. On some subdivisions of this area higher figures have been reached, with a maximum of 35.2 in. on 4,225 square miles. The annual and monthly records of rainfall indicate that the maximum annual precipitation will not exceed 30 in. for the entire drainage area south of

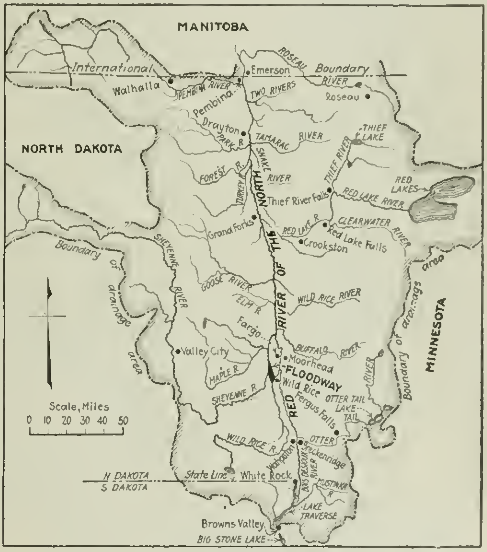


FIG. 1—DRAINAGE AREA OF RED RIVER OF THE NORTH

the Canadian line, 37 in. for areas of 2,000 square miles or more in the eastern section, 25 in. in the extreme western section and 36 in. above Fargo. These maximum conditions are not likely to occur more often than once in 50 to 75 years, and maximum precipitation on the smaller drainage areas is not likely to occur on all these subdivisions in one year.

Runoff records for this 38-year period show an annual runoff from the drainage area south of Grand Forks ranging from 23,590,000,000 cu.ft. in 1911 to 190,880,000,000 cu.ft. in 1897, with a mean of 90,870,000,000 cu.ft. and a mean rate of flow of 2,881 sec.-ft. The shape of the drainage area tends to produce quick runoff. Since the width is nearly equal to the length, the runoff from large portions tends to concentrate at certain points. Maximum monthly records of rainfall and runoff are shown in Table I. Drainage ditches do not materially increase the spring runoff from melted snow, because a majority of these ditches are obstructed by snow and ice so that they do not begin to function until some days after the melting of the snow on the drainage area.

Tributaries and Drainage Ditches—In the upper reaches of the tributaries the fall is much greater than in the Red River, but in the lower parts the fall is slight. Many of

these streams parallel the main river for a considerable distance before finding an outlet. The channels are sinuous and badly obstructed by vegetation. During heavy runoff the general condition is that of increasing bodies of water coming down obstructed channels of small and diminishing slope. These bodies finally unite in a common channel having the same characteristics, resulting in the overflow of large areas of flat land along the river.

Drainage ditches in the flat lowlands have but little fall and their efficiency depends largely upon the conditions of river flow. This drainage work is more extensive on the Minnesota side, where 41.3 per cent of an area of 4,391 square miles is within half a mile of ditches, while on the Dakota side the proportion is only 11.5 per cent for an almost equal area. The upland drainage systems have greater fall and free-flowing outlets. A condition which appears to be beyond relief is that many of the ditches

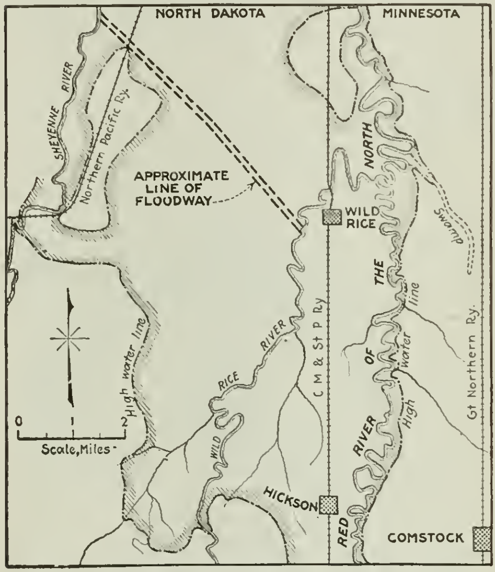


FIG. 2—PROPOSED FLOOD DIVERSION CHANNEL

To extend a distance of seven miles from the Wild Rice River to the Sheyenne River and to bypass flood water around Fargo. Note the winding course of the river.

are filled with snow and ice in the spring. Tile drainage is very limited as yet but it will accelerate the removal of water in the soil and thus reduce the bad effects of excessive moisture.

Snow and Ice Conditions—Snow accumulates on the drainage area in varying quantities from November to March, inclusive, and has an important effect on the runoff during March and April. For the highest flood on record (April, 1897) the average depth of snow just before the

TABLE I—MAXIMUM MONTHLY PRECIPITATION AND RUNOFF OF THE RED RIVER

Month	Precipitation Inches Max.	Year	Runoff: Billions of Cubic Feet Max.	Year
Jan.	1.57	1916	4.70	1906
Feb.	1.48	1908	3.48	1906
March	1.91	1902	22.60	1910
April	4.94	1896	81.92	1897
May	5.17	1896	42.72	1893
June	7.56	1915	32.48	1906
July	6.93	1897	30.40	1916
Aug.	7.40	1900	19.20	1897
Sept.	4.52	1900	11.70	1905
Oct.	3.20	1901	16.58	1900
Nov.	2.33	1896	13.64	1900
Dec.	1.52	1909	6.49	1909

TABLE II—STORMS IN RED RIVER VALLEY

Duration, Days	Precipitation, Inches Total	Max. in 24 Hours	Date
3	11.10	10.75	July, 1909
8	10.50	3.15	Aug., 1900
4	9.02	4.92	July, 1919
4	8.18	4.31	Aug., 1899
6	7.42	5.86	July, 1897
6	6.93	5.85	Aug., 1908
4	6.13	5.30	June, 1919
3	5.04	3.95	June, 1915

spring break-up was 26 in. and all of this melted in about twenty days. All the larger floods have been due to the melting of snow on the drainage area rather than to precipitation at the time of the flood, although in some cases the flood has been increased by precipitation. Nearly every year more than 25 per cent of the annual runoff occurs in April. This is owing to the melting of snow, as the April precipitation is usually less than 10 per cent of the annual precipitation.

With a northward flow through a region of low winter temperature and heavy ice, spring thaws begin in the upper portions of the watershed and move gradually downstream, causing the runoff from large areas to reach lower portions of the river when the ice is breaking up. This ice lodges against trees and other obstructions so as to retard the current and reduce materially the discharge capacity of the stream. Prof. Chandler's paper on "The Floods of the Red River Valley" (*Journal of the University of North Dakota*, 1918) states that in some cases this ice retardation has raised the water 2 to 7 ft. higher than would have been necessary for the same discharge capacity with a free channel.

Storm Records—For the 26-year period 1894-1919 there were 130 storms with a precipitation of 2 in. or more in 24 hours. Of these, 62 were in June-July, 30 in April-May, 31 in August-September, 2 in March and 5 in October. In duration, there were 41 storms of three days each, 38 of four days, 18 of five days, 17 of six days, 8 of seven days, 7 of two days and 1 of eight days. Eight of these are noted in Table II. The storm of July, 1897, covered the entire drainage area and was the maximum storm of such wide extent.

Storm precipitation during the summer often has a marked effect on the runoff, this effect being relatively greater on the drainage areas of tributary streams because the most intense precipitation occurs in comparatively small areas. Storms sometimes cause maximum runoff on drainage areas up to 10,000 square miles, but on the larger areas, such as that above Grand Forks, the spring runoff due to melting snow is the greater.

Flood Conditions—Serious spring floods due to rain and melting snow occur at intervals of one to fifteen years along the Red River north of Wahpeton. From May to October local floods are caused by storms of very heavy rainfall over areas up to 6,000 square miles. Seven times during the 40-year period including 1920 the Red River at Grand Forks rose above flood stage (El. 819.5 or 40 ft. on the gage of the U. S. Geological Survey). In each case this occurred soon after the spring thaw. High stages occurred in the two consecutive years 1882 and 1883, but the longest period between flood stages was twelve years, 1904 to 1916. Only two of these seven floods were serious throughout the entire valley. Some have been most serious below Grand Forks, but that of 1916 was most serious around Fargo and in the upper parts of the valley.

Conclusions based on the records are as follows: (1) A serious flood may occur in any year; (2) the probable frequency is one in fifteen years; (3) the largest probable interval between floods is thirty years.

Recommended Improvements—From the study of the situation it is evident that adequate drainage of the wet and overflowed lands in the valley will require control or reduction of the floods and the provision of ample drainage ditches to remove excess water rapidly from these lands which have insufficient natural drain-

age. The work divides naturally into three parts, which can be carried out separately or as one large project: (1) Lake Traverse and the Bois de Sioux River; (2) the Red River; (3) the Red Lake River.

For the first section, it is proposed to develop Lake Traverse as a detention reservoir by means of a dam at the outlet and a levee at the south end; also to excavate a new direct channel for the Bois de Sioux and to provide a system of drainage ditches (see *Engineering News-Record*, July 29, 1920, p. 225).

Channel improvement and one stretch of stream diversion are the main features of work proposed along the Red River. It is only during times of excessive runoff that flood stages occur and a relatively small reduction of the high stages would prevent overflow. In the opinion of the authors of this report there is no opportunity for detention reservoirs, while levees from 5 to 20 ft. in height along the river and its numerous tributaries would be of prohibitive cost. To relieve the flood flow at Fargo, it is proposed to construct a wide and shallow floodway with a capacity of 2,250 sec.-ft. from the Wild Rice River near Wild Rice, N. D., to the Sheyenne River, a distance of about seven miles. The approximate route of this floodway is shown in Fig. 2, but no definite location has been made. In this way, high stages of flood water would be bypassed around Fargo and discharged below that city by the Sheyenne River. There would be a concrete inlet sluiceway, with gates, but the channel would be formed with gentle slopes so as to be used normally for pasture.

In improving the main channel, its enlargement and the construction of cutoffs are both impracticable, owing to the enormous amount of excavation which would be required and the difficulty of disposing of the material. The most economical and effective plan is considered to be that of clearing the channel of the numerous obstructions which retard the flow and are largely responsible for overflow. Throughout its length the channel is more or less obstructed by trees, brush, bridge piers and other structures, refuse dumps and débris. This condition is shown clearly by the typical cross-sections in Fig. 3, these sections including the normal open channel and the restricted channel at bridges. Particular attention is called to the narrow section at Fargo, which indicates the desirability of bypassing the floodwaters around the city by means of the relief channel noted above.

For the 394 miles from Wahpeton to the Canadian line it is suggested that the entire high-water channel should be cleared of all obstructions except bridges. To maintain this condition it will be well to utilize that part outside of the flow line for pasture or hay. Many of the bridges are old and new ones should span the entire channel and be placed above high-water level. The high-water channel would include from 100 to 200 ft. on each side of the present low-water channel, giving a total cleared width of 300 to 600 ft.

Red Lake River—An important factor in the Red River flow below Grand Forks is the flow from Red Lake and the Red Lake River. Except for high rolling land at the south, the lake of 441 square miles is in low flat country. The high-water level of the lake is 1,177 ft. or 4 ft. above low water. A project developed by the U. S. Engineers provides for limiting the range to 3 ft. by a control dam giving a maximum elevation of 1,174 ft. This dam would have concrete floor and piers with stop-log sluices between the piers. The present ill-defined channel below the lake would be improved for a distance of 45 miles. By thus lowering the lake level, local flooding would be prevented and drainage facilitated, while the increased flow would benefit present and future water-power plants on the Red Lake River.

Cost of Improvements—The estimated cost of the entire project is $6,179,000 at 1920 prices. This amount is distributed as follows: Dam and sluices at Lake Traverse, and new river channel and drainage ditches along the Bois de Sioux, $1,400,000; channel clearing along the Red River, $3,395,000, with $250,000 additional for extending the work 30 miles beyond the Canadian line to make the improvement fully effective; Wild Rice River floodway, $355,000; Red Lake and Red Lake River improvement, $779,000.

Possibility of flooding now makes the farming of large areas of the valley impossible or hazardous, and overflows which do occur interfere with urban activities and transportation. In the great flood of 1897 the loss was estimated at $7,000,000 and a similar flood at the

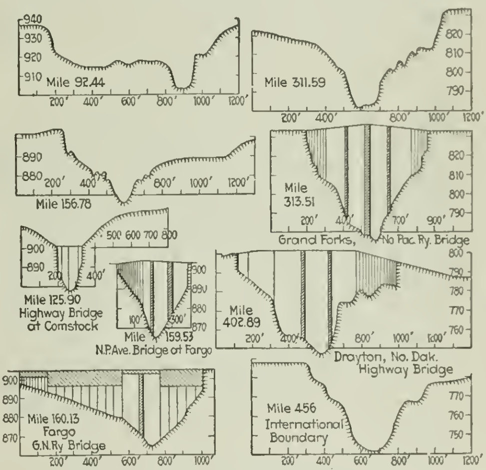


FIG. 3—TYPICAL CROSS-SECTIONS OF RIVER
Note restricted and obstructed channel at bridges.

present time would cause much greater loss. It is considered that these unfavorable conditions can be eliminated by the proposed improvements, which would lower the flood level by 5 ft. or more. Further, the benefits to be derived would warrant considerably greater expenditure than will be necessary for relief.

Organization—For this interstate project it would be necessary under existing State laws for organizations in the three states to enter into an agreement as to the distribution of cost. To insure satisfactory results it is essential to have a definite centralized control during construction and for subsequent maintenance. One plan suggested in the report is for each state to organize a drainage district including the lands benefited. The officers of these districts could then meet as one board having charge of the project as a whole. As an alternative, it might be possible to enact legislation providing for a joint commission. In any case, legislative action should provide authority for maintenance of watercourse channels, since lack of such authority has resulted in damage due to channel obstruction and ungoverned flow.

North Dakota Reservoir Project—A system of reservoirs and other works for control of floods of the Red River is proposed by Herbert A. Hard, chief engineer of the North Dakota Reclamation Commission. In a recent report he states that the losses during the three flood years 1915-1917 amounted to $50,000,000 and that the total cost of reservoirs, canals and controlling works will be about half that sum. This work by the State is being planned to meet the terms of the U. S. War Department. Impounding reservoirs are proposed at Lakes Traverse, Tewaukon, Ottertail and Red, at three points on the Sheyenne River and on the Pembina River west of Walhalla. The following is from a statement submitted by Mr. Hard.

An intensive survey has been made of the Sheyenne River gorge, especially for a hundred miles from Valley City to the headwaters. This narrow gorge varies from 100 to 250 ft. in depth and from 1 to 2 miles in width at prairie rim. The flood plain varies from a few rods to a mile in width. The gradient varies from 1 to 3½ ft. per mile. A stadia survey covered the entire gorge. Topographic maps are complete, as are preliminary designs for the proposed control dams, which are to be of the earth fill type with puddled clay core and concrete controlling works and spillway.

Taking as an example the dam ten miles north of Valley City, designs were made for heights of 50 and 60 ft. The valley floor is at El. 1239. A dam with spillway crest at El. 1280 will contain over 630,000 cu.yd. of earth and, with its concrete culvert, spillway, etc., will have an estimated cost of $344,134, exclusive of land and damages. This will give reservoir capacity of about six billion cubic feet and will afford relief from floods for the lower Sheyenne and Red valleys. For the Wild Rice River, a small dam at the outlet of Lake Tewaukon would partly control the flood stages and reduce the crest at Fargo. Alternative designs for dams 6 and 8 ft. in height have been prepared, with costs of $8,000 and $20,000 respectively. At this reservoir, as well as at Lake Traverse and Red Lake, there would be very little damage by flooding of surrounding lands.

The state and federal reports recommend a dam near the outlet of Lake Traverse, which lake is 30 miles long and from 1 to 3 miles wide. It can be made to impound 12,000,000,000 cu.ft. of water and will remove the flood menace of the waters of the Mustinka River, Minn., which caused much of the loss in 1915-1917. That loss became the basis of the $1,500,000 damage suit brought by the Dakotas against the state of Minnesota. The federal estimates, made during the war, are $1,400,000 for the Traverse project or $12.50 per acre of the lands protected. Estimates on improvement of the Red River channel from the outlet at White Rock to a point thirty miles north of the Canadian line are $4,000,000 or $8 per acre. The state has made no survey of the channel, but from the work on Lake Traverse prior to and during the federal survey, its post-war estimates are about two-thirds of the above values.

The War Department has made similar surveys of Red Lake and Red Lake River, Minnesota, and the state and federal engineers are in agreement on the efficiency of impounding reservoirs and channel improvements as means to avert floods in the afflicted valleys which have each caused losses equal in amount to the cost of all the improvement projects recommended.

Concrete Poles for Large Swedish Transmission Lines

Concrete Poles Produced by a Centrifugal Process Prove to Be Economical and Have Unusual Tensile Strength

By F. A. Brackmann
Berlin-Lankwitz, Germany

On account of the high price and the cost of maintaining iron structures, and the comparative short life of wooden structures, Swedish electric light and power companies have turned their attention to the development and use of concrete poles for transmission lines. The line from Trollhättan Falls in south central Sweden to Vaestreos, northwest of Stockholm, is the largest one on which they have been used. It is about 200 miles long and at present transmits current at 110,000 volts. It is intended to increase the voltage to 240,000 later on.

Eight hundred concrete poles produced by the centrifugal process were used in the construction of this line. They were erected in pairs. The first few hundred were connected by an iron transverse beam, but in view of the favorable result of tests made in the course of construction reinforced hollow beams were used later on.

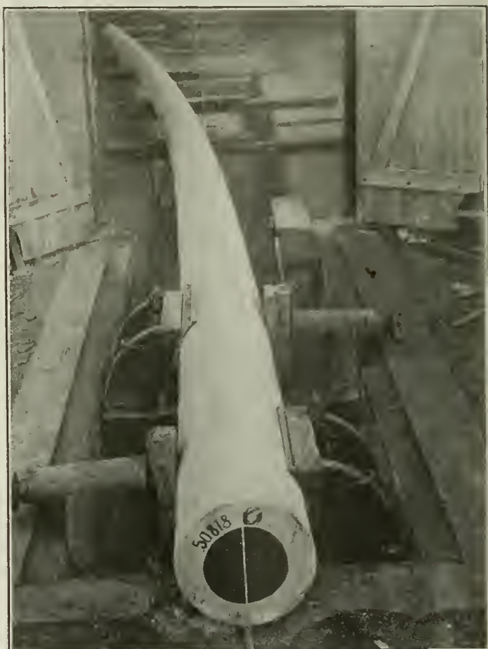


FIG. 1—TESTING ONE OF THE CONCRETE POLES

A pole 64 ft. long bent 7½ ft. out of line at the top without showing signs of failure.

These carry two cables between the poles and two at the ends outside. The length of the cross beam is about 54 ft., and the width between the two poles is 36 ft. According to the changing local conditions along the line, and the variations in the load from 1,200 to 1,400 lb., four different size poles were made, 56 to 59 ft. in

FIG. 2—A DOUBLE REINFORCED-CONCRETE POLE
A pole 61 ft. high on one of the smaller lines subjected to a top load of 10,000 lb.

length, and in diameter from 9 to 10 in. at the top, and from 18.5 to 23 in. at the bottom. The average thickness is about two inches. Nearly six per cent of them were tested, and some of them, about one per cent of the whole number, were subjected to bending stresses till fracture occurred. It was stipulated that the latter had to stand at least four times the highest ultimate load at the top. The others had to be subjected to double that load without showing any cracks or alterations of form.

The tests proved however that the poles were exceedingly elastic, and could carry six to eight times the highest ultimate top load. During the tests the load was taken off several times, and the top went almost completely back into its original position, showing that the bending was of an entirely elastic nature. In some cases when the breaking stress had been reached, cracks from the tensile stress outside the bend, and signs of excessive pressure inside the bend appeared at the same time, which shows that the tensile stress which centrifugal concrete will stand is considerably above the usual for concrete. Fig. 1 shows one of the poles, 64 ft. long, being subjected to a bending stress of 7,300 lb., bent 7½ ft. at the top without any signs of damage. The poles were tested at an age of six to seven weeks.

Of the poles and the beams which were manufactured at the works of a German firm at Cossebaude near Dresden, two-thirds were transported by rail the whole way, via the ferry Sassnitz-Trelleborg, and the rest were shipped by lighters from Stettin. Considering the great stresses to which the transport subjected them, it speaks well for their quality that all arrived in first-class condition.

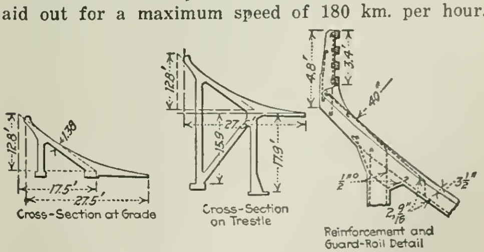
The poles are manufactured in a wooden mold, which is revolved in a special machine. The mold consists of two half-round forms, and is lined with sheet iron. The reinforcement is formed by rolled rods, of open-hearth material, placed longitudinally, which are interwoven with three spirals of wire one within the other. It is wound upon a special automatic machine, so that uniformity in the measurements of the spiral and in the strength of the poles is insured. The spirals influence the fracture stress comparatively little, but they determine to a certain extent the rigidity of the pole, and by using three spirals it has been possible to reduce the bending to ½ per cent of the length at the normal load, and to 1½ per cent at the double load. In order to give the maximum strength to the pole, care is taken that the reinforcement comes as close as possible to the circumference, and is at an equal distance away from it. Small slabs of concrete are therefore fitted to the outside of the reinforcement to keep it in the proper position within the mold. The cement mortar is mixed in proportion of one to three, and some asbestos fiber is added for additional toughness.

After the wire structure and the cement have been put into the mold, this is closed, and put into a machine which revolves it at a speed of 500 to 1,000 revolutions per minute, according to the diameter of the pole. The excessive water in the mortar accumulates in the hole in the center and in striking the wall of the pole during the revolving increases its compactness. The fear that the cement would be thrown to the outside, and that the mixture would become less rich towards the center has been proved unfounded.

After revolving the mold in the machine for about ten to fifteen minutes it is taken out, the lid at the end is removed, and the water is poured out of the center. The pole is left in the mold for one to two days. It has then set sufficiently to be taken out, and is kept in moist sand for about three to four weeks.

Concrete Motorcycle Track in Prague

A combined horse-racing and motorcycle-racing track was built recently in Prague, the cycle track being a concrete frame-and-slab structure surrounding the running track. This cycle track is of unusual design, as the cross-section herewith indicates. It has a measured length of 1,125 m., and is 8 m. wide on the straight and 9½ m. at the middle of the curves. The banking follows the curve of a cubic parabola, and is said to have been laid out for a maximum speed of 180 km. per hour.



CONCRETE BENT OF PRAGUE CYCLE-RACING TRACK

At the upper side the track structure continues vertically to form a protection rail, formed by four 3x6 timbers. The track is briefly described by Dr. J. Polivka, of Prague, in *Beton und Eisen* of May 20.

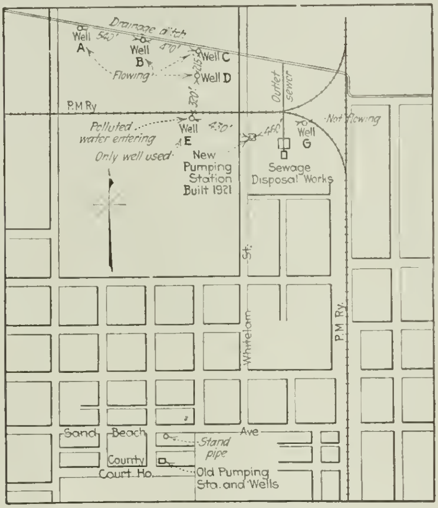
Underground Contamination of the Bad Axe Water Supply

Pollution Entering Unused Well 430 Ft. from Used Well Reached Latter Through Fissure Opened by Dynamite

By W. C. Hirn
Assistant Engineer, Bureau of Engineering, Michigan Department of Health, Lansing, Mich.

FORMATION of fissures by dynamiting wells probably is accountable for the pollution of the water supply of Bad Axe, Mich. The dynamiting took place several years ago but only recently have the dangerous conditions become possible.

Bad Axe is a city of 2,200 population, located in the upper part of the thumb section of Michigan in a level sandy lake bed area. In the vicinity of this city Marshall sandstone is the upper layer of the bedrock formation and is covered by only 30 to 50 ft. of glacial drift. The sandstone is several hundred feet thick. The upper layer is relatively free from water-soluble materials and furnishes water of a hardness of about 200 p.p.m. Previous to 1921 the city procured its water supply from three 6-in. wells, each about 150 ft. deep, located in the south central section of the city. These wells when first driven flowed a limited quantity of water. To procure a sufficient quantity for the city during recent years they have been pumped by air-lift.



RELATIVE LOCATION OF USED AND UNUSED WELLS AT BAD AXE

Several years ago one 8-in. and six 6-in. wells were drilled in the northern section of the city to be used for supplying water to a proposed beet-sugar mill. These wells were drilled to a depth of 260 ft. and after drilling was completed a heavy charge of dynamite was exploded in the bottom of each well. The amount of dynamite used is not known, but an observer stated that water spouted up more than 50 ft. high from the explosion. The proposed sugar mill was not built and these wells were not used for several years. Persons living in the vicinity state that a considerable quantity of water flowed from them continuously.

Because of the excessive cost of operating the air-lift pump at the old pumping station the city authorities decided in 1921 to build and equip a new station to pump water from one of the seven unused wells. This installation was finished during the fall of 1921. Tests had shown that the largest of these wells would furnish sufficient water for the city when the head was lowered not more than 10 to 15 ft. Water from this well has a hardness of 315 p.p.m. but as the city has no important industries which might be affected by hard water the additional hardness was not seriously considered.

A state law requires that plans of public water systems be submitted to the State Department of Health. An engineer was not employed for this work and no plans were prepared or submitted, nor were samples of water sent by the city authorities to a laboratory for either bacteriological or chemical examination. On Nov. 30, 1921, a sample for bacterial analysis was collected from the city supply by a representative of the State Department of Health who was collecting routine railway supply samples in U. S. Public Health Service work. This sample complied with the requirements of the Public Health Service standards.

About March 25, 1921, several cases of intestinal disorders were treated by physicians of the city who judged that the sickness was a form of influenza. This trouble was not brought to the attention of the State Department of Health. Near April 1 a second epidemic of intestinal disorders developed which by April 8 affected at least 75 per cent of the population of the city. On April 12 the State Department of Health was notified of the trouble by the city authorities and was asked to send investigators to the city. A physician and a sanitary engineer were at once detailed to this work. On arriving in the city it was learned that the authorities had circulated handbills advising that all drinking water be boiled.

An examination of the new source of water supply was started immediately. Records showed that the casing of the 8-in. well in use extended down 40 ft. to rock. A screw cap was fitted to the top of this casing and a 4-in. suction pipe from the pump was screwed into the cap and extended about 40 ft. down into the well. All of the fittings appeared to be in excellent condition. To learn if the casing might be leaking a motor-driven air pump was borrowed from a garage and connected to a tap in the cap of the casing. An air pressure of 16 lb. was maintained after the air pump was stopped, which indicated that the casing and connections outside the suction pipe were free from leaks.

It was learned that the old source of supply had been used on different occasions for fire protection. The times when this was used seemed to correspond with the times of the outbreaks of sickness closely enough to direct suspicion in this direction and it was found that a small reservoir at this station was not properly protected against contamination. However, bacterial examination showed the water from the new pumping station to be grossly polluted but that from the old station to be free from contamination.

A further investigation was at once begun to determine the source of the pollution. Meteorological records from the U. S. Weather Bureau Station at Port Huron showed a rainfall of 0.76 in. on March 24 and 0.42 on March 27. These rains flooded a considerable portion of the area about the new pumping station. It was

found that wells marked A, B, C and D on the map were flowing. Well G was not flowing but water stood in the casing above ground level. After some inquiry well E was located in a large pond of water with the top of the casing submerged. On examination it was found that this well was not flowing but that surface water was flowing into it and was no doubt responsible for the gross pollution in the city well 430 ft. distant as shown on the map.

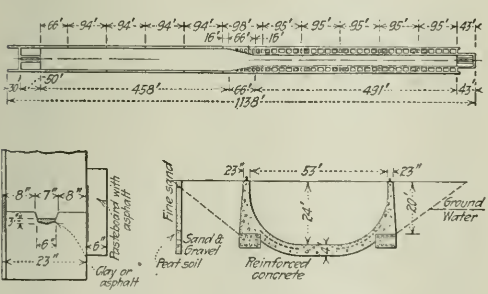
It would seem reasonable to assume that the fine dense nature of the Marshall sandstone would preclude any danger of contamination traveling a distance of 430 ft. but it is possible that the charge of dynamite exploded in these wells opened fissures through this formation. It has also been learned that in some places a very porous material lies between the upper and lower layers of Marshall sandstone and this porous connection may have been partially responsible for the trouble.

Unusually Large Tank for Testing Working Models of Ships

By Prof. Otto Colberg
Hamburg, Germany

One of the most important pieces of reinforced-concrete tank construction carried out in Germany in recent years was the ship-testing tank built at the Hamburg Ship-Testing Institute during the war. The tank has a total length of 1,138 ft. and is built in two sections that can be used either independently or as one continuous tank. When used as one tank it is the longest tank of its kind in existence. The compartments are of different sections. The larger tank is approximately 53 ft. wide, 458 ft. long and 24 ft. deep, while the smaller tank is 491 ft. long, 26 ft. wide and 16 ft. 5 in. deep. The two tanks are connected by a conical tank 65 ft. long. Both tanks are used in testing models of different types of ships, the larger one being used for large models and the smaller tank or the combined tank being used to test small models.

The requirement for the test of models made it essential that the tank be waterproof and of as uniform a



PLAN AND SECTION OF HAMBURG SHIP-TESTING TANK

section as possible without any abrupt changes. In order to insure the tank against settlement, which might occur due to the unstable conditions of the ground at the point where the excavation for the tank was made, the design of the tank was made unusually heavy as shown in the diagram.

To insure watertightness each construction joint was provided with a groove that later was filled with asphalt or clay and the outer surface was covered with a layer of felt and asphalt. Upon completion the interior of the tank received a carefully troweled surface As far as possible the construction joints were placed at such intervals as to provide for expansion and contraction.

In order to keep weather conditions from affecting the tests a steel frame building with brick-filled walls was built over the entire length of the two tanks.

Steam Railroad Tracks in Paved Streets at Philadelphia

A new design of track for steam railroad lines in paved streets, adopted by the Department of Public Works at Philadelphia, Pa., has as its main features a 159-lb. 9-in. grooved girder rail and separate rail blocks instead of the usual cross ties, the gage of track being maintained by tie rods. About 5¾ miles of this new track construction have been laid to carry slow-moving freight traffic. The rail is shown in Fig. 1 and the track construction in Fig. 2.

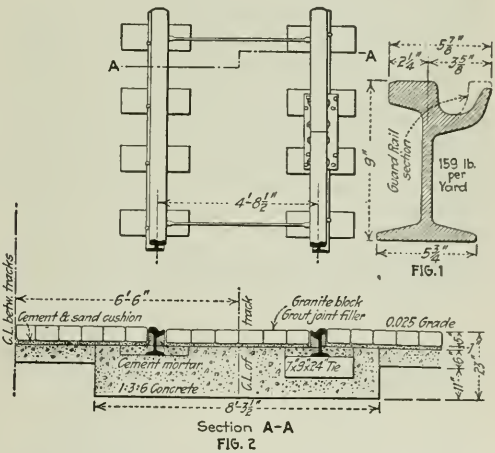


FIG. 1—GROOVED RAIL FOR STEAM RAILROAD TRACKS IN STREETS
FIG. 2—TRACK CONSTRUCTION IN PAVED STREETS

A 9-in. 143-lb. T-girder rail with flat head was used formerly for freight tracks in paved streets, but a more rigid section and a grooved head were considered desirable to stand the wear and traffic and also to permit of laying the paving close to the rail, thus affording a better surface for street vehicles. The form of groove adopted is such that the rail gives a good bearing for the wheels of such vehicles and facilitates their movement in turning out of the track.

A concrete base is used for the entire track area of main tracks and industrial connections, and it is found that the use of separate rail blocks or supports reduces repairs to the granite paving in the track area to a minimum. These blocks, which are of treated wood, are 7 x 9 in. in section and 24 in. long. The foundation is of 1:3:6 concrete and over the base of the rail is a filling of 1:4:8 concrete carrying the 1-in. cushion course of cement and sand upon which the granite blocks are laid. Grout filler is used for the paving and cement mortar is packed against the web of the rails.

Items in Cost of Pumping Water for Irrigation Use

Vital Operating Factors Necessary to Consider in Deciding on Construction Best Adapted for Securing Water Supply

By Barry Dibble

Project Manager, U. S. Reclamation Service, American Falls, Idaho

Looking forward to the future of irrigation development in the West it is apparent that the acreage which depends on pumps is sure to increase. Cheap gravity water supplies have all been used and other methods must be applied. Often pumps can properly be considered an alternative to long gravity canals, tunnels or other expensive features. Both from construction and operation standpoints they frequently can be proved the most economical and the most reliable solution of the problem. Each case involves many special conditions which must be considered from all angles before a decision is made on the construction best adapted for securing the water supply.

In the first place a large pumping plant supplying an extensive tract of land presents very different questions from a small unit which pumps water to a single farm or at most to a few neighboring farms. In this region electric drive or direct water-turbine drive are the only ones that need be considered for larger installations. Feasibility in these days is more a matter of cost than of mechanical limitations. Annual costs include fixed charges, power, supplies and repair parts and labor.

Fixed Charges—Interest will vary with the investment. It is often a large factor in determining feasibility, but the case is no different with a pumping plant than with canals or other parts of an irrigation system. When depreciation allowances are made they are assumed to provide against the day when large replacements will be necessary and to retire machinery that becomes obsolete through advances in the art. Within a few years after a plant is put in operation, replacements of apparatus begin and if the plant is well maintained the expenditures for this purpose largely offset the depreciation.

TABLE I—OPERATION AND MAINTENANCE COSTS PER ACRE IRRIGATED

Year	Pumping Division Minidoka Project	Average All Projects	Year	Pumping Division Minidoka Project	Average All Projects
1915	$1.64	$1.61	1919	$2 63	$2 46
1916	1.71	1.66	1920	2 77	2 95
1917	2.02	2.00	1921	2 52	2 55
1918	2.12	2 34	1922	1.85	2.12

Power—The cost of power is usually very important. In recent years there has been such a growth in irrigation pumping that the valley in the load curves of western power companies has been changed into a summer peak. This means that generating machinery installed to carry the irrigation load is to some extent idle in the winter. The result is that a year's interest on the invested capital must be returned by the revenue secured during the irrigation season. As a consequence, in the future cheap power development must usually go along with pumping projects that involve high lifts. Not infrequently it happens that storage or diversion dams can be used at least for seasonal power and, by serving a double purpose, bring the first cost or investment within reach and greatly reduce the annual cost.

TABLE II. COST OF PUMPING PLANTS OPERATED BY THE U. S. RECLAMATION SERVICE DURING FISCAL YEAR 1921-22

Project	Type of Pumping Unit*	No. of Units	Net Lift, Ft.	Acre-Feet Pumped	Cost of Operation and Maintenance	Cost per Acre-Foot	Cost per Acre-Foot per Foot of Lift
Grand Valley, Colo.	V. T. D. C.	1	31	6,635	$1,202.66	$0.18	$0.0058
Huntley, Mont.	V. T. D. C.	2	45	10,200	2,992.91	0.29	0.0065
	G. E. D. C.	2	45	1,870	2,901.71	1.55	0.0345
Minidoka, Idaho	V. M. D C	5	29.2	186,283			
	V. M. D. C.	4	30.2	153,805	20,720.90	0.21	0.0072
	V. M. D. C.	3	29.9	92,923			
	V. M. D. C.	2	19.8	12,951			
	Scoop wheel	1	3.5	2,950			
	Scoop wheel	1	2.5	2,601			
	H. M. D. C.	1	7	432	7,825.65	0.27	0.0182
	H. M. D. C.	1	4	2,258			
	Scoop wheel	1	4 8	1,087			
	H. M. D. C.	2	21 2	6,604			
North Dakota	S. T. D. C.	2	56	1,004	7,238.10	7 21	0.1286
	H. M. D. C.	2	26.6	958	6,303.75	6.58	0.2474
	H. M. D. C.	3	12-32	2,386	12,724.52	5.34	0.2427
	H. M. D. C.	1	25-27	628	3,908.71	6.22	0.2392
North Platte, Neb.	V. M. D. C.	1	41				
	V. M D. C.	1	30	1,235	5,000.00	5.41	0.1353
	V. M. D. C.	1	49				
Okanogan, Wash.	G. E. D. C.	1	55				
	M. D. C.	1	55	370	3,292.84	8 89	0.1617
	V. M. D. C.	2	av. 35	78	268.52	3 45	0.0986
	H. M. D. C.	2	188	1,372	14,716.05	10.73	0.0571
	G. E. D. C.	1	av. 10	808	5,611.16	5.41	0.5410
Salt River, Ariz.	10 V. M. D. C.						
	1 H. M. D. C.	11	av. 33.6	17,451	8,180.70	0.47	0.0140
	H. M. D. C.	4	47	33,927	14,294.10	0.42	0.0089
	V. M. D. C.	16	20.7	13,472	6,334.85	0.47	0.0227
	V. M. D. C.	14	54.6	12,041	18,416.01	1.53	0.0280
	V. M. D. C.	21	av. 29.6	12,727	4,840.53	0.38	0.0128
	H. M. D. C.	1	30	293	543.13	1.85	0.0617
	V. M. D. C.	21	av. 28.4	25,138	11,897.87	0.47	0.0165
	V. T. D. C.	1	103	400	300.00	0.75	0.0073
	H. T. D. C.	1	50	...	200.00	....	....
	V. T. D. C.	2	110	16,429	3,769.01	0.2294	0.0021
	H. T. D. C.	1	105	3,304	1,117.82	0.3383	0.0032
	V. T. D. C.	2	200	6,511 6	1,940.00	0.297	0.0015
	H. T. D. C.	1	90	3,672	1,351.63	0.368	0.0041
Yuma, Ariz.	G. E. D. C.	2	5.6	2,000	2,753.28	1.38	0.2460
	G. E. D. C.	2	av. 10	31,969	14,737.23	0.46	0.0460
	G. E. D. C.	1	7	102.5	618.19	6.03	0.8614

* Type V. M. D. C. — Vertical motor-driven centrifugal pump.
H. M. D. C. — Horizontal motor-driven centrifugal pump.
S. T. D. C. — Steam-turbine-driven centrifugal pump.
V. T. D. C. – Vertical hydraulic-turbine-driven centrifugal pump.
H. T. D. C. — Horizontal hydraulic-turbine-driven centrifugal pump.
G. E. D. C. — Gas-engine-driven centrifugal pump.
G. E. D. S. — Gas-engine-driven screw pump.

Good efficiencies can do much to keep down the power input to the pumping plant. There is little difficulty in obtaining electrical apparatus of a high standard. A great improvement has been made in recent years in the efficiency of pumps for both high and low lifts, but a high pump efficiency must be combined with a characteristic (or head-capacity curve) suited to local conditions.

Supplies and Repair Parts—While supplies and repair parts are usually a relatively small percentage of the annual cost they can by no means be disregarded. High efficiency means less wear and tear on working parts and hence results in a reduction of this item. Adequate supervision and frequent inspection can effect considerable saving and improve reliability.

Labor—The number of employees needed both for ordinary operation and for repairs can be controlled in large part by the selection of the machinery and by its arrangement. This factor is too often given scant consideration until the operating man comes on the ground, but if it is evaluated by capitalizing labor savings its importance will be better appreciated. If one large plant serves the project, then one man on a shift represents only a modest outlay (and there is little excuse for designing a plant to require more than one operator), but to keep constant attendance at small and scattered plants requires a large expenditure. In the latter case automatic devices to start, stop and protect the plant are well worth consideration.

That pumping does not necessarily cause increased cost is well illustrated on the Minidoka Project of the U. S. Reclamation Service where water is lifted to an average height of 70 ft. to irrigate 49,000 acres, of which 46,000 acres are actually irrigated. The topography made it necessary to build three stations, each lifting the water 30 ft. All the water (800 sec.-ft.) is pumped by the first station, 650 sec.-ft. by the second, and 430 sec.-ft. by the third. The highest canal is 90 ft. above the first intake. Over the period of years since 1915 the cost per acre irrigated under this system has not varied greatly from the average cost per acre on all the projects of the Reclamation Service (which cover over 1,000,000 acres), as Table I indicates.

These costs are for operation and maintenance only and do not include interest or depreciation allowances. Both columns are on the same basis. As the Minidoka system has been operated since 1909, replacements are now an annual necessity and are included in maintenance costs. In 1921 the cost chargeable to power generation and transmission and to pumping was 80c. per acre; in 1922 it was 69 cents.

It is impossible to fix any physical limit to the height at which irrigation pumping becomes prohibitive. The limit is determined by the cost—the annual cost as compared with the returns from the crops produced. If favorable conditions make for low costs or high yields the height pumped can be much higher than where the opposite conditions prevail.

About 150 pumping plants costing $2,360,000 are operated for irrigation and drainage on the various projects of the U. S. Reclamation Service, lifting water against heads of from 2½ to 200 ft. In the various stations motive power is installed from 5- up to 2,760-hp. capacity. The combined requirements of the stations are 17,500 hp., and the annual consumption of the stations driven with electricity is more than 33,000,000 kw.-hr. An interesting compilation of the operating costs of these stations is given in Table II. Results of operation of pumping plants vary widely, but it is convenient to use a common unit, and for this reason, the final column in the table shows the cost of raising an acre-foot (325,829 gal.) of water 1 ft. high.

Subgrade Results in the Pittsburg Road Tests

Extract from the report of highway research at Pittsburg, Calif., by Lloyd Aldrich, engineer in charge, and John B. Leonard, assistant engineer.

METHODS of constructing subgrade on adobe soil so reduced the objectionable features of this material that a reliable foundation for pavement resulted. This subgrade was not injured by water which filled the side ditches for three months. Rock ballast was less efficient than the earth subgrade.

The site of the test highway was a field in which the soil was a very obstinate black adobe. The ground sloped gently from the south to the north and to avoid variations of subgrade condition the entire subgrade was on fill. On the south side excavation was carried to 3 ft. inside borrow pits and the material was placed loosely outside; the fill for the entire track was then started approximately 3 ft. below finished subgrade elevation. The bottom soil was first plowed about 8 in. to produce a bond and layers of earth approximately 9 in. in thickness, loose, were successively placed from the borrow across the entire width of the roadway, and each layer was pulverized by using a disk harrow followed by a straight-tooth harrow and a Johnson scarifier. After pulverization was complete, a light spray of water was applied over each entire layer sufficient to moisten but not excessively wet the soil, and to aid in compacting it into a dense homogeneous mass. A 12-ton, 3-wheel road roller rolled each layer, and weak spots in the subgrade layers that developed were excavated, and refilled, and rolling continued. The compacted layers were approximately 6 in. thick and each was scarified with a Johnson scarifier for 2 in. to furnish a complete bond with the succeeding layer.

On this approximately completed subgrade, header boards were set true to line and grade and extending slightly below the surface. Then the material between was scarified to a depth of 6 in. by a Johnson scarifier. The surface was then graded with a Carr subgrade machine to an elevation approximately 1½ in. above subgrade. The surplus earth was temporarily placed on the shoulders. Then the subgrade was scarified to a 4-in. depth and water applied with a very light spray, after which the subgrade was immediately rolled from the edges inward. While still moist it was again cut with the subgrade machine to the correct elevation. Up to the time of laying concrete the subgrade was given a light sprinkling daily to prevent cracks forming. Where inverted curbs were involved in the design, excavations were made with pick and shovel.

The sub-base for Section A was especially prepared. After preparation of the subgrade as for all sections, sufficient soil was removed to provide for a layer of crushed rock 12 in. deep on the longitudinal center line, tapering to a thickness of 4 in. at the edges of the pavement and extending out 2 ft. onto the shoulders. The rock was placed in two layers and rolled, the bottom layer consisting of 1¾-in. to 2½-in. rock and the top layer ¾-in. to 1¼-in. rock. After rolling and filling the depressions with small rock to bring the surface within 1 in. of the finished subgrade elevation, a layer of earth about 1½ in. thick was placed over the rock and rolled to final compression. The proper subgrade elevation was obtained in the usual way by cutting off a layer of earth with the Carr subgrade machine. The object of placing the soil on the rock was to provide a smooth surface upon which to deposit the concrete and not in any sense to be used as a binder. Rock fill drains were constructed to the borrow pits on each side of the pavement.

Results of Some Researches in Concrete

Abstracts of Papers Presented to the Annual Meeting of the American Society for Testing Materials—Accelerators for Concrete; Fatigue of Mortar, Curing Agents, Workability Tests, and the Behavior of Slag Aggregate

Effect of Accelerators on Concrete

DURING the past two years a sub-committee of Committee C-9 has conducted a co-operative series of tests on accelerators of the calcium chloride type. For some reason, or perhaps several reasons, tests of accelerators do not always give as uniform results as other kinds of tests, and the general conclusions of the report should not be assumed to hold for every possible combination of accelerators and concrete materials. On the other hand, it seems safe to assume that an accelerator which adds to the concrete mixture 2 or 3 per cent (by weight of the cement) of calcium chloride will in the very great majority of cases markedly increase the rate of early hardening.

The tests show that 2 to 4 per cent additions to 1: 2½ mortars increase 2-day strength from 40 to 70 per cent, 7 day from 15 to 32 per cent, 28 day from 1 to 18 per cent and 3 months and one year from 2 to 10 per cent.

The individual results show a very wide range and numerous inconsistencies. However, the averages of all the results seem to establish the general conclusion that the beneficial effects of the accelerators are confined to the early age under the prescribed laboratory conditions of curing and storage. Under these conditions the effect of the calcum chloride is to accelerate the hydration of the cement markedly during the first few days, but the resulting gain in strength largely disappears at the 28-day period and thereafter. The relative strengths of the mortars containing the accelerators after the 28-day period are slightly higher than those of the concretes and of the plain mortars for the later periods.

The marked differences in the results reported from the different laboratories indicate that different brands of cement respond in different degree to the accelerators but the inconsistencies in the results are sufficiently numerous to warn against drawing any positive conclusions in this respect. While the action of calcium chloride on cement is not well understood, it is to be presumed that it is effective in promoting the hydration of one or more of the main constituents of the cement, and as these constituents are known to exist in different proportions in different cements, and even in different lots of the same brand of cement, it should be anticipated that different brands or lots would respond in different degree to the action of accelerators.

In regard to the comparative effects of different accelerators, the data obtained in this investigation suggest that the acceleration of hardening is probably dependent either upon the proportion of calcium chloride to the cement, or the concentration of calcium chloride in the gaging liquid. A considerable amount of time was therefore given to an analysis of the complete data from three of the co-operating laboratories, in which the relative strengths were plotted against the two factors: ratio of anhydrous chloride to cement, and concentration of anhydrous chloride in the gaging water. Curves of the same type were obtained in both cases but the wide range of individual results made it impossible to determine to which of these two factors the relative strengths were more closely related. It would undoubtedly be of interest to know more than we do at the present time regarding the relation of quantity or strength of calcium chloride to the acceleration of the hardening of concrete, and in fact to know more about the action of calcium chloride on cement, but this information must come from a more comprehensive and carefully planned investigation. So far as the data from these tests can be interpreted, the different accelerators produce effects which are mainly dependent upon their calcium chloride content. It is not to be inferred, however, that the acceleration of hardening is directly proportional to quantity or concentration of calcium chloride, for a maximum effect upon the strength of concrete exists on the average not much beyond the maximum concentrations employed in these tests.

In conclusion, the sub-committee would recommend that if further data were to be sought on the effects of accelerators, perhaps the information of greatest practical value would be forthcoming from their effects upon mortar or concrete at temperatures in the neighborhood of the freezing point, and also under conditions where wet curing is impracticable. Results indicate that calcium chloride is more effective under dry curing than under moist curing. It is important also that definite knowledge be obtained regarding the effect of accelerators upon the steel in reinforced concrete. Such meager information as is available at the present time indicates that when steel is completely embedded in dense concrete, the danger of serious corrosion from the chloride is negligible, but it is doubtful whether this statement applies to all types of reinforced-concrete construction under all conditions of exposure.

* * *

Fatigue of Mortar

By R. B. Crepps
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THIS PAPER describes in more detail the series of tests already outlined by Prof. W. K. Hatt in *Engineering News-Record.* Concrete beams are tested in reverse loaded as cantilevers mounted on a rigid column. The specimens were 1:2 mortars in 4x4-in. sections 30 in. long.

There is a progressive deformation in the extreme fibers until failure of the test specimen takes place. A straight line of constant slope relation is indicated up to 110,000 reversals of stress. At this point, four cracks appeared on the outermost fibers of the specimen, and the slope of the line changed. An additional 35,000 reversals of stress were necessary to produce complete failure. The critical point in the progressive deformation cycle is designated as the premature failure limit.

Rupture or failure of the bond occurs first on the extreme outer fibers where the deformation is a maximum. This action is progressive toward the center of the beam until complete failure is imminent. Continual progressive deformation of the outer fibers is significant of the fatigue element. Progressive deformation may occur in some cases for a certain number of reversals when it becomes evident from the flatness of the deformation curve that the material is showing no ill effects from repetitions of the load. The assumption is made that loads producing constant deformation are below the endurance limit or the safe working stress of the material.

Recovery Phenomenon — An interesting feature of the fatigue tests is that of the appreciable recovery during a period of rest of the strength of mortar undergoing a fatiguing action. It has been necessary each night to stop the machine and, as a result, the strength recovery phenomenon is clearly illustrated. A parallel action is common to many materials, such as, metals, wood, and soils when they are stressed beyond a safe limit. The amount of recovery in the case of cement mortar is directly proportional to the duration of the period of rest. It is to be noted that no recovery occurs after the premature failure limit has been attained.

During this series of tests it became necessary to stop the machine for five weeks, and as a result the effect of a prolonged rest period is clearly evident from the trend of the deformation curves. The degree of deformation following the rest period indicates that the beam had fully recovered from the initial overstressings. As these beams were five

months old, it is thought that the increase in strength due to age over the rest period exerted a minor influence upon the subsequent resistance of the mortar.

This phenomenon seems to indicate that the rate or number of intermittent applications of load ranging in intensity above the endurance limit would have considerable bearing upon the life of a concrete structure.

Summary—The purpose of the paper has not been to present finished data or to draw definite conclusions concerning the fatigue of mortar and concrete, but more to stimulate interest and discussion of the subject. There are, however, several indications of prominence which are emphasized by this investigation:

1. (*a*) 28 Day Tests, 12 Beams, 1: 2 Mix.—Results of this series of tests indicate that no definite endurance limit between 40 and 60 per cent of that load required to break the beam under a single application can be assigned to cement mortar of this age.

(*b*) 4 Month Tests, 8 Beams, 1: 2 Mix.—Results of this series of tests indicate that the endurance limit is approximately 50 to 55 per cent of the static load.

(*c*) 6 Month Tests, 6 Beams, 1: 2 Mix.—Results of these tests indicate that the endurance limit is 54 to 55 per cent of the static breaking load.

2. The number of reversals of stress necessary to cause failure decreases in a proportion to the respective increase of the percentage of stress above the apparent endurance limit.

3. Stresses above the endurance limit cause continual progressive deformation.

4. Stresses below the endurance limit may cause progressive deformation within certain limits.

(In either 3 or 4, progressive deformation is not significant of permanent injury to the product unless actual rupture of the bond occurs on the extreme outermost fibers.)

5. The effect of a rest period indicates that the rate and number of intermittent applications of load ranging in intensity above the endurance limit would have considerable bearing upon the life of a concrete structure.

6. (*a*) The amount of recovery in strength in the case of cement mortar is directly proportional to the duration of the period of rest.

(*b*) Above the premature failure limit no appreciable recovery occurs.

* * *

Calcium Chloride as a Curing Agent and Accelerator

By H. F. Clemmer and Fred Burggraf
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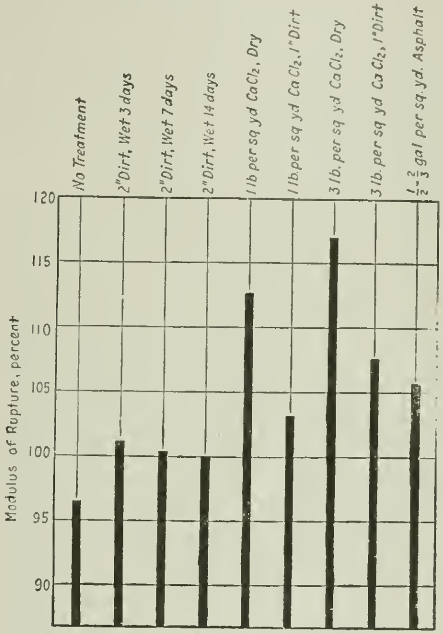
THIS PAPER reviews the investigations in the use of calcium chloride both as a curing agent and as an eccelerator in the setting of concrete, conducted by the Illinois Division of Highways, the results of which have led to the adoption of both the external and internal usage of calcium chloride in concrete highway construction.

External Treatment—Over 500 concrete slabs, 8 x 12 x 30 in., were subjected to various surface treatments and tested for transverse strength. Cylinders, 6 x 12 in., were also made to serve as a check on the compressive strength of the concrete making up the transverse specimens. The same volumetric mix of 1:2:3½, which is the standard adopted by the state of Illinois for concrete highways, was used in all specimens. Portland cement was used in all cases and the aggregates consisted of sand and washed limestone which passed all state specifications.

As Illinois was interested primarily in securing a satisfactory curing at the end of 28 days or earlier, more emphasis was placed on these short-time tests than on 60- or 90-day specimens. For the purpose of checking the strength of the untreated specimens at the older ages, a number of 60- and 90-day specimens were made. At the time of testing, the specimens were removed from their forms and broken in a universal testing machine with the treated side in tension. The modulus of rupture was then computed and the variation in strengths considered as a measure of the completeness of curing.

[Three series are reported, of which the first is typical.]

The accompanying diagram contains a graphical comparison of the results of the various curing methods as indicated by the moduli of rupture of the specimens in Series 1, the results shown being the average of 11 specimens. As the curing of concrete with 2 in. of dirt wet for 14 days has been considered by this state a satisfactory method of curing, the specimens cured under this method have been regarded as 100 per cent cured and the results obtained by other methods taken as a percentage of this.



COMPARISONS OF EXTERNAL TREATMENT OF CONCRETE WITH CALCIUM CHLORIDE
Strength of Specimens Cured with 2 in. Dirt, Wet 14 Days, Taken as 100 Per Cent Cured. Each Result Is the Average of 11 Specimens. Age 28 Days.

As shown in the figure, only those specimens which received no treatment showed a strength less than 100 per cent, while the specimens cured with 3 lb. per sq.yd. of calcium chloride indicate the maximum of 116.9 per cent curing. Those slabs cured with 1 lb. per sq.yd. of calcium chloride also show a high degree of curing.

The early strength obtained with using calcium chloride curing would indicate that a pavement could be opened for traffic at the end of 14 days, whereas under the old method of curing it was felt unsafe to subject a pavement to traffic in any less time than 30 days. The results obtained from the specimens which were treated with calcium chloride that was removed some hours later illustrate that at the end of 28 days, proper curing has taken place. In other words, if the calcium chloride remains on the concrete for a period of 24 hours, its removal will not affect the curing of the concrete. Later tests in this regard illustrate that even less time than 24 hours was required for calcium chloride to properly cure concrete.

A brown surface stain developed on the specimens cured with magnesium calcium chloride. This discoloration of the concrete seems to result from the use of magnesium calcium chloride and for this reason this material as a curing agent is eliminated.

It is evident in the comparison of results on the speci-

mens cured in like manner, but having both a normal and oiled subgrade, that no benefit is derived from the oiled subgrade. In both the 14- and 28-day tests, less strength resulted from the specimens placed on the oiled subgrade than was obtained with the normal condition of subgrade.

A study was also made of the effects of concentrated and excessive amounts of calcium chloride on the surface of mortar briquettes. The proper distribution of this material is a constant source of trouble with the highway department and it was thought advisable to learn as far as possible in the laboratory the effects of too much calcium chloride on the surface of concrete. Consequently, a number of briquettes were made and were subjected to surface applications of calcium chloride up to what would amount to 10 lb. per sq.yd. of surface. A puffing up of the surface was noticed with the result that a deadened concrete was developed. The danger of a like condition developing in a pavement surface is seen when, in cases where moisture is present in the calcium chloride drums, the salt has a tendency to lump into pieces of considerable size. When these pieces are larger than the size of an egg, their use should not be allowed until they are broken up, since injurious effects of uneven application of the salt will result.

Though the exact action which takes place in the concrete when a surface application of calcium chloride is applied is not known, a theory has been advanced which appears to be the most logical of any yet advanced. The great amount of work done with calcium chloride by the Illinois highway department corroborates so far as is known the theory which is as follows:

The hygroscopic properties of calcium chloride are responsible almost entirely for the value of the material as a curing agent. Though the calcium chloride may not obtain sufficient moisture from the air to satisfy this property, its presence on the surface of a concrete specimen which contains more moisture than the air, attracts moisture to aid in the dissolution. This action of the moisture being drawn to the surface of the specimen leaves minute channels, which, after the complete dissolution of the chemical, affords passages for the calcium chloride solution to penetrate the surface, thus giving it access to more cement particles and causing more complete hydration in a shorter time. This quick hydration and decomposition of the lime compounds of the cement particles on the surface causes an impervious layer which prevents drying of the concrete.

An understanding as to the reason for approximately as great a strength resulting in 14 days from the use of calcium chloride as that resulting in 28 days when curing with wet dirt is apparent when the two methods of curing are considered. In curing with wetted dirt, the increase in strength and hardness of the concrete is due to the ever present moisture which gradually hydrates and decomposes more of the lime compounds. In curing with calcium chloride, the chemical acts as an accelerator in hastening the hydration and inter-reaction of the cement particles on and immediately below the surface.

Rules for Application of $CaCl_2$—As a direct result of the investigation in curing concrete, the Illinois highway department is now permitting the use of calcium chloride in curing state highways. In order to reduce the cost of curing by this method, the amount used has been specified as 2½ lb. per sq.yd. of surface, this amount being considered as effective as the 3 lb. which was employed in the tests. In order to acquaint the engineers and contractors with the use of the material, a circular has been issued which reads:

"Calcium chloride may be used in connection with curing of pavements, taking the place of the usual curing with earth and water, or the curing with water by what is known as the "ponding method." Two and one-half pounds of the flaked or granular material (the flaked is preferred as it is more easily distributed and less easily removed by wind or rain) shall be applied to each square yard of pavement and it shall be distributed uniformly over the surface of the finished pavement by means of a mechanical drilling device or by the use of shovels and long-handled brooms. The material shall not be spread upon the pavement until the latter has thoroughly set—ordinarily from six to eight hours time after the particular pavement has been laid

"Calcium chloride shall not be applied during rains and experiments have definitely determined that if a rain follows the placing of the calcium chloride after a period of two or three hours there will have been enough absorption of the calcium chloride by the new pavement preceding the rain so that there will not be required additional applications of the material.

"Although the water line for curing of pavements with water may be omitted where central mixing plants are operated and calcium chloride is used in curing; nevertheless the general specifications with regard to wetting of subgrade and the general specifications with regard to placing of burlap on the freshly deposited concrete and the wetting of burlap shall be strictly enforced. The use of calcium chloride for wetting the subgrade will not be permitted. When calcium chloride is used in curing, the sides of the concrete pavement shall be banked with earth as soon as the forms are removed."

Internal Treatments—The investigations in internal treatment with calcium chloride was mainly in reference to the effect on setting time, the strength in low temperatures, the internal temperatures, and the variable strengths obtained with the same percentage of material in different brands of standard cements. Some work was begun on determining the percentage of hydration caused by the calcium chloride but sufficient data are not at hand for a comprehensive discussion of the experiment at this time, although a short outline of the work will be given. Both physical and chemical tests were included in this investigation. A uniform incorporation of calcium chloride was obtained by dissolving the chemical in the gaging water before the water was placed in the mixer.

It was observed that the setting time of the specimens at both temperatures is reduced through the addition of calcium chloride. The specimens containing 3 per cent by weight of calcium chloride indicate the best results as far as securing the quickest set is concerned.

The investigations conducted with concrete specimens poured in low temperatures merely illustrated the fact that even the presence of a large percentage of calcium chloride will not allow the placing of concrete in freezing temperatures without some provision being made to protect the concrete from the cold weather. Probably the most striking feature of this experiment was the failure of the specimens to gain strength past the 14-day period.

Considerable time was spent on the study of the variation of internal temperatures caused by the incorporation of the different amounts of calcium chloride. It was found that a greater heat is generated by the specimens containing the larger percentage of calcium chloride.

It has been fairly well established that various brands of standard cements hydrate four to five times as fast as others when incorporated with a constant solution of calcium chloride.

Rules for Inclusion of $CaCl_2$—The results secured in these investigations were such that the Illinois Division of Highways was satisfied that calcium chloride could be incorporated in concrete to advantage under certain conditions. Consequently, its usage is allowed in cold weather construction upon the permission of the engineer in charge of the job. To insure the proper supervision, the department has issued a circular explaining how this material must be used. The circular reads as follows:

"The department will permit the use of calcium chloride in the concrete mix for pavement construction during cold weather. When used, the solid, granulated, flaked, or powdered materials shall be thoroughly dissolved in water. It is recommended that the proper amount of calcium chloride solution should enter the mixer drum just before the water is added to mix the aggregates, or the solution may be added direct to the stone or sand when in the skip.

"When used in the pavement work, not more than two per cent by weight of the cement shall be used.

"Calcium chloride should not be used in a pavement that crosses an electric railroad, but its use should be discontinued approximately one quarter of a mile from the elec-

tric railroad crossing. There is no objection to using the material when the highway parallels an electric line. Calcium chloride shall not be used *in pavements which are reinforced.*

"It is not definitely known at what temperature concrete will freeze when the two per cent of calcium chloride is mixed with the concrete and it will, therefore, be necessary to arrange to cover the pavement with loose straw or earth as soon as it has taken sufficient set to prevent marring of the surface. In other words, calcium chloride hastens the setting of the concrete but is in no sense a protective. It makes possible an earlier application of a straw or earth covering.

"Due to its action on reinforcing steel, calcium chloride shall not be used in bridge or culvert construction; therefore, the usual precautions should be taken when placing concrete in culverts and bridges during temperatures around freezing point.

"All material should be purchased with the guarantee that it contains from 70 to 75 per cent calcium chloride and before using samples should be submitted to the testing laboratory, as in the case of any other materials."

* * *

A New Test for the Workability of Concrete

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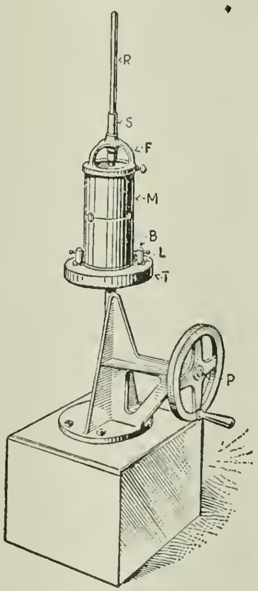
IT IS NOT easy to define the terms "workability," "plasticity," "consistency," etc., as applied to concrete mixtures. Some authorities use these terms more or less synonymously; others prefer to distinguish between workability and consistency, considering the latter as a property directly related to water content and measureable by the slump, flow, and other tests, whereas workability is regarded as more intrinsically a characteristic of a given mixture, dependent not only on the water content, but essentially upon the other ingredients of the mixture. We incline to this latter view, and without attempting to give an exact definition of workability, we consider one concrete mixture more workable than another when the process of mixing, handling and placing are accomplished with less effort in the one case than in the other. The direct quantitative measurement of this effort, for example, in placing a concrete mixture in any sort of a form or mold is a very difficult thing, chiefly because there is no telling when one arrives at a definite condition that may be taken as a stopping point in the placing operation. We have made many attempts to measure the workability of various concrete mixtures in this way, but thus far without success.



During the past two or three years we have given a great deal of thought to the possibilities of measuring the workability of concrete by some indirect method and eventually came to the penetration test which is the subject of this paper.

Apparatus—The apparatus used in the penetration test is shown in the drawing. *M* is a 6 x 12-in. pipe mold with a watertight bottom, fitted with slotted lugs, *L*, by means of which the mold is fastened to the small drop table *T*. The latter is in reality an ordinary flow table with a special top carrying two clamp nuts, *B*, which engage the lugs, *L*, of the pipe mold. The table top can be raised and dropped through a height of ⅛ in. by means of a cam on the end of the shaft *P*. Fitting the top of the pipe mold closely is a detachable brass spider *F* carrying a fixed sleeve *S*, which, when the frame is in position on top of the mold, is exactly in alignment with the axis of the mold. The sleeve *S* is ⅝ in. inside diameter and 6 in. long. A steel rod, *R*, ⅝ in. diameter, 20 in. long, weighing 1100 g. completes the apparatus. The lower end of the rod *R* is hemispherical, and the upper portion is graduated in 0.1 in. in such manner as to read directly the depth of the lower end below the top of the mold when inserted in the sleeve *S*.

Method of Test—The mold *M* with the brass spider *F* clamped to the top is fastened to the table by means of the clamp nuts. The batch of concrete to be tested is scooped into *M* until the latter is filled to the brim. No attempt is made to puddle the concrete into the mold, but a rod is used to spread the concrete uniformly as it falls from the scoop. After the mold is filled, the table top is raised and dropped a given number of times to subject the concrete to a definite amount of compacting force. Our practice throughout has been to give the concrete thirty ⅛-in. drops. At the completion of the preliminary jolting or settling, the rod *R* is inserted in the sleeve *S* and lowered gently into the concrete until it comes to rest under its own weight. The table is then raised and dropped, and from the force of the impact the rod penetrates a certain distance into the concrete, indicated by the reading of the scale. The impacts are repeated and the successive penetrations of the rod are noted until the latter has reached nearly to the bottom of the mold. In practically all of our tests the penetration has been carried to a depth of 11 in.

It is quite obvious that different mixtures should show different resistances to the penetration of the rod, the more plastic mixtures allowing the rod to penetrate readily, the harsher mixes offering high resistance. The property that we were admittedly trying to measure was the tendency of a mixture to pack under a definite amount of settling or compacting. This we seemed to have accomplished, judging from the results of a considerable number of preliminary experiments, but a more complete interpretation was lacking. It was primarily to furnish an interpretation of this test that the present investigation was undertaken; incidentally the investigation was so planned as to contribute some interesting information regarding the effects of certain powdered admixtures.

Conclusions—The penetration test described in this paper is the first worthwhile solution of the problem of measuring the workability of concrete which the authors have found in a research extending over a period of several years. As used in this investigation, the test is lacking in desirable precision; it furnishes a measurement of workability in arbitrary units only, and it is not applicable to the entire range of concrete mixtures. On the other hand, these faults can probably be eliminated, and even in its present stage of development, its indications seem correct and in accord with the best judgment of a number of experienced operators. This is true if workability is defined as that property of a concrete mixture upon which depends the amount of work required to handle and place the concrete *uniformly*, under the ordinary conditions of use.

As indicated by the penetration test, the workability of a concrete mixture seems to depend upon two factors, segregation and lubrication. It appears that both of these factors can be controlled by a suitable selection of ingredients, an increasingly fine aggregate reducing the segregation, and powdered admixtures reducing segregation and promoting lubrication. This increase in workability brought about by the use of finely divided admixtures seems to be proportional to the fineness as measured by the completeness or extent of dispersion of the material in the mixture. Thus, celite was found to have greater effect in improving the workability of concrete mixtures than kaolin, and kaolin a greater effect than hydrated lime.

In studying the relation between workability and consistency, as indicated by the penetration and flow tests,

respectively, the interesting conclusion was reached that workability depends more on the character and proportions of the solid ingredients in the concrete than on the amount of mixing water used. Although this conclusion may appear open to question, the authors believe it to be correct, and they also believe that false notions in regard to workability of concrete have been created by reference to chuting operations. The facility with which concrete flows down a chute is probably dependent both upon workability *and water*, the effect of the latter predominating in the over-wet mixes. Whatever the facts may be, the indications of the penetration test substantiate the authors' opinion that there is no premium upon, and rarely an excuse for, employing a consistency higher than that giving the maximum workability obtained in these tests.

Under damp storage conditions, small quantities of admixtures generally increase the strength of lean mixtures, even though they require an increase in the amount of mixing water for a given consistency. The richer mixtures under the same conditions suffer a slight loss in strength. It is important, however, that further work be done to establish the effects of admixtures under drying conditions, where it is quite probable that strength, as well as workability, will be benefited. It is important also that further work on the subject include studies of the relative yield and shrinkage of concretes with and without admixtures, since these factors must be taken into account in determining the resultant effect in the finished product.

* * *

Blast-Furnace Slag as an Aggregate in Concrete

By Raymond Harsch
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THE U. S. Bureau of Public Roads started an extensive investigation in the summer of 1919 to obtain information relative to blast-furnace slag as an aggregate in concrete. This investigation consisted in obtaining plant data from the field inspection of about thirty crushing and screening plants which were at that time producing slag in commercial sizes.

In these tests, everything was held constant except the coarse aggregate. This varied from the very porous, honeycombed material produced by some plants to the black, glassy slags of others. The consistency of the mix was kept constant throughout the entire investigation. A slump of 1 in., corresponding to a flow of 160, was used. All results shown in the table are averages of tests on 3 to 5 specimens made and tested on different days and are the results of the compression and wear tests outlined above. These are represented by the part of the table down to and including limestone from Plant L. The tests on slag from Plants A, B, and C were made to determine the effect of maximum size of coarse aggregate.

Comparing the results of compression tests on concrete containing coarse aggregate from Plants Nos. 1 to 30 with those containing gravel and limestone, the highest strength obtained was 3656 lb. per square inch with slag aggregate, and the lowest 2809 using Potomac River gravel. The lowest strength of the slag concrete is 2906, which represents a high-silica, low-lime slag of glassy texture. The strength of limestone concrete is practically equal to the average strength of the slag concrete. The results of the wear tests show a lower percentage of wear for slag concrete than for either gravel or limestone. The differences, however, are small in most instances, and the test does not warrant any specific conclusion other than the fact that the slag concrete is as satisfactory as gravel or limestone concrete when tested by the Talbot-Jones rattler.

The lower part of the table contains results of tests on slag, gravel, and limestone concrete, when the variable was the maximum size of the coarse aggregate used. Group A refers to $\frac{1}{4}$- to 2-in. aggregate, B is $\frac{1}{4}$ to 1 in., and C from $\frac{1}{4}$ to $1\frac{1}{2}$ in., all being proportioned between the sieves in amounts necessary to give a straight-line grading. The results seem to indicate that the $\frac{1}{4}$- to 1-in. slag and limestone make the strongest concrete, while the reverse is true for the gravel used. The slag shows a strength equal to that of limestone and superior to the gravel in every case.

As in the preceding results, less wear was found for the slag concrete than for the concrete containing either gravel or limestone. The wear tests results show the strongest slag concrete to have a greater loss in wear that the weaker concrete. The $\frac{1}{4}$- to 1-in. slag concrete (the strongest slag concrete), however, still shows less loss than either the gravel or limestone concrete of any sizes of aggregate.

Wear Investigation—An investigation of the suitability of many doubtful aggregates has been in progress for some time, consisting of circular track wear tests. The results of tests on the control specimens, made in connection with this investigation, throw some additional light on the relative value of slag as an aggregate in concretes. At the time the test sections of this experimental pavement were placed, three compression cylinders, three Talbot-Jones wear blocks and two 6 by 8 by 48-in. plain concrete beams were molded for each type of surface.

These results bear out the conclusions derived from the other investigations. They show slag concrete to be superior to the gravel concrete and also to the limestone concrete used in these compression and transverse-bending tests. Slag concrete wear blocks showed a lower percentage of wear than either the limestone or gravel except in the case of Section 1.

Attention is directed to the result of tests of a blast-furnace slag which had been hand picked from the lightest commercial slag available. In selecting this material, only the honey-combed pieces were included. The unit weight was only 56 lb. per cu.ft. when the material was uniformly graded from $\frac{1}{4}$ to $1\frac{1}{2}$ in. This represents the type of slag which is the cause of most of the unfavorable comment regarding its use as an aggregate in the wearing surface of concrete pavements. An analysis of the test results on this material shows that the strength and wearing quality is not greatly impaired by the lightness or porous nature of the aggregate.

TABLE SHOWING RESULTS OF COMPRESSION AND WEAR TESTS OF SLAG AGGREGATE CONCRETE.

Mix: 1:2:3
Cylinders: 6 by 12 in.
Blocks: 8 by 8 by 5 in.
Age: 28 days
Average of 3 to 5 specimens

		Compression Test		Talbot-Jones Test	
Plant	Aggregate	Average Strength, Lb. per Sq. In.	Weight per Cubic Foot, Lb.	Wear, Per Cent	Weight per Cubic Foot, Lb.
No. 1	Slag—river sand	3,359	139	11.2	139
No. 2	Slag—river sand	3,316	138	10.1	139
No. 3	Slag—river sand	3,510	140	9.2	138
No. 4	Slag—river sand	3,219	144	8.6	146
No. 8	Slag—rivtr sand	3,353	136	10.1	136
No. 9	Slag—river sand	3,223	136	8.5	137
No. 10	Slag—river sand	3,159	141	10.3	142
No. 13	Slag—river sand	3,422	139	7 0	140
No. 15	Slag—river sand	3,547	142	9.5	141
No. 16	Slag—river sand	3,565	142	9.8	141
No. 17	Slag—river sand	3,265	141	8 3	140
No. 21	Slag—river sand	3,069	138	9 2	136
No. 23	Slag—river sand	3,051	132	10 8	135
No. 25	Slag—river sand	2,936	143	8.7	143
No. 26	Slag—river sand	3,064	140	8.9	144
No. 27	Slag—river sand	3,231	141	9.2	145
No. 28	Slag—river sand	3,656	141	9.3	142
No. 29	Slag—river sand	3,409	137	9.3	141
No. 30	Slag—river sand	2,906	140	11.1	140
G	Gravel—river sand	2,809	146	11.6	147
L	Limestone—river sand	3,301	152	11.8	150
A	Slag, $\frac{1}{4}$ to 2 in.	2,979	140	9.4	138
B	Slag, $\frac{1}{4}$ to 1 in.	3,345	142	10.1	138
C	Slag, $\frac{1}{4}$ to $1\frac{1}{2}$ in.	2,914	138	9.6	137
G-A	Gravel, $\frac{1}{4}$ to 2 in.	2,648	147	10.6	147
G-B	Gravel, $\frac{1}{4}$ to 1 in.	2,455	146	11.5	145
G-C	Gravel, $\frac{1}{4}$ to $1\frac{1}{2}$ in.	2,733	147	10.8	146
L-A	Limestone, $\frac{1}{4}$ to 2 in.	2,791	133	11.2	148
L-B	Limestone, $\frac{1}{4}$ to 1 in.	3,001	154	13.8	149
L-C	Limestone, $\frac{1}{4}$ to $1\frac{1}{2}$ in.	2,931	150	12.6	151
P	Slag—Potomac River sand	2.462	134	13.1	140
S	Slag—slag sand	2.029	127	13.7	127
G	Slag—granulated slag	1,670	121	14.7	121

Summary—The data presented do not indicate any new development in the knowledge about slag used in concrete. They merely represent the work of unbiased operators endeavoring to find the value of slag as compared to two other concrete aggregates, limestone and gravel.

Specimens have been made for testing at the age of one, two and five years. A series of corrosion tests have been planned to determine the relative corrosive effect of slag, gravel and limestone aggregates upon reinforcing steel.

The following general conclusions are interpreted from the data resulting from this investigation:

1. The unit weight of blast-furnace slag as produced commercially has little if any effect upon the structural strength or the wearing property of the resulting concrete.
2. A limit of 70 lb. per cubic foot would admit practically every well-graded crushed slag product.
3. The gravel used in these tests is one of accepted quality and is considered to be of average strength. The limestone used for comparison with the slag is somewhat superior to the average limestone used for concrete. The strength of all of the slag concretes exceeded that of the gravel concrete. The average strength of the slag concretes is equal to the strength of the limestone concrete.
4. Because of the excessive chipping at the edges of the wear blocks, the wear test is not considered a very favorable indication of the resistance of concrete to wear. It is a means of comparing the value of various types of concrete subjected to the action of the shot, and is interpreted as such by the author. On this assumption, the wear-resisting properties of slag concrete are equivalent to those of the limestone concrete and superior to those of gravel concrete tested in comparison.
5. The physical properties of the slag when tested by the usual rock tests do not seem to be an important factor in determining the quality of the concrete made with slag as the coarse aggregate.

Possibilities in Engineering Society Co-operation

President of American Society of Civil Engineers Outlines His Views As To Methods of Getting Together

From the Presidential Address of C. F. Loweth, President, American Society of Civil Engineers, at the Annual Convention, Chicago, July 11, 1923.

MUCH HAS BEEN said of late of co-operation of engineering societies as though it was something new. It is not new. There has always been a goodly degree of co-operation; however, the great increase in the number of such societies and the fact that many of them are so highly specialized has seemed to call for an increased co-operation and at the same time made it increasingly difficult to bring about.

The membership requirements of some societies stress most strongly technical qualifications; in fact, in some the technical qualifications are highly specialized, and are fully met by manufacturers and expert technicians. In others the outstanding qualifications for membership are those of professional attainments and in some of these professional attainments of a highly specialized nature; in still others, social or local affiliations are a large factor in membership qualifications. It must be obvious then that under such widely varying society ideals co-operation will necessarily be restricted to matters of common interest. These may be local or national affairs, may be purely technical matters, or be those of a professional character; in each case the incentive for co-operation will vary. The incentive and opportunity for co-operation depends therefore, in a very large degree, upon a common interest, the purposes and ideals of the several groups and equally so upon an approximate equality of ability for the furtherance of that common interest. With such a multiplicity of engineering societies as now exist, co-operative efforts, if unduly forced, will naturally tend to a compromise of essentials or to the over-emphasis of many things of minor importance. In such case the danger would be to the societies of largest prestige and highest ideals.

This society has recently and for the third time, declined to join with certain others in an all-inclusive plan of engineering society co-operative work. There is ample evidence that these decisions have been based upon the plan of and not upon the spirit of co-operation. Clearly this is so, for the whole history of the society shows time and time again a deeply rooted disposition to co-operate fully and freely whenever there has been opportunity to do so effectively. At the present time there is a very large degree of co-operation amongst engineering organizations in technical matters. The extensive and very excellent work being done by the Engineering Standards Committee, which is sponsored by a number of the engineering societies and participated in by many of their members, is a co-operative effort of high order; the same is equally true of the excellent work of the Division of Engineering of the National Reseaıch Council. Much other technical activity is being fostered through the joint agencies of various engineering societies. It makes but little difference whether this is accomplished through temporary agencies, such as joint committees, or more permanent ones. The American Society for Testing Materials and the American Railway Engineering Association may be considered, in view of the fact that many of their members are also members of other less specialized societies as co-operative organizations by engineers. Effective co-operation calls for united effort and, equally at other times, requires that one party shall refrain from duplicating the activities of the other. The setting up of Engineering Foundation for the furtherance of research in engineering and of United Engineering Societies for the management of the joint property interests of the four large national societies, called by these acts the Founder Societies, are other notable instances of co-operation.

In other than technical matters co-operation has not progressed as far, although far from being negligible. In those matters pertaining to the services of the engineering profession to the country and those pertaining to the general welfare of the profession, there is room at this time for more concerted activity on the part of engineering organizations. Considering these in their broadest aspects, it would seem as if it was the especial obligation, and as well the privilege, of the large national societies, particularly those in which the professional qualifications for membership are the highest and which for these reasons have the prestige and wealth of personnel, leadership and funds beyond those of local or specialized societies, to undertake primarily and largely the burden of representing the engineering profession at large. In that case then the Founders Societies with other national organizations of approximately similar standing and character might profitably set up some agency through which they might co-operate as occasion requires.

Such an agency might well meet the following requirements: Its field of activity should be specific. It should have definite responsibility to its sponsors, yet with some freedom of initiation and action. It should be elastic enough to meet varying needs, to act promptly in emergencies, to enlist such aids as might be helpful. Its vision should be nation-wide and its organization such that the influences initiating its action should be no less broad. Its chief function should be largely to bring about concerted action of various organizations as their mutuality of interest and influence might make necessary, rather than to attempt to speak for them, and it should so function as to leave room for expression of minority opinion or qualified approval where unanimity could not be obtained except as a result of compromise. It should have no incentive to be active solely for the sake of activity. The dangers of a super-organization should be thoroughly guarded against by tying it closely to its sponsors, and it may well be that its organization could be composed of men serving automatically by virtue of their offices in the sponsoring societies.

Such an agency, by whatever name it may be called, in addition to be being useful in co-operative efforts, would doubtless promote the welfare of each sponsoring society.

From Job and Office

Hints That Cut Cost and Time — For the Contractor and the Engineer

Reinforced-Concrete Patch on Pipe Elbow Withstands Heavy Wear

IN PLACING the concrete lining in a small tunnel around one end of Priest Dam, on the Hetch Hetchy project in California, it was most convenient to deliver the concrete by the pneumatic method through a 6-in. pipe. The pipe, however, had to pass down a vertical 50-ft. shaft and at the bottom make an abrupt 90-deg. turn to enter the tunnel. Under this condition the air pressure of 100 lb. per square inch used for delivery,

BEND IN 6-IN. PIPE REINFORCED WITH CONCRETE
This bend had given more than seven times the average life of unreinforced pipe and was still in service when the job was finished.

plus the effect of gravity, caused excessive wear on the sharp bend in the bottom of the shaft. In fact the wear was so great that standard pipe bent to make the 90-deg. turn within a length of about 8 ft. sometimes had to be renewed after eight hours of service and seldom lasted more than three shifts.

To overcome this excessive wear a special bend was made up with an 8-ft. length of pipe bent into a right-angle turn, as usual, but reinforced by a concrete block or patch cast around it for the purpose of continuing to withstand the wear after the pipe itself had worn through. The concrete was 6 in. thick, entirely encircled the pipe, and was reinforced with $1\frac{1}{4}$-in. drill steel bent to parallel the curve of the pipe. This steel was wired together and placed in the form with the pipe before the concrete was poured. The total weight of the 8-ft. pipe elbow and the patch which was cast around it was about 800 lb.

The special bend made in this way, and shown in the accompanying photograph, served continuously for the remaining 21 shifts required to complete the job. When the pipe line was dismantled, inspection of the special elbow showed that the wear had gone through the pipe and also entirely through the $1\frac{1}{4}$-in. drill steel but had not yet worn through the surrounding concrete.

The tunnel lining work was done under the direction of W. F. Webb, president of the Universal Concrete Gun Co.

Suspended Structure Carries Sanitary Sewer Over Stream

By J. C. Keeley
Paducah, Kentucky

IN PLANNING the $1,300,000 sewer program in Paducah, Kentucky, half of which is now under construction, it became necessary, in order to serve certain territory, to cross a stream, known as Island Creek, with a small sanitary sewer, the point of crossing being about 500 ft. upstream from its junction with the Tennessee River.

Due to long periods of high backwater from this river, during which an inverted siphon would be submerged to a depth of 30 ft., it was decided to effect a crossing with an overhead structure, rather than an inverted siphon, as flow through the latter would be seriously retarded and cleaning rendered difficult; the danger of destruction to the overhead, or suspended, structure by floods in the creek is considered slight, owing to the small watershed of the creek and its large channel so near the Tennessee River. The floods in the creek do not reach the height of the sewer except when the river is high; and, at such time, the current is diffused and reduced because of its expanse over a wider channel. The danger due to ice is also slight, as ice of sufficient thickness to endanger the structure does not form in this section. No serious flow of drift need be expected.

The crossing was built of 18-in. cast-iron pipe—in 12-ft. lengths, weighing 110 lb. per foot—carried on reinforced piers on the approach and over the channel suspended by steel members swung from the floor over the existing concrete arch bridge.

Piers of reinforced concrete to carry the approaches were built on 12-ft. centers, the upper portion being shaped to fit the lower half of the pipe.

Five structural steel hangers were used to suspend the sewer over the main creek channel. Each hanger was built of two 6-in. x 6-in. x $\frac{3}{8}$-in. angles, riveted back to back and bolted to the under side of the bridge floor with three 1-in. bolts; lateral braces to the hanger, made of 6-in. x 4-in. x $\frac{3}{8}$-in. angles bolted to the hanger near the bottom and to a 3-in. x 6-in. angle clamped around the arch ring, served to stiffen the structure and to provide additional support. Holes for the 1-in. bolts were drilled through the bridge floor from the roadway with an air drill; and a cable, lowered through one of the holes and operated by a derrick on the roadway above, hoisted the hangers into place, the hangers having been previously floated into position on a scow. The lateral braces were erected by means of a scaffold mounted on the scow.

After all the hangers were in place, the 15-in., 33-lb. channel was floated into position on the scow, raised and bolted to the hangers. The pipe was then floated on the scow into position, raised and suspended by bolts to the hangers and to the channel. The individual pipes, however, were not drawn fully into position until

HANGERS, BOLTED TO BRIDGE FLOOR, CARRY SEWER

all the pipes were assembled; after which the joints were calked with lead wool. After the calking was completed, the sewer line was drawn into final position by taking up on the nuts on the U-bolts.

The work above described is a part of the $620,000 sewer construction now being done by the city of Paducah, Ky., the E. R. Harding Co. of Racine, Wis., being the contractor. Design and engineering supervision is being done through the office of the Department of Public Works of Paducah, of which Henry A. Pulliam is commissioner and chief engineer.

Cost of Cleaning Ballast by Machine and Hand; Pennsylvania R.R.

A WORK-TRAIN outfit used for cleaning stone ballast on the Western Pennsylvania division of the Pennsylvania R.R. consists of a locomotive, a flat car with 20-ton ditcher or revolving crane handling a grab bucket, a gondola car with a fixed inclined screen, and cabooses for the train crew and cleaning gang. A ballast cleaning train is shown in Fig. 1, but the train is sometimes made up with two or three ditchers and screens.

For the one-unit train, a gang of twenty laborers with a foreman works ahead of the train to remove the ballast between the ties, piling it in the center ditch to be picked up by the bucket, which also excavates the ballast outside of the track. With 'the train there are the operator and fireman on the ditcher, two laborers, the locomotive engineman and fireman, the conductor and a brakeman, making about twenty-nine men.

A ¾-, ⅞- or 1-yd. grab bucket is used, according to the distance between track centers. It is fitted with teeth to tear up the compacted ballast to a depth of about 20 in. below base of rail. The quantity of ballast averages 1.07 cu.yd. per yard of single track. No new material is added when the cleaned ballast is put back.

COST OF CLEANING BALLAST BY MACHINE: P. R. R.

Train Service		
Engine service, including oil, fuel, etc...	9¾ hr. @ $4.59............	$44.75
1 Engineman..................	9¾ hr. @ 0.86 ($1.29)*....	9.14
1 Fireman.....................	9¾ hr. @ 0.63 (0.945)*....	6.69
1 Conductor....................	9¾ hr. @ 0.725 (1.0875)*..	7.16
2 Brakemen, each..................	9¾ hr. @ 0.56 (0.84)*.....	11.06
		$78.80
Ditcher expense for three-ditcher unit.		
1 Ditcher foreman..................	8 hr. @ $0.628 per hr......	$5.02
3 Ditcher enginemen, each..........	8½ hr. @ 0.567 per hr......	4.82
3 Ditcher firemen, each	8½ hr. @ 0.506 per hr......	12.90
9 Ditcher laborers, each	8 hr. @ 0.37 per hr......	26.64
Cost of repairs, fuel, oil, etc., each.....	8½ hr. @ 1.00 per hr......	25.50
Depreciation......................	8½ hr. @ 0.75 per hr......	19.12
	Three-unit ditcher expense.	$94.00
	Train service...........	78.80
Total cost to clean 3,000 lin.ft..........	....	$172.80
or cost per linear foot..........	....	0.0576

* Pay 1½ time after eight hours.

A woven screen may be used, of ¾-in. rods spaced 1½ in. c. to c., or a ¾-in. plate screen punched with holes 1¾ in. square and ½ in. apart, the holes in alternate rows being staggered. As shown in Fig. 2, the screen frame is 9 ft. wide and 11½ ft. high, with its lower end pivoted to a horizontal base frame which rests upon the sides of the car and has a hinged support or back leg to support the screen in its inclined position. This base frame is clamped to the car.

The screen itself tapers from full width at top to 27 in. at the bottom, each side being formed by a 3x3-in. angle and 12-in. upstanding plate riveted upon the frame. At the bottom is a steel hood delivering the cleaned stone to an inclined chute which is hung along the side of the car (see Fig. 1) and deposits the stone just outside the ties, ready to be thrown back into place with forks. The dirt which falls through the screen goes into the car and the screen is shifted along as the car fills.

FIG. 1—BALLAST CLEANING TRAIN
At left, train with ditcher and screen. At right, bucket picking up old ballast and chute delivering cleaned stone from screen to track.

The ballast train on one track handles the ballast of the adjacent track and must keep clear of regular trains. Extra trains get orders to look out for the ballast train. A portable telephone outfit enables the conductor to keep informed as to train movements and thus avoid unnecessary delays in getting clear of trains which are late. As a rule a two- or three-mile stretch of line between interlocking plants is given up to the ballast train. The actual working time averages from three to five hours per day, except where special arrangements are made for exclusive use of the track. In length of track cleaned per day, the maximum record is 3,455 ft. with one ditcher in 6 hr. 50 min. working time, the dirt screened filling five gondola cars. Other records include 1,320 ft. for one unit, 2,100 ft. for two units and 3,000 ft. for three units in one train.

Cost of Ballast Cleaning—In the comparison of cost of cleaning by machine and by hand, the cost is based on length of center ditch cleaned, as in both cases hand labor is employed for removing the ballast from cribs or between the ties and piling it in the center ditch. But the cost of machine work includes the screening of this extra ballast, while that of hand work is for the ballast in center ditch only. The figures in the accompanying table are for three ditchers and screens in one train and for an 8-hour day.

In a test for cost of cleaning ballast by hand, the men were required to clean to the same depth that is cleaned by the machine, 10 to 12 in. below the bottom

of the ties, and to dispose of the dirt over the bank about 20 ft. away. The labor used was exceptionally good and the men worked hard with the knowledge that the job had a special significance. The average per man was 26 ft. of center ditch (9-hour day). Cost per linear foot, 14.6c., as compared with 5.76c. for the machine work.

It is pointed out that in making comparisons the fact should be kept in mind that the machine cleaning is not affected by rain, extreme heat and other weather conditions that affect the efficiency of labor. Another decided advantage in machine cleaning is that the long digging teeth of the bucket tear up the "cleaning floor" at least 6 or 7 in. below the depth actually cleaned. The term "cleaning floor" is given to the bottom of the compacted mass of dirt and ballast that the trackmen shovel and fork over. This floor is gradually built up by successive cleaning and is objectionable in that it holds water and prevents it from draining away. This method of handling the cleaning of ballast on a busy main line was planned under the direction of Robert Faries, division engineer, Pennsylvania R.R., Pittsburgh, Pa.

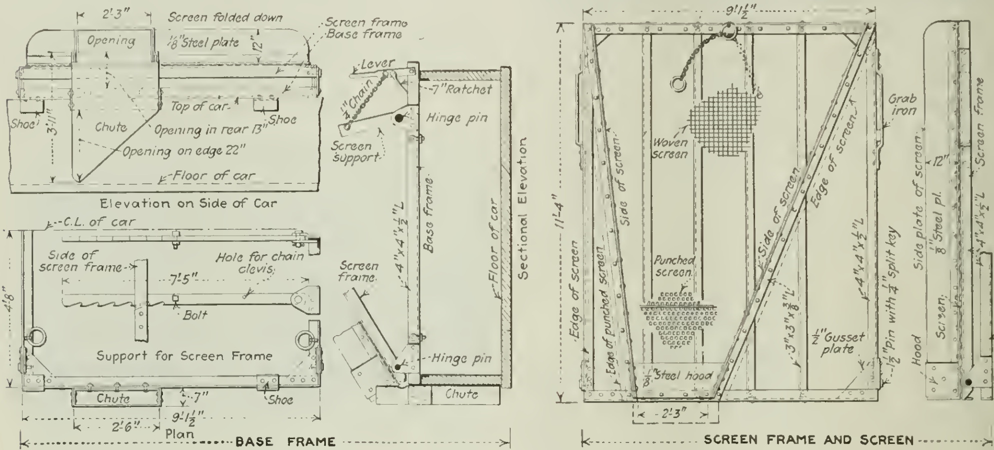

FIG. 2—FOLDING SCREEN FOR CLEANING BALLAST

Importance of Intercepting Ditches on Highway Construction

By F. M. Balsley

Engineer-Inspector, Wisconsin Highway Commission

In the planning of road projects it is believed that not enough attention is paid to the necessity of installing intercepting ditches above the top of the back slopes in cuts and outside the toe of slopes where the ground slopes toward the fill. This is particularly true in side-hill construction where there is a considerable drainage area above the road. Practically all highway specifications call for a neat and smoothly trimmed back slope in the cuts. In order to preserve this neat appearance it is essential that all water from the area above the top of the cut be prevented from running down the face of these slopes.

The simplest means of preventing erosion is an intercepting ditch placed far enough from the top of the slope to prevent the erosion of the ditch itself from caving the bank. Where the drainage area is not large we simply specify that one furrow shall be plowed from 4 to 10 ft. back of the slope stakes, turning the furrow toward the cut. It is not always necessary to clean out this ditch by hand, but it is essential to have the course of the furrow run in such a direction as to maintain as near as possible an even grade all the way down the hillside. Where the slope is fairly even the ditch may be close to parallel to the top of the cut, but in rough ground, of course, this is not true.

This intercepting ditch should be cut immediately after the slope stakes are set, then the work is protected while it is under construction. In cases where farm fences interfere and it is necessary to cut the intercepting ditch inside the fence line, it has been found that it is fairly easy to convince the property owner that the ditch will be a protection to his property rather than a damage. If the erosion of the slopes is not headed off, eventually the banks will cave in and the fence will go with them.

Where fills are made on sloping ground it is essential that an intercepting ditch be cut beyond the toe of the slope to protect the fresh fill from being washed out by the first flood. Many of our contractors and county commissioners fail to protect their work in cases of this kind. One furrow at the right point will form a ditch that will protect the toe of the slope and prevent material from washing out.

The plan shows a special type of culvert and downspout that was designed to take care of the water from the intercepting ditch on Project 41 in Grant County, Wisconsin. In this case there was a large drainage area above the road and the slope of the hillside was extremely steep. The ditch was first plowed and the loosened material was removed with a slip scraper. The culverts were placed in such a position that it was pos-

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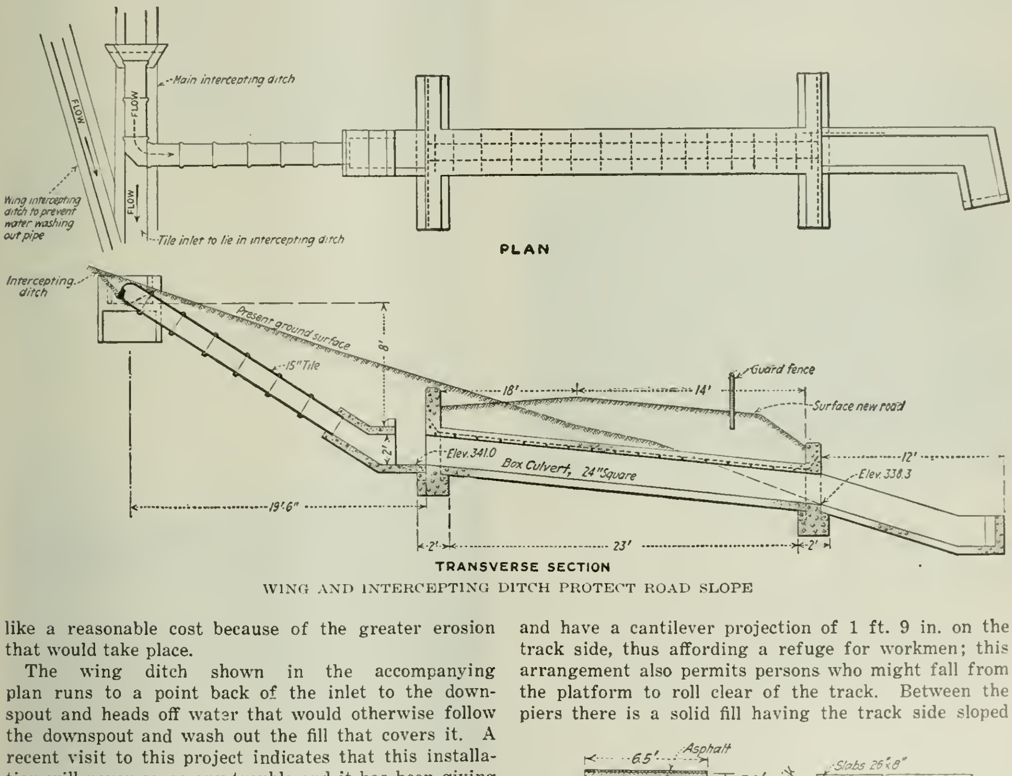
sible to drain the intercepting ditch directly into the culverts, thereby relieving the road ditch from a large amount of water. The grade on the finished road is 7 per cent, and it can readily be seen that if the accumulated water from the road surface itself, plus the water from the side hill, were carried in the road ditch it would be impossible to maintain the road at anything like a reasonable cost because of the greater erosion that would take place.

The wing ditch shown in the accompanying plan runs to a point back of the inlet to the downspout and heads off water that would otherwise follow the downspout and wash out the fill that covers it. A recent visit to this project indicates that this installation will never cause any trouble and it has been giving excellent service for the last three years.

In making a survey in rough country the notes should indicate the points where an intercepting ditch will be required and information relative to the size of a ditch necessary to carry the water. The typical sections for the finished work should also show the installation of an intercepting ditch in the cut as well as the fill section. If the ditch is large bids can be asked for on a cubic-yard basis. Where a plowed ditch is sufficiently large bids should be asked for at so much per linear foot of ditch. In the state of Wisconsin, where we must maintain roads after they are constructed, the matter of protecting the work as it progresses is of the utmost importance. In spite of this fact, many of our engineers fail to realize that a cheap, easily constructed intercepting ditch will save many times its cost in maintenance thereafter.

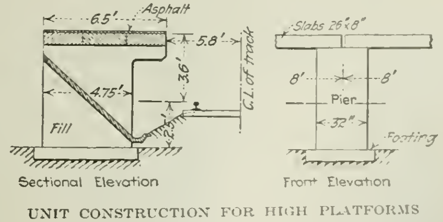


WING AND INTERCEPTING DITCH PROTECT ROAD SLOPE

Concrete Units for Station Platforms

HIGH platforms to replace low ones were required in the electrification of the suburban lines of the Buenos Aires Western Ry. at Buenos Aires, Argentina, and it was necessary that this work be done without interrupting traffic or inconveniencing passengers. To meet these conditions a type of reinforced-concrete unit construction was adopted, so that the units could be placed during the night, the platforms consisting of piers with cantilever tops carrying deck slabs, as shown in the accompanying drawing.

The piers, about 32 in. thick, are spaced 8 ft. c. to c. and have a cantilever projection of 1 ft. 9 in. on the track side, thus affording a refuge for workmen; this arrangement also permits persons who might fall from the platform to roll clear of the track. Between the piers there is a solid fill having the track side sloped



UNIT CONSTRUCTION FOR HIGH PLATFORMS

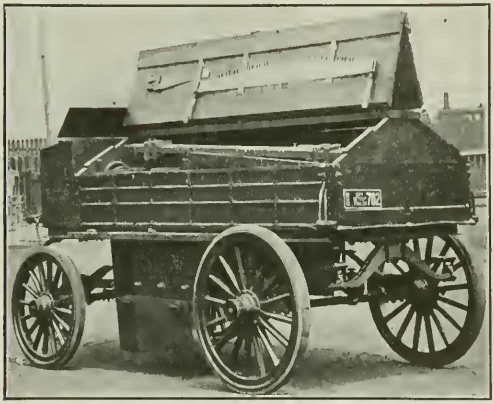
and faced with concrete which ends in a drain or gutter. The slabs are 8x2.2 ft., with a thickness of 8 to 9 in. and are covered with a layer of asphalt.

In carrying out the work, portions of the low platform were removed to allow of placing the shallow footing for the piers the openings being covered before the next day's traffic began. The next night a work train with a supply of units was run to the station and

a 5-ton steam locomotive crane set the piers on the footings and then placed the slabs. In this way about 330 ft. of platform could be built in two nights, including the erection of temporary wooden handrails, steps and ramps. The finishing work was then done by day and night shifts. At the terminal station a temporary high platform for the suburban tracks was built on one of the low platforms by placing timber bents which were framed in advance and handled by the crane.

Truck Trailer Carrying Tools for Water-Works Emergencies

FOR serious emergencies the Detroit Water Department has a truck trailer with tool boxes filled with everything likely to be needed. The truck has rubber



TRAILER WITH FIVE BOXES FILLED WITH EMERGENCY TOOLS
This outfit is always packed and ready to be taken to serious pipe breaks, large fires or other emergencies requiring quick action.

tires and good springs, which permits it to be pulled at any speed the hauling truck can make without disarranging the contents.

The following named articles, listed alphabetically for ease in finding, are included in the five sections:

EMERGENCY TOOL LIST, DETROIT WATER-WORKS

Article	Section	Article	Section
1 Axe	3	6 Pails, galvanized	2
1 Axe, hand	3	12 Picks, concrete	3
6 Bars, concrete	2	6 Picks, dirt	3
3 Bars, steel, ⅜-in., 7 ft. long	2	2 Pc. Pipe brace, 1½-in., 3 ft. long	3
3 Bars, steel, tunnel, 5 ft long	3	50 Points, large diamond	4
2 Books, gate	1	2 Pots, lead pouring	4
6 Pr. Boots, rubber	5	40-Ft. Rope, 1-in.	4
1 Broom, heavy	3	1 Ruler, 6 ft. long	1
6 Cutters, asphalt	3	1 Saw, cross-cut	3
50 Cutters, handle	4	1 Saw, hand	3
3 Hammers, calking	4	2 Scrapers, ice	3
4 Handles, concrete pick	3	2 Shovels, concrete	3
4 Handles, dirt pick	3	2 Shovels, iron, snow	3
4 Handles, sledge	3	3 Shovels, short handles	3
10 Handles, sledge	2	18 Shovels, long handles	3
24 Handles, tool	4	6 Sledges, heavy	2
2 Hooks with rope 12 ft. long	3	3 Sledges, light, 6-lb.	2
4 Hooks, lead pot	4	6 Sticks, pipe	2
4 Hooks, timber	2	6 Suits, oil-skin	1
4 Horses, collapsible	2	1 Tape line, 50-ft.	1
1 Key and bar, shut-off	2	2 Tools, calking, large sets	4
1 Key wheel, 8 sticks	2	6 Washers, 3-in. suction hose	4
3 Knives, packing	4	6 Wedges, frost	2
8 Lanterns, red	5	12 Wedges, steel	4
4 Lanterns, white	5	1 Wrench, hose	4
2 Ladders, short	3	1 Wrench, hydrant	4
6 Lifters, lead	4	1 Wrench, monkey, 15-in.	4
1 Light flash	1	1 Wrench, monkey, 12-in.	4
1 Map section	1	1 Wrench, Stilson, 18-in.	4
5 Lb. Nails, 10d	2	1 Wrench, Westcott, 10-in.	4
5 Lb. Nails, 20d	2		
1 Pail and dipper, water	5		

From Job and Office

Hints that Cut Cost and Time

Santa Fe Ry. Moves Six Bridge Spans 43 Ft. Endwise

SHIFTING five bridge spans simultaneously was accomplished by the Atchison, Topeka & Santa Fe Ry. in moving a six-span single-track deck-truss bridge 43 ft. lengthwise, in order to place the structure on new piers. The bridge in question crosses the Des Moines River near Dumas, Mo., and was built originally in 1887, but the superstructure was renewed in 1904. The 150-ft. deck truss spans are in good condition, but the stone masonry was found to be disintegrating badly. It was decided, therefore, to build new double-track piers on the same center line but east of the old piers, at a distance of two panel lengths of the trusses, or 42 ft. 11¼ in., this distance giving the necessary working space to construct the new piers. Solid rock is found about 6 ft. below low-water level and there were no difficulties in the foundation or pier construction. The height from low water to base of rail is about 56 ft.

In order to make the change it was necessary to revamp the east truss span by cutting off one panel at each end, thus shortening this span 42 ft. 11¼ in., after which this span was moved east to its final location, the intervening gap being filled in with falsework (Fig. 1). Between the old and new piers falsework was placed, as shown in Figs. 1 and 2, to carry the rollers for shifting the remaining five spans. The adjoining vertical end posts of the remaining five truss spans were fastened together by means of diaphragms and also securely

FIG. 1—MOVING TRUSS SPANS ON SANTA FE RY.
At top, west end of east span resting on new pier, with falsework at left closing gap in deck and between new and old piers. At bottom, upper-deck falsework removed and spans moving to right towards new pier.

From Job and Office

For Contractor and Engineer

tied with steel cables. The spans were jacked up, the shoes removed and a grillage of T-rails was installed, which carried the load directly to the roller nests, as shown in Fig. 2.

Two stationary hoisting engines were installed between the old east abutment and the first new pier, one on each side of the bridge; these operated the 1¼-in. hemp ropes, passing through two 6-sheave blocks which were used in moving the spans. After the spans were moved to the new piers, the gap at the west end was filled in with a 42-ft. deck girder span resting on the old remodeled west abutment and on a steel bent on the new west pier. The placing of the bent on the new pier and of the girder span on abutment and bent is shown in Fig. 3.

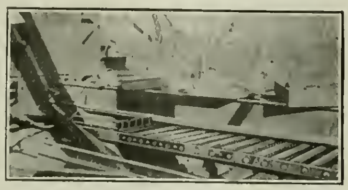


FIG. 2—ROLLER NEST UNDER SPANS

Actual moving of the spans occupied a little less than an hour, while traffic was blocked only 5½ hr. The entire work was planned and carried out under the direction of A. F. Robinson, bridge engineer of the Atchison, Topeka & Santa Fe Ry. System. The moving of the steel spans was done by the American Bridge Co., while the Missouri Valley Bridge & Iron Co. built the new substructure and removed the old piers.

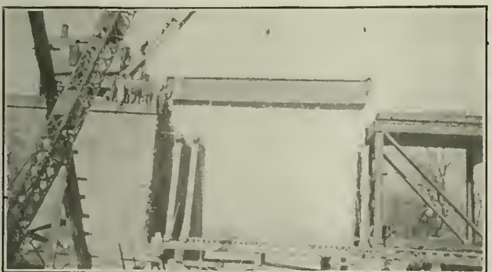


FIG. 3—CLOSING GAP IN BRIDGE

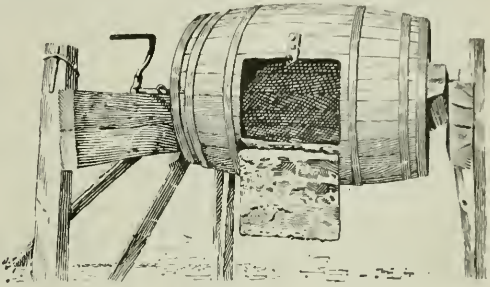
At top, placing new steel bent on new pier carrying west end of last truss. At bottom, placing 42-ft. girder span to rest on abutment and steel bent.

Barrel and Automobile License Plates Form Tar Cold Patch Mixer

By John S. Crandell

Consulting Engineer, The Barrett Co., New York.

A VERY simple form of mixer for making up tar cold patching aggregate is shown in the illustration herewith. It consists of a strong barrel with a door cut in one side and hinged so that it may be securely shut and latched. On the inside three old motor license plates are bolted so as to form blades to assist in churning the mix. The barrel is mounted on strong supports, and a substantial crank is attached to the axle on which the barrel revolves. One man can do the entire work of mixing, and can supply sufficient material to keep a small maintenance gang busy. Or, where there is maintenance patrol by single patrolmen, this simple mixer is all that is required to make up the daily batch.



HOME-MADE DEVICE MIXES TAR COLD PATCH

This mixer has been in operation for a year, and the output has taken care of the needs of one patrol gang's section.

The apparatus illustrated could be improved by making it more substantial. A steel drum might be substituted for the wooden barrel, and a rigid support mounted on wheels so that the mixer might easily be moved from one location to another.

Fender Chains Protect Panama Lock

One of the chain fenders protecting the lock gates at the Gatun locks of the Panama Canal proved its value on May 25 when struck by a steamer. The following account is condensed from the *Panama Canal Record:*

The steamship "Hoven" in tying up at the Gatun locks, on arrival from Gatun Lake, struck the chain fender protecting the upper guard gate. It is estimated that the vessel was going approximately four miles an hour and it was stopped within 50 ft. The chains prevented a collision which might have resulted in serious damage to the vessel and the locks, as the water in the upper chamber was about 15 ft. lower than Gatun Lake. Both chain fender machines apparently worked satisfactorily as about thirty-five links were pulled out from one and forty-two from the other. The incident was caused by a misunderstanding of signals in the engine room. These fender chains are stretched across the lock chamber from near the tops of the walls. To allow a ship to pass, the chains are lowered into a recess in the side walls and lock floor. After the ship passes, they are raised again. The mechanism consists of a hydraulically-operated system of cylinders, so that 1 ft. movement by the cylinder accomplishes 4 ft. by the chain. When a pressure of more than 750 lb. to the square inch is exerted against the fender, the chain is paid out by an automatic release until the vessel stops.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Safe Roadway Widths

Sir—In connection with the discussion on safe roadway widths, a point deserving attention is the tendency of automobile traffic to form a single lane in each direction, regardless of the width. This tendency does not occur in wide city streets; but on suburban and country roads, where the traffic is crowded, the impulse to drive in the middle of one's own half of the road seems to be almost impossible to overcome.

In theory, a suburban road 25 or 30 ft. wide ought to be good on holidays for two lanes of outgoing travel in the morning and for two lanes of homeward travel in the evening. I have never, however, seen this occur.

The principle reason for using a roadway width of more than 20 ft. is to make it easy for faster cars to overtake and pass slower ones. In *Engineering News-Record*, July 12, 1923, p. 74, is a letter by G. F. Schlesinger, urging the undesirability of roadways of 20-ft. width on the ground that they invite a third lane despite their insufficient width. I have never noticed any such tendency, but, on the contrary, I have often noticed the insufficiency of such a width for permitting a faster car to overtake and pass a slower car, especially a truck. To make the roadway so narrow as to force an overtaking car over to the left of the road may be good engineering, but it is exasperating to the driver on a winding road who finds himself compelled, sometimes for miles, to trail a car ahead which is just fast enough so that he cannot safely pass it within the visible distance.

Unless the shoulders are very smooth, drivers on main roads will seldom turn onto them to allow an overtaking car to pass. The writer's conclusion is that a roadway less than 20 ft. wide, and preferably 22, is not safe. This refers to the concrete or bituminized surface. The width over shoulders should be at least 30 ft., and the shoulders should be kept smooth and flush with the main surface.

Where one such road is insufficient for the traffic, two alternative routes are better than one wide road, on account of the tendency to drive in single lanes each way.

HERBERT L. TOWLE,
David Lupton's Sons.

Philadelphia, Pa., July 19, 1923.

The Bar to the Solution of the North Jersey Water-Supply Problem

Sir—The water-supply situation in northern New Jersey, commented on editorially in your issue of July 12, p. 46, suggests comparison of the way public water supplies have been handled in that section and in eastern Massachusetts.

More than 30 years ago, some cities and towns adjacent to Boston were situated, as regards their public water supplies, very much as are now situated the municipalities encircling Newark and Jersey City. For this district in Massachusetts there was created by legislative action a Metropolitan Water Commission of three members appointed by the governor. This board took over the water-supply works of Boston and acquired other water-supply property. It borrowed large sums of money, issuing bonds on the credit of the state as security. It built works ample for the purposes of supplying water to the Metropolitan District. It paid the interest on the money borrowed, and paid off the principal from the money received for the water furnished in wholesale lots, and at wholesale prices, delivered to the several municipalities to be supplied, Boston included. The commission, since merged with like district commissions for main sewerage and for parks, is still at work.

Nothing is simpler in general outline; nothing more effective, or economical. Each municipality attends to the details arising within its own borders, the commission selling water in wholesale quantities, delivered to each municipality, and furnishing the main channels by means of which it is again removed in a sanitary manner.

Why cannot precisely the same plan of operation be engrafted on the life of the municipalities of northern New Jersey? Why has it not long ago been done? Why is there a continuance from year to year of a dearth of ample sanitary public works in northern New Jersey, conceived, constructed, operated and paid for, in a sane manner? The answer may be found in a portion of Art. IV of the New Jersey constitution which reads: "The credit of the state shall not be directly or indirectly loaned in any case." Therefore, instead of having Commissioners *with powers of initiative* to construct and operate for them ample works of public, sanitary necessity, the inhabitants of northern New Jersey are put to it to get such works at all. As population increases, each little municipality becomes unable to properly care for these needs. The works then, and thereafter, needed, must be planned with a vision that extends far into the future, and far beyond the boundaries of any and of all these municipalities, and mayhap into other states than their own. Such planning must continue indefinitely, and the commissioners must have full powers of initiative and of condemnation.

Of what need any "Jerseyman" be afraid should a proposition be presented amending Art. IV to read: "Except for the construction, maintenance and operation of works of water supply and main drainage, to be owned by and operated for the sole benefit of the people, the credit of the state shall not be directly or indirectly loaned."

The existing prohibition was intended, so it is said, to prevent the legislature from extending state aid to works of private enterprise, conducted for private gain, as in the wild days of the Camden & Amboy and other railroad ventures. It should no longer stand in the way of the creation of sanitary works needed for the public good.

How many states of the Union have such a clause, as this of New Jersey, in their constitutions, it would require some study to determine. It is plain that no state should throttle the construction of needed sanitary public works in this manner. All states may, instead, well follow, in their metropolitan districts, the example of Massachusetts, since public sanitary works, comprehensive as to political subdivisions served and as to time of construction, must needs be built in the manner described or they will not be built at all.

This is said with full knowledge of the fact that New Jersey is helping build a monumental bridge to Pennsylvania and a vehicular tunnel to New York; has voted $40,000,000 to build roads and has managed, by invoking the individual credits of some twenty towns, to go far toward completing a Passaic main sewerage scheme, while certain cities, acting singly have built commendable water-supply works. Roads, bridges, and tunnels can be estimated and provided for, by a single, lump-sum appropriation. It is doubtful if any one cognizant of all the facts would ever want to repeat the Passaic main sewerage mode of working under the sustenance of a lot of independent warring municipalities, forced to act as commercial partners.

A water supply for the communities of northern New Jersey is a piece of work whose practical problems must largely be met as they arise. With the constant increase of population on the territory under consideration, it is a work without end. It is the need of the greater part of the population of the whole state. And it should have the support of the legislation of the state, modeled upon the legislation of any state of the Union most favorable for the planning, construction, and operation of works supplying such a need. New Jersey should no longer be prevented by an antiquated clause in the constitution, designed for a wholly different purpose, from adopting the sole rational method for the procuring by the people of what the people must have to live.

CLEMENS HERSCHEL.

New York City, July 16, 1923.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Contract for the Construction of a Dam and Power House at Island Portage on the Abitibi River on the power development project of the Hollinger Consolidated Gold Mines, of Porcupine, has been awarded by the company to Sir William Arrol, Ltd., of St. Catharine's, Ont., and London. Plans call for the installation of equipment with a capacity of 25,000 hp.

Orders for 1,000 Freight Cars have been placed by the Canadian National and Canadian Pacific Railways, the cars to have a capacity of 60,000 lbs. and to be much larger than the ordinary freight cars. The orders are distributed among several companies. The Canadian Pacific cars are of various types and are to be built at the Angus shops of the company in Montreal.

Traffic Tests on the Bates Experimental road near Springfield, Ill., conducted for more than a year by the Illinois State Division of Highways were discontinued last week. Approximately 1,000,000 tons of traffic have been imposed on the road and the majority of sections have shown decisive failures. H. F. Clemmer, engineer of materials, suggests that those who care to view the results arrange a visit within a few days as the road will be turned over immediately to the contractor for reconstruction.

Bonds of the Canadian National Railways to the amount of $22,500,000, bearing 5 per cent interest and guaranteed by the Dominion Government, will shortly be issued for the purpose of equipping the railways with the necessary rolling stock. Hon. W. S. Fielding, Canadian finance minister, has announced. The total cost of the equipment required is $3,000,000, one-quarter of which is provided by the general appropriation made by Parliament for railway purposes. Equipment orders given for the railways owned or controlled by the government have since 1918 reached a total of about $130,000,000.

Competitive Examinations of Applicants for cadet engineers to fill vacancies in the Coast Guard will be held in several of the large cities of the country, commencing Sept. 10, 1923. Applicants must be between 18 and 23 years of age at the time of the examination and successful candidates will report about three weeks later at Coast Guard Academy, New London, Conn. Cadet engineers are trained to become engineer officers; during training they receive the same pay and allowances as midshipmen in the navy and upon graduation, after three years at the academy, are commissioned as ensigns. Information as to the places of examination and further details may be obtained from The Commandant, U. S. Coast Guard, Washington, D. C.

St. Paul Votes $5,500,000 Bonds for Water-Works and Sewers

Bonds totaling $5,500,000, of which $2,500,000 are for water works improvements and $3,000,000 for trunk sewers, were authorized at a popular election in St. Paul, Minn., on July 16. At the same time a charter amendment was approved that will for the immediate present increase by $550,000 a year the total amount that may be appropriated by the city for certain purposes. This amendment provides that at least $400,000 of the amount shall be used to pay (1) the city's portion of paving intersections and (2) the cost of paving that portion of streets that are over 24 ft. wide and (3) to apply on the cost of trunk or main sewers.

The chief purpose for which the water-works bonds will be used is for an 8-ft. reinforced-concrete conduit to parallel the present brick conduit, built in 1885 from Vadnais Lake to the city. The estimated cost of the new conduit is $900,000. Other conduits and open channels connecting the Vadnais Lake system are estimated to cost $150,000; new feeder mains to new districts in the city, $600,000, and new distribution mains and meters, $170,000 a year for a period of five years.

The $3,000,000 trunk sewer bonds will provide for what is known as the belt line in the northeast part of the city at an estimated cost of $1,200,000; Trout Brook extension, $700,000; the Maryland-Como system, $400,000, besides seven other projects ranging in cost from $30,000 to $200,000.

U. S. Engineers Order Survey in Los Angeles

Washington Correspondence

A survey of the port development at Los Angeles has been ordered by the Board of Engineers for Rivers and Harbors. This survey, however, is not to include the proposed extension of the break-water so as to shelter Terminal Island. The hope is expressed at the Corps of Engineers that this survey can be co-ordinated closely with that of the municipality. If that can be arranged, much duplication and unnecessary expense can be avoided, it is believed.

The proposal to establish terminal facilities on Terminal Island does not meet with the approval of many of the Government's engineers who have looked over the project. They see no reason for expending $8,000,000 to extend the breakwater especially in view of the experience indicating the inadequacy of breakwater protection against the surges which characterize the Pacific.

In addition to the drawbacks of the physical formation of the Island, it is pointed out that inside terminals would be justified if there were no other argument in their favor than the better accessibility from the land side.

Architects' Bridge Design Again Under Discussion

Three Allegheny River Bridges In Pittsburgh To Be Rebuilt—Engineers Design Declared Unworthy

Controversy over whether important bridges should be designed by architects has again broken out in Pittsburgh, where discussion of the same kind developed four years ago. At that time the county commissioners retained two architectural firms for the design of two of the new Allegheny River bridges, that at 40th St. and that at 16th St., the architects to have full direction of both design and construction. Protests by the American Institute of Consulting Engineers, the Board of Direction of the American Society of Civil Engineers, and the Engineers Society of Western Pennsylvania against this delegation of engineering work to persons not trained in the problems and art involved were of no effect. The present controversy involves the 6th, 7th, and 9th St. bridges, which must be rebuilt under orders of the War Department for more clearance and channel width.

Work Delayed

Work on these three bridges has been delayed by the county officials for a number of years, and appeal made to the War Department to receive its order for the raising of bridges over the Allegheny River issued seven years ago. However, early this year the department reaffirmed its position that the bridges must be raised, and the county is now preparing to proceed with the work.

Preliminary plans for the 7th St. bridge were prepared last spring by V. R. Covell, county engineer, and were approved as to channel location and clearance height by the War Department. The design was then submitted by the county to the Pittsburgh Art Commission, whose approval is required for all city structures exceeding $25,000 in cost but which has no authority over county construction; this commission declared the county design to be "inadequate and unworthy." Later the county commissioners requested the local chapter of the American Institute of Architects to recommend a number of architectural firms for the artistic development of the three bridges.

Prior to this a joint conference committee of the chapter and the Engineers Society of Western Pennsylvania had considered the question of engineering and architectural work in bridge design, and under date of May 22 passed a resolution recommending that the county engineer be in direction of the design and construction of the bridges, that engineering and architectural consultants of experience be retained to advise him, and that the art element be recognized as an important

(Continued on p. 157)

Design of Bear Mt. Bridge Attacked as Ugly

Contributing Editor of the Outlook Characterizes Structure as Shown by Artist as "Tin Trumpery"

An attack on the design of the Bear Mountain suspension bridge across the Hudson River, now under construction, was published by Lawrence S. Abbott, contributing editor of *The Outlook*, in the July 18 issue of that magazine. The article says that because a beautiful bridge would draw sight-seeing tourists to New York and so "promote the money-making power" of the city, the Bear Mountain bridge design should be deplored; that the men who conceived the structure are apparently not men of architectural training; and that the bridge, judged by an artist's aerial perspective of the design (reproduced herewith), "looks in its wonderful setting of mountains and river like a piece of tin trumpery." It charges that many good judges are united in saying that the piers "look like poles carrying high-tension electrical power" and should be of stone. And, after admitting that the author is not competent to say what kind of bridge should be built at the site, it affirms that the design shown is "hopelessly incompetent." Finally, the article rumors that members of the Palisades Park Commission are interested in the bridge as stockholders, that they are thus acting as judges in a matter in which they have a pecuniary interest, and that "they are permitting an impression to get abroad that they are not insisting on a clean-cut distinction between questions of private profit and public trust."

The Palisades Park Commission, an interstate body of New York and New Jersey in charge of the management of Bear Mountain Park, a forest reservation along the west side of the Hudson, which the western end of the bridge touches, authorized the bridge company to build its approach, and in this connection approved the design after certain minor changes were made.

J. D. White, chairman of the Palisade Park Commission, in a statement replying to the article, says that upon receiving the original design the commissioners criticised the piers and engaged the best architectural advice obtainable, with the result that the design was changed. He also says that the legislative charter specified steel towers, and that the commission was bound by this requirement; and he cites the approval of the plans by the state engineer, the War Department, by William H. Burr, consulting engineer, and experts of the commission.

Speaking for the company which is building the bridge, E. Roland Harriman, president, says:

"The type of design was accepted after expert study of its soundness and adequacy and the consideration of other types. Eminent engineering and architectural advice was sought, and while it was realized that massive stone towers and corresponding architectural treatment would undoubtedly add to the attractiveness of the bridge, it was found that adequate structures of this nature were impossible because of the physical limitations of the site and would involve an additional cost that was prohibitive. The company was, therefore, confronted with the alternative of providing a well designed and adequate bridge which will be of the greatest benefit to the public and the state or the abandonment of the project, of which it chose the former. It is felt by those responsible for the affairs of the bridge company that they are willing to rest their case on the merits of the design when the project is complete."

The bridge has a span of 1,632 ft. between towers, and side spans of 210 ft. each. The cable sag is 200 ft. and the camber of the roadway in the main span about 15 ft. It was designed by Howard C. Baird.

A.A.E. to Ask Congress Investigate Dismissal of A. P. Davis

A congressional investigation of the dismissal of Arthur P. Davis as director of the U. S. Reclamation Service will be asked for by officials of the American Association of Engineers, the matter to be followed up by the committee on political policies. The Civil Service Reform League has been urged by A.A.E. to look into the circumstances of the dismissal.

"Information from several sources all point to this course as the wise one," said Webster L. Benham, president. "We admit at the outset that in the selection of an executive, the person directly responsible for the work is entitled to exercise his judgment in appointing his subordinates. While this is the essence of executive control, we view with grave concern the dismissal without notice of an admittedly capable engineer who has been in administrative charge of an important government service for many years. We are particularly concerned in that such is purported to have been accompanied by threats intended to intimidate Mr. Davis into giving out publicly a statement that the resignation was initiated by himself."

New York-Duluth All-Water Service to Be Opened

A nine day all-water service between New York and Duluth without transshipment, starting in August, is announced by the Minnesota-Atlantic Transit Co. The route will be by way of the Hudson River and the Barge Canal to Oswego on Lake Ontario, thence by way of the Great Lakes and the Welland Canal to Duluth. The motor barges will be 285 ft. long by 42 ft. wide, and 19 ft. deep, with a carrying capacity of 2,000 tons. They will be propelled by Diesel engines and will operate under their own power.

ARCHITECT'S AERIAL PERSPECTIVE OF THE BEAR MOUNTAIN SUSPENSION BRIDGE

Bridge Design of Architects Again Under Discussion

(Concluded from p. 155)

factor. The resolution also advised against professional competition for designs. On July 10 the architects' chapter submitted the names of thirteen architects for the design and supervision of bridge construction and at the same time disavowed the committee resolution as not representing architectural opinion and as having been unauthorized.

On the architectural attitude the following statement of E. B. Lee, president of the chapter may be quoted, "No city in the world's history has ever had such an opportunity to design and erect in one group three great bridges under a comprehensive plan, which thus gives their creators so rich a chance to consider the whole picture as it shall be presented to the eye up the river, down the river, and from either shore." John W. Beatty, director emeritus of the department of fine arts, Carnegie Institute, who has taken a prominent part in the movement to place architects in charge of the bridge design, said in regard to the request of the county commissioners for names of architects, "This simply means that able men will finally be chosen to create the designs for these bridges and that they will be architecturally important and beautiful. This is as it should be. The day has gone by for the erection of bridges without regard to grace and beauty of line. Pittsburgh will therefore take a foremost place among American cities in this respect and I predict that it will in time become known as the City of Beautiful Bridges."

Engineers Protest

Resolutions of protest against the delegation of the bridge design to architects have been passed by the Engineers' Society of Western Pennsylvania and by the Board of Direction of the American Society of Civil Engineers. Protest was also made by the Pittsburgh chapter of the American Association of Engineers, pointing out that safe and proper construction is the primary essential in bridge design and that architectural appearance is only of secondary importance. The resolution of the Board of Direction of the American Society of Civil Engineers is as follows:

Whereas, it has been brought to the attention of the Board of Direction of the American Society of Civil Engineers that the Commissioners of the County of Allegheny, Pennsylvania, have under consideration the employment of architects for preparing plans and specifications and for supervising the construction of several important bridges in the city of Pittsburgh and

Whereas, these bridges are primarily engineering works demanding safety and economy and involving principles of design, construction and maintenance which come indisputably within the province of engineers and

Whereas, it is detrimental to the public interest to subordinate safety utility adequacy for future traffic and cost of these structures to their appearance, although it is recognized that the embellishment and aesthetic features of bridges may properly be entrusted to those especially skilled in architecture

Therefore be it resolved, that the responsibility for the design and supervision of construction of such bridges should be entrusted only to qualified civil engineers and that a copy of this resolution be transmitted to the Commissioners of the County of Allegheny through the Secretary of the Pittsburgh Section of the American Society of Civil Engineers.

Santa Fe to Spend $60,000,000

The need for additional railroad facilities is noted in the annual report of the Atchison, Topeka & Santa Fe Ry., which states that: "One outstanding feature of the year's railroad operations is the clear demonstration of the country's imperative need for greatly increased transportation facilities, a need which has been realized and persistently urged by the railroads since the termination of federal control." At the beginning of 1922 the company undertook as large a program of improvements as seemed possible and carried it through; but only a beginning was made of providing for the traffic demands of its territory.

For the year 1923 contracts were let for 7,150 freight cars and 59 new locomotives; this equipment with passenger cars on order and improvements to existing equipment, will cost upward of $24,000,000. The second-track work undertaken and authorized since the beginning of 1922 involves an expenditure of over $15,000,000. Preliminary work is under way for a new double-track bridge over the Mississippi River, on the Chicago-Kansas City line, to cost $4,000,000. Enlargement of shops, terminals and sidings will be pushed and it is probable that cash expenditures during the year for all improvements and equipment will amount to at least $60,000,000. "The improvements have been practically confined to what will increase handling traffic, other improvements, even though desirable, being deferred, because the present program is all that the company can efficiently handle this year."

Southern Pacific Co. Surveys New Line in Oregon

Surveys for a new railway line to connect California and Oregon are now being made by the Southern Pacific R.R. Co. The new line which is in the old Central Pacific territory will extend from Kirk, a point southeast of the Cascade Mountains, over the mountain to Oak Ridge, a distance of about 118 miles. Construction was started on this line a few years ago working from both ends but it was stopped by the central & Southern Pacific litigation and will not be taken up again until this litigation is settled.

N. Y. Aerial Survey Proposed

Aerial photographic maps of New York City, covering the area within the legal limits of the city and made on scales of 600 ft. and 2,000 ft. to the inch, are soon to be made by the Fairchild Aerial Camera Corp. It is expected that the photography will be completed by November 1 and that the maps made therefrom will be finished about April 1, 1924. The proposed aerial survey is strictly a city enterprise and title to all photographic negatives, as well as reproduction rights, will be vested in the city under the terms of the contract.

Hirst-Potts Charges Are Modified at Hearing

"Revenge" Only Motive Now Charged Against Potts—Stock Conferences Before Trenton Plans Filed

Modification by E. Jerome Hirst of the Direct-Oxidation Disposal Corp., of Philadelphia, of the charges made by him to Governor Silzer against Cylde Potts, an engineer-member of the New Jersey State Board of Health, in connection with the Trenton sewage-works plans, was the chief feature of the hearing at Trenton July 24. The hearing was held by Dr. J. C. Price, director of the New Jersey Department of Health, at Gov. Silzer's request.

In Mr. Hirst's charges dated Feb. 19, 1923, he alleged that failure of the Board to act on Trenton's application for a sewage-works permit filed Dec. 15, 1922, "was attributable unequivocally to one member of the State Department of Health, Clyde Potts, a consulting engineer of New York and Mayor of Morristown, N. J." In his charges Mr. Hirst said no other motive for Mr. Potts' opposition to the Trenton plans was apparent except that Mr. Potts "sought and was denied donation of a large stock interest in the patented process involved" in the Trenton plans. Mr. Potts sent a letter to Governor Silzer denying the charges, both against himself and as against the other members of the board as having been influenced by him. (See *Engineering News-Record*, March 8, 1923, p. 462; March 15, p. 507; Apr. 5, p. 635.)

At the hearing on July 24 Mr. Hirst voluntarily stated that Mr. Potts had not improperly sought an interest in the Direct-Oxidation Process, while on cross-examination by Mr. Potts' attorney Mr. Hirst made it plain that the stock incident occurred in 1918-1919.

Mr. Hirst brought out nothing at the hearing that was definite as to negotiations with Mr. Potts as to a stock interest in the Direct-Oxidation Process, beyond the statement that a citizen of New Jersey suggested to a man in Reading, Pa., that it would be advisable to engage Mr. Potts' interest in the process; and that Mr. Potts attended several conferences on the subject in 1918-1919, at which various witnesses named by Mr. Hirst were present, and at which Mr. Potts was favorable to the process and alleged that he could help get the process adopted in the Middle West. The Direct-Oxidation people, Mr. Hirst stated, decided against giving Mr. Potts an interest because they finally concluded that to have a consulting engineer thus interested would be bad policy.

Mr. Hirst also stated that his decision to file charges against Mr. Potts was reached on hearing indirectly that Mr. Potts was opposed to the approval of the Trenton plans, after having expressed himself favorably to the process during the negotiations. Mr. Hirst could see neither then nor at the time of the hearing any reason for Mr. Potts' approval except "revenge" and "instinctive opposition."

Mr. Hirst's general statements as to conferences with Mr. Potts about giving the latter an interest in the Direct-Oxidation Process were confirmed by F. D. Chandler, of the banking firm of Chandler Bros., Philadelphia.

Mr. Potts, who was present at the hearing, replied through his counsel that in view of the record it seemed useless for him to make a statement.

Random Lines

"How Firm a Foundation"

Sir—I have noted with interest recent attention paid the ever-widening scope of the engineering profession. I propose a candidate for the concrete moustache-cup. You will find him on the outside back cover of that estimable magazine *The Christian Century*, in an advertisement by that equally estimable publisher, The Century Co. He is the author of "Hymns for the Living Age." But let me quote the advertisement:

"When you plan a church edifice you consult an architect; when you want an organ you go to an organ builder. The hymn-book is just as important. Consult a man who is giving his life to the development of congregational singing. H. AUGUSTINE SMITH, the HYMN-BOOK ENGINEER, has done more for church music than any man of his generation."

K. H. B.

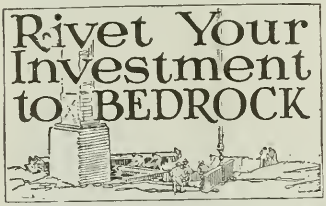
Sir—*Out our way there is a sign* "Horticultural Engineer" *in large letters across the window front of a place of business on the main street. A little further observation indicates that the chief activity of the proprietor lies in promoting the sale of certain lands, said to be suitable for apple production.*

J. J.

* * *

From the Bottom Up?

"RIVET YOUR INVESTMENT TO BEDROCK," says the New York Title & Mortgage Co. (Capital funds over $8,000,000) in an advertisement headed by this sketch. Here are possibilities of a new form of riveting technique. In



riveting bedrock we can visualize the man who operates the compressed air gun but we can't figure out how the "holder-on" functions.

* * *

They All Look Good When They're Far Away

In America a time-table is not a thing to miss trains by. When it says a train will leave such and such a place such and such a time it does; and, more important still, it sees that it gets there when the time-table says it should. Portion of a coupon ticket issued on one of the American railways was circulated on a Sydney suburban train one morning recently—the train was 55 minutes late—and every passenger read it twice before he'd believe his eyes. It says that if the train arrives at its destination 55 minutes late, the fare—full fare, that is—will be refunded. Of course, it wasn't a fair thing to circulate in a Sydney suburban business train, running almost an hour late.—From the Sydney, Australia, *Sun*.

Committee to Report California's Highway Needs

The Governor of California has has signed a bill passed by the recent session of the state's legislature authorizing the appointment of a committee of nine to enter upon a detailed and comprehensive study of the road problem of the state.

The committee, which is to serve without pay, is to "propose a complete system of state roads, study types of construction and materials to be used, recommend the inclusion of additional mileage, the exclusion of certain legislative roads now included in the system, and the time to be occupied in the completion of the system." This report is to be made to the legislature two years hence and is to include some plan for financing the necessary work. The engineering department of the commission estimates that to complete the 6,500 miles of highway now included in the system will require at least $200,000,000.

An announcement issued by the Highway Commission in commenting on this states: "To issue bonds for so vast a sum would seem to be bad financing, so some other mode of raising funds for new construction would seem advisable. It might come from a gasoline, weight or tire tax made just sufficiently large to carry construction over a period of years. There is also a widespread and growing sentiment in the state in favor of an oil production tax of a few cents a barrel or small percentage of selling cost."

The bill provides that the new committee shall be composed of the state highway engineer, one member of the state highway commission, one member of the state board of control, one member each from the state senate and assembly and four from the state at large to be named by the governor.

Steel Canopy Over Broad Street Station Being Removed

Work of removing the steel canopy that covered the fire-wrecked Broad Street station of the Pennsylvania R.R. is progressing rapidly. The wooden understructure has now been completed, and demolition of the steelwork started last week.

The scheme of demolition is by use of a wooden structure erected upon four-wheel car trucks. This wooden structure has a platform at the top from which the steel canopy can be reached. A central section of the wooden falsework reaches to the top of the structure. Two canopies on each side cover the tracks being used for trains, protecting them and at the same time providing space for handling members removed from the structure. The central traveler is capable of reaching any portion of the shed roof. Railroad engineers state that the demolition will require four to six weeks.

A feature of the recent fire in the trainshed is the effect of the fire upon the paint. In several places on the north wall of the shed, the outer coat of black paint has been blistered and has chipped off completely, but the priming coat of red lead paint is bright and in good condition. Most of the spots where such effect is noted are near the floor level where the heat was less intense, but a few spots are about half way up the structure.

Jobs Open for Reserve Officers

The Corps of Engineers will employ reserve officers as civilians, according to an announcement made by the Chief of Engineers on an important survey being made of the Tennessee River, under direction of the District Engineer in charge of river and harbor work at Chattanooga. The work will include the preparation of maps by aerial photography surveying and the collection and interpretation of stream-flow data. Experience in hydro-electric power and flood-prevention work will be an advantage. Salary will be from $200 to $325 per month and the period of employment will be one or two years. Positions are also announced by the District Engineer at Chattanooga for three junior engineers to assist in making computations, plans and estimates of navigation and power plant structures, and six junior engineers to take charge of survey parties.

18-Ft. Channel for Merrimac Is Subject of Controversy

Washington Correspondence

That the Board of Engineers for Rivers and Harbors does not regard an 18-ft. channel in the Merrimac River as an entirely practicable improvement could be judged from the attitude of members of the Board at the recent hearing in which the advisability of such a channel was urged by numerous witnesses. They argued that this channel would provide cheap transportation to the several populous mill towns along the Merrimac. The principal need for the channel, it was contended, is to bring in coal.

Representatives of the mills and other industries, however, testified that they are opposed to the project. It is their opinion that it would not justify the $12,000,000 or more which it would cost, at least half of which would have to be raised by the local interests. A depth of 18 ft., they pointed out, would be inadequate for the ships engaged in the coastwise coal trade.

Civil Service Examination

UNITED STATES

For the U. S. Civil Service examinations listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Valuation Engineer, and Associate Valuation Engineer—Vacancies in the Technical Staff of the Income Tax Unit of the Bureau of Internal Revenue, Treasury Department: valuation engineer in oil and gas, mining, timber, salary $3,600 to $4,800 a year; associate valuation engineer, salary $3,000 to $3,600. Applications must be filed with the Civil Service Commission, Washington, D. C., on or before August 31, 1923.

Junior Engineer, U. S. Geological Survey—Vacancy in the Water Resources branch of the Geological Survey, at entrance salary of $1,620 a year plus increase of $20 a month granted by Congress; work to consist of field investigations in any part of the United States, and the writing and review of resulting reports. Applications must be filed with the Civil Service Commission not later than Sept. 25, 1923.

Personal Notes

W. E. ANDERSON, engineer of Cameron County Water Improvement District 2, has resigned and accepted a position as manager of Cameron County Water Improvement District 3 at La Feria, Texas. During his three years' service with District 2, Mr. Anderson has also had charge of the street paving of San Benito, Texas, and has served as consulting engineer on the construction of the pumping plant and distribution system for Nueces County Water Improvement District 3 at Robstown, Texas, besides other consulting work in the valley.

G. F. SCHLESINGER, formerly chief deputy of construction in the Ohio department of highways, has been named state highway engineer of Ohio. Mr. Schlesinger was for several years assistant professor of civil engineering at Ohio State University and had served five years with the Rock Island Lines as assistant engineer on the St. Louis division.

DR. MATTHIAS NICOLL, JR., deputy commissioner of health of New York State, has been appointed commissioner to succeed the late Dr. Hermann M. Biggs. Dr. Nicoll was secretary of the department and director of public health education from 1914 to 1919 and has been deputy commissioner since the latter date. Before going to Albany he had been associated for many years with Dr. Biggs and with Dr. William H. Park in public health and laboratory work in the New York City Department of Health.

LEWIS D. ASMUS, of the U. S. Bureau of Public Roads, District 6, located in the Austin, Texas, sub-office, has been transferred to Baton Rouge, La., as assistant to M. J. Cramer, senior highway engineer, in charge of the State of Louisiana for the Bureau.

COLONEL FREDERICK MEARS, chairman and chief engineer of the Alaskan Railway Commission, has been appointed chief engineer of the Union Depot Co., St. Paul, Minn., to succeed WILLIAM C. ARMSTRONG, recently deceased.

WILLIAM E. WHITE, civil engineer, formerly in the Iowa State Highway Department's testing laboratories at Ames, has accepted a position with the George T. Wilhelm Co., construction engineers of Cedar Rapids, Iowa, for work on a 19-mile concrete road contract in Dyer County, Tenn.

A. S. HOLWAY, superintendent and chief engineer of the water-works of Oklahoma City, Okla., has resigned and his resignation has been accepted by the city commissioners. Mr. Holway will continue for a short time as supervisor of construction on the new filtration plant which is now nearing completion, after which he will join his brother in Tulsa in engineering work.

MARSHALL W. MARTIN, traffic commissioner of Arkansas, is now traffic manager for the George T. Wilhelm Co., construction engineers, Cedar Rapids, Iowa, and is located at Helena, Ark. He is in charge of materials on their contracts in southern territory.

JOHN L. LEHMAN, an engineer of Denver, has been made superintendent of the Trinidad, Colo., water-works. He succeeds Walter R. Lewis, who recently resigned after sixteen years' service in the department.

JEPTHA A. WADE, who has been engaged for the last two years on the design and construction of a pumping station, at Harrisburg, Pa., where he has been in charge representing James H. Fuertes, New York, has completed this work and is now with Viele, Blackwell & Buck, consulting engineers, New York.

RALPH H. GREENWOOD, who for the past three years has been conducting a private practice at Hamburg, Iowa, has taken a position as locating engineer with the state highway commission of South Dakota at Pierre.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 15-17.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga.; Nov. 12 to 16.

KALTENBACH BROS. have opened offices at 201 Board of Trade Building, Wheeling, W. Va., to engage in civil and architectural engineering work.

WEBSTER P. BUSHNELL, city engineer of Quincy, Ill., in 1912 and 1913 and civil engineer connected with various levee districts, specializing in reclamation of swamp and overflowed lands in Illinois and Missouri, has been again appointed city engineer of Quincy, Ill.

E. B. HILLMAN, formerly engineer and contractor, has been appointed a member of the board of local improvements at Quincy, Ill.

WILLIAM F. COCKE, state highway engineer of Florida, resigned July 10. No reasons have been announced for the resignation.

G. FRANK HYATT, formerly city engineer of East San Diego, Calif., and for the past three and a half years city manager of Coronado, Calif., has resigned to accept a position with the Bent Concrete Pipe Co. of Los Angeles.

HARRY J. KIRK, Defiance, Ohio, has been appointed chief engineer of maintenance in the Ohio Department of Highways and Public Works. Louis A. Boulay, director of the department, has also appointed the following division engineers: GEORGE E. CARR, Marietta, Ohio, District 10; MARTIN I. HENAHAN, Toledo, District 2; F. A. DAUM, Defiance, District 1; and FRED E. SWINEFORT, Akron, District 4.

FRANK W. SALFENGERE, civil engineer, has resigned his position as superintendent of construction at Fort Benning, Ga., to accept an engineering position with A. Bentley & Sons, contractors of Ohio. He will be stationed at Jacksonville, Fla., beginning August 1.

TOM J. ALLEN, who served during the World War as captain of engineers, has been elected city manager of Coronado, Calif., succeeding G. FRANK HYATT, resigned. Following the war Mr. Allen entered the service of the Erie R.R. as assistant division engineer at Youngstown, Ohio, and more recently has been connected with the engineering department of the Santa Fe R.R.

HADLEY BALDWIN has been promoted from assistant chief engineer to assistant to the general manager of the Cleveland, Cincinnati, Chicago & St. Louis R.R., with offices at Cincinnati, Ohio.

J. A. LENECEK has resigned from the engineering and construction department of the Erie R.R. at New York and accepted the position of chief engineer of the Quito-Esmeraldas R.R. in Ecuador. Mr. Lenecek will be in complete charge of locating, design and construction of this lengthy connection of the Ecuadorian capital with the sea coast.

EUGENE H. PAULUS has resigned as architect and construction superintendent of Federal Home Builders Corp. and is entering business under the firm name of E. H. Paulus Co., 4955 Northland Place, St. Louis, Mo.

M. H. MERRILL & Co. of Boston have opened an office in Dallas, Texas, at 608 Interurban Bldg. with Charles C. Allen as southwestern manager. This firm specializes in the design and construction of textile mills.

JOHN R. NICHOLS has opened an office at 161 Devonshire St., Boston, Mass., as consultant and designer in civil and structural engineering. Mr. Nichols graduated from Harvard in 1906, was for three years designer with contractors specializing in reinforced-concrete construction, four years instructor in mechanical and civil engineering at Harvard, and ten years with Monks & Johnson, architects, Boston, the last five years as their chief engineer.

LORENZO HAMILTON, architect and engineer of Meriden, Conn., has recently moved to new offices in the Dondero Building, that city.

SHEVLIN ENGINEERING CO., of New York City, power plant engineers, has recently established a branch office at 821 Chapel St., New Haven, Conn., with W. V. Pietsch as manager.

WYTHE M. PEYTON, Asheville, N. C., district engineer of the 9th district of the North Carolina state highway commission, has resigned and has opened an office in Asheville as a consulting engineer. JOHN C. WALKER, construction engineer of the highway commission, has been appointed to succeed Mr. Peyton.

J. C. NAGLE of the firm of Nagle, Witt & Rollins, consulting engineers, Dallas, and T. A. THOMPSON, chief engineer of the Wichita Falls Water Improvement District, have been selected as consulting engineers on the location of the proposed new Dallas reservoir for which $5,000,000 in bonds has been voted. Mr. Nagle is a member of the

firm who are district engineers for Dallas County on highway construction. He has been at various times dean of engineering at Texas A. & M. College, on the State Board of Water Engineers, and a major of engineers in the Officers Reserve Corps. Mr. Thompson is a hydraulic engineer of long practice in the southwest; he was both a designer and construction engineer of the Wichita Falls project.

Obituary

William Holabird, of Holabird & Roche, architects, Chicago, died July 19 at the age of 69 years. Following two years in West Point he spent several years in the office of W. L. B. Jenney before organizing the present firm of Holabird & Roche. He was one of the first to use steel-skeleton building construction, and is sometimes credited with originating the type. His first application of it was in the Tacoma building, at Madison and LaSalle Sts., Chicago. Subsequently his firm was the architect for the other three buildings on the same corner, LaSalle Hotel, Otis building, and Lumber Exchange. Mr. Holabird was one of the first to use sub-basement space, first in the Tribune building. His firm's latest structure in Chicago is the Chicago Temple building.

George Whitney Bates, city engineer, Lincoln, Neb., died July 11. Born 44 years ago in Hartford, Conn., Mr. Bates was educated at the University of Nebraska. From 1901 to 1907 he was a United States land surveyor in South Dakota and became deputy state engineer of Nebraska in 1905. Four years later he entered city service in the position retained until his death.

Sir John Strathearn Hendrie, president of the Hamilton Bridge Works Co., Hamilton, Ont., and former lieutenant-governor of Ontario, died July 17 at Johns Hopkins Hospital, Baltimore, aged 65 years.

Theodore Isson, of Chicago, structural engineer in charge of construction on a Fort Dodge, Des Moines & Southern Ry. bridge across the Des Moines River at Rivera, near Boone, Iowa, was electrocuted when the derrick on which he was working came in contact with a trolley wire. The heavy current had been ordered shut off, but before the disconnecting switch was turned the contact between derrick boom and trolley wire had been made. The accident happened July 12.

Major Henry H. Wadsworth, consulting engineer of San Francisco, died in that city on July 11 after an illness of several months. Major Wadsworth graduated from Sheffield Scientific School, Yale, in 1886. For fourteen years he was engineer for the California Debris Commission; during the war he held the rank of Major, Engineer Corps, U.S.A.; and last year he was chairman of a committee selected by the Oakland Chamber of Commerce to investigate the water supply of the East Bay cities and make recommendations for necessary developments. At the time of his death he was vice-president of the San Francisco Section Am. Soc. C. E.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Canvass Opinion on Need of 21-S Concrete Mixers

Joint Committee on Construction Equipment Queries Contractors as Part of Standardization Program

Members of the Associated General Contractors of America are being asked for their opinion as to the advisability of manufacturing side-loading building mixers with a capacity of 21 cu.ft. Ballots are being sent out by the Joint Committee on Construction Equipment, which met in Chicago June 27-29, as reported in *Engineering News-Record* of July 5, p. 36, and July 19, p. 120. At that meeting there was a difference of opinion among concrete mixer manufacturers as to the need for the 21-S mixer. Certain companies believed that two sizes larger than the 7-S, namely the 14-S and the 28-S, were capable of serving the industry satisfactorily; others felt that the 21-S size should be included. It was agreed, therefore, to ascertain the desires of contractors.

In the Joint Committee's report it is stated that if the 21-S size is desired its capacity shall be a four-sack batch of 1:2:4 mix and a three-sack batch of 1:3:6 mix, based upon 40 per cent of voids in sand and stone and a maximum of 1½ gal. of water per cubic foot of mixed concrete.

Arguments, Pro and Con

The size under discussion is that commonly designated as a ¾-yd. mixer. From the construction viewpoint the real issue is whether the job economics actually necessitate a mixer of this size.

The points mentioned in favor of the 21-S mixer were as follows:

(1) The weight and capacity of the 21-S fit in economically with many jobs where the larger machine would be cumbersome and over-sized.

(2) Some construction companies are already standardized on a ¾-yd. machine and would not like to change.

(3) The ¾-yd. machines can be more conveniently moved from one city job to another than the 1-yd. machines.

(4) The job economics create a need for both the ¾ and the 1-yd. mixer.

In opposition to the 21-S size it was pointed out: (1) Certain mixtures of concrete for full-sack batches will overrun the capacity of a ¾-yd. machine and necessitate using either the 28-S at a slightly reduced capacity or the ¾-yd. machine at the next lower even-sack batch.

(2) The drum of the 28-S building mixer is used on the 21-E paver and elimination of the ¾-yd. machine will permit greater production on a single size, reducing the number of parts and the production costs.

(3) Sales during the past year indicate that the 28-S is growing in favor.

(4) Concrete towers are being standardized on 1-yd. capacities.

(5) The 28-S can be operated economically at less than full capacity and covers a wider range of jobs than the 21-S.

To Reduce Wire Fence Styles

Elimination of 87½ per cent of the styles of woven-wire field and poultry fences was recommended at a conference July 12 between manufacturers representing 85 per cent of the fence manufacturing capacity of the United States and W. A. Durgin, chief of the Commerce Department's Division of Simplified Practice. The recommendations include that no rolls of poultry fence be manufactured except 10 and 20 rod rolls and that no rolls of field fence be manufactured except 10, 20, and 40 rod rolls.

A. G. Moore of the Fence Institute and chairman of the committee representing the fence manufactured, declared that "if the above styles are adopted by the entire fence industry, as recommended, the styles now made by 27 manufacturers will be reduced from 552 styles to 69. Considering all of the different sized packages as previously made there was a total of 2,072, while in the simplified program there are only 138 packages.

Standards for Wheelbarrows Approved by Committee

At a meeting of the Joint Committee on Construction Equipment held in Chicago, June 27-29, wheelbarrow manufacturers representing about 95 per cent of the construction wheelbarrows production of the country presented for approval a report on the standardization of wheelbarrows and a plan for establishing the standards. Their report was approved by the Joint Committee in accordance with the following:

With respect to trays wheelbarrows were grouped into four classes as follows:

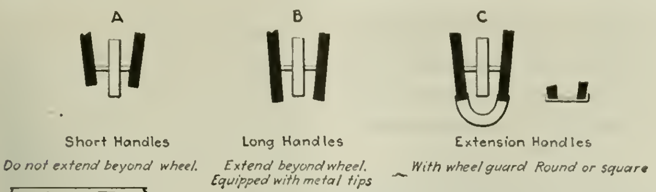
Class	Capacity Cu.ft.	Gage
1	2	18-15
2	2½	16or15
3	3	16
4	3½	16

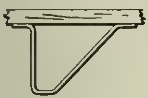
Classes 1 and 2 have trays of medium capacity intended for dry material wheeling. The capacities are struck level capacity of dry material. For wet material figure one-third less capacity in wheeling position. For heaped dry material capacity add one-third to struck capacity.

Classes 3 and 4 have deep trays intended especially for wheeling wet materials. The capacities rated, however, are level full dry material. Figure one-quarter less of wheeling capacity for wet materials, and add one-third for heaping capacity of dry materials.

Three types of handle were adopted as shown in the accompanying sketch. All handles are to be of hardwood. Wheelbarrow leg construction for A. G. C. A. requirements is of steel, preferably of channel or angle steel, with steel cross-braces.

The final development of the standards is to be officially tied in with the American Engineering Standards Committee, and sponsorship for the development is to be placed with the Associated





WHEELBARROW STANDARDS FOR HANDLES AND LEGS APPROVED BY JOINT COMMITTEE ON CONSTRUCTION EQUIPMENT

Handles to be of hardwood. Legs of steel, preferably of channel or angle steel, with steel cross braces.

General Contractors of America and the American Society of Mechanical Engineers.

Standards are to be designated as A. G. C. standards until such time as the American Engineering Standards Committee authorizes them to be designated as American Standards.

The proposed standards are to become effective upon approval of the Executive Board of the Associated General Contractors and will as soon as possible thereafter be followed in the manufacture of wheelbarrows.

Large Use of Equipment Indicated by Federal-Aid Road Program

For manufacturers of road building equipment and materials the extent of the federal-aid road building program is indicated by the mileages, by states in the accompanying table. Roads which will comprise the federal-aid system of highways have been definitely designated in 34 states according to the U. S. Bureau of Public Roads.

A study of the system in the 34 states now approved shows that nearly every city of over 5,000 population is located upon it and the few which are not will connect with it over improved roads. The indications are that over 90 per cent of the entire population of the United States will live within 10 miles of a federal-aid highway. In a number of states the figure is as high as 98 per cent and in none of the states will it drop below 65 per cent.

In the tabulation of the mileage in the system by states estimates are given for those states whose systems are not yet approved.

MILEAGE OF FEDERAL-AID HIGHWAY SYSTEM

State	Federal-Aid System Miles	State	Federal-Aid System Miles
Alabama....	3,958*	New Hampshire......	988
Arizona.....	1,498	New Jersey..	983
Arkansas...	5,037*	New Mexico.	3,258
Calif.......	4,467	New York...	4,498
Colorado....	3,360	North Carolina......	3,816
Conn.......	835	North Dakota......	4,855*
Delaware...	266	Ohio.......	4,506
Florida.....	1,855	Oklahoma..	7,889*
Georgia....	5,662*	Oregon.....	2,814
Idaho.......	2,772	Penn.......	3,954
Illinois.....	4,987*	Rhode Island	165
Indiana.....	3,957	South Carolina......	3,179*
Iowa.......	7,154	South Dakota	8,077*
Kansas.....	6,423	Tennessee..	4,565*
Kentucky...	3,250	Texas......	11,655*
Louisiana...	2,667*	Utah.......	1,430
Maine......	1,393	Vermont....	1,043
Maryland...	1,036	Virginia....	3,016
Mass.......	1,290*	Washington.	2,887
Michigan....	4,582	West Virginia	1,901
Minnesota...	6,801	Wisconsin...	5,516*
Miss.......	3,290*	Wyoming...	3,234
Missouri....	7,040		
Montana...	4,697		
Nebraska...	5,500		
Nevada.....	1,456		
		Total......	187,406

*Estimated.

Winter Discounts on Materials Sought by Contractors

Following the convention in Los Angeles last spring, the Associated General Contractors of America, through its committee of methods, is seeking from material manufacturers winter discounts on their products in order to equalize sales throughout the year, insure early deliveries and reduce shop costs. It is pointed out by the contractors that early delivery of materials on the construction site means an early start in construction work each year and thus tends to lengthen the construction season. This result, coupled with an increased use of construction machinery, it is hoped, will offset the shortage of labor.

A. P. Greensfelder, chairman of the Committee of Methods of the A.G.C., has prepared a memorandum headed "Winter Discounts—Fourteen Points" reproduced herewith.

Winter Discounts

Reduce construction costs.
Induce twelve months' sales.
No pyramiding of peak prices.
Lengthen construction season and insure early spring field work.
Reduce shop costs.
Discourage seasonable unemployment.
Intelligently reward early buyers.
Make savings to users and manufacturers.
Cause continuity of manufacture.
Reduce overhead costs.
Create uniformity in production.
Cut transportation delays.
Take account of steady labor.
Standardize factory practice.

It is suggested by the contractors that manufacturers offer a winter discount on contracts awarded in December, January and February, and only on such shipments on these contracts as are made within these months.

Brick Men to Meet in Los Angeles

The Common Brick Manufacturers' Association of America, Cleveland, will hold its next annual convention during the week of Feb. 11, 1924, in Los Angeles, according to a decision reached at a recent meeting of the board of directors.

The increased activity in the brick producing field on the Pacific Coast during recent years was a strong factor in deciding to hold the next convention in California.

Nine Cities Report Cast-Iron Pipe Mileage

From nine of the large cities of the United States the Cast Iron Pipe Publicity Bureau, Chicago, has secured figures indicating the mileage of cast-iron pipe used in their distribution systems. New York has the largest mileage and Philadelphia shows the earliest use of cast-iron pipe.

City	Total Miles Of Cast Iron Pipe	Date First Cast Iron Pipe Laid
New York......	3,060.0	1832
Chicago. ...	3,027.1	1852
Philadelphia ...	1,749.0	1801
Detroit	1,732 0	1838
Cleveland. ..	1,063.0	1855
St. Louis	1,000.0	.
Baltimore......	1,102.6	1829
Boston	885.7	1847
Pittsburgh..............	749.3	1824

Construction Machinery Statistics Compared for 1914 and 1919

Based on the fourteenth census (1919) of the United States, the Department of Commerce has compiled statistics on the number and value of the country's industries. Those relating to machinery employed in the field of engineering and construction for the years 1914 and 1919 are presented below.

MACHINERY IN CONSTRUCTION FIELD

Class	Census Year	Number of Establishments	Value of Products
Air compressors....	1919	44	$18,650,074
	1914	84	5,158,121
Blowers and fans	1919	69	12,141,74[illegible]
Brick and clay machinery..	1919	49	3,186,505
	1914	89	2,438,861
Concrete mixers.	1919	62	10,450,344
	1914	44	2,956,058
Cranes			
Electric...	1919	36	27,324,864
	1914	.	. .
Hydraulic and steam..	1919	16	13,972,133
	1914	.	.
All other	1919	59	11,237,025
	1914	26	4,194,457
Dredging machinery..	1919	9	1,824,025
Elevators and elevator machinery			
Electric............	1919	94	29,607,380
	1914		.
All other.	1919	157	40,579,919
	1914	213	17,228,101
Excavating machinery..	1919	38	7,284,333
	1914	21	2,968,965
Meters, gas and water.....	1919	111	27,764,884
	1914	40	11,638,074
Mining machinery	1919	133	51,243,489
	1914	153	13,253,634
Pumps and pumping machinery	1919	228	66,456,444
	1914	298	27,456,916
Road making machines....	1919	58	15,777,652
	1914	31	3,545,272
Steam shovels.	1919	8	12,453,763
	1914	...	.... ..
Well-drilling machinery, other than oil well......	1919	30	2,566,668

Patent Office Rules on Trade Name

Trade marks involving an identical name may be used on products sufficiently unlike in character to avoid confusion in the user's mind. This, in effect, is the decision of the U. S. Patent Office in a case involving the use of the word "Eversharp" by the American Safety Razor Corp., Brooklyn, N. Y., as a trade mark for safety razors and blades, notwithstanding the prior use of the same trade mark by the Eversharp Pencil Co., Chicago. According to the Patent Office ruling the goods of the two companies are not sufficiently alike to cause confusion in trade by reason of the simultaneous

use of the mark on their goods. It was held, also, that the likelihood of the Eversharp Pencil Co. expanding its business to include razors was not such as to warrant a claim of interference with its business expansion and also that the mark was not merely the essential feature of the corporate name of that company.

Business Notes

GUY H. HALL, formerly director of the National Institute of Progressive Farming has been appointed manager of the division of public relations and sales promotion, newly created by the Holt Manufacturing Co., Peoria, Ill., and Stockton, Calif., manufacturer of Caterpillar tractors.

FOAMITE-CHILDS CORP., Utica, N. Y., manufacturer of fire-protection equipment and motor street sweepers, has leased a 2½-acre plot near its present plant for the construction of an outdoor experiment station.

M. P. MATTHIAS, export manager of the Foamite-Childs Corp., Utica, N. Y., manufacturer of fire-protection equipment, has sailed for South America on a tour which will include visits to the company's agencies in the Latin American republics.

FRED H. MARSH, formerly with the Pittsburgh-Des Moines Steel Co., Des Moines, Ia., is now with the Paxton & Vierling Iron Works, Omaha, Neb.

J. C. BLOOMFIELD, for a number of years with R. W. Hunt & Co., contractors, of Chicago, has assumed charge of the Chicago office of the Industrial Works, Bay City, Mich., manufacturers of cranes.

STROUD & CO., Omaha, Neb., manufacturers of dump wagons and earth-moving equipment, announce an involuntary petition in bankruptcy filed against them July 11. The court will be asked to appoint a trustee so that the business may be continued. The company states that it is in a position to make prompt shipment of elevating graders, dump wagons, scrapers, road maintainers, plows and drags, and that its present condition is due principally to the cessation of new railroad construction, closing a large outlet for earth-moving machinery. Another contributing factor is said to be the present gradual decline in earth-moving prices in the Missouri Valley, amounting to 20c. per cubic yard this year, as against 25c. in 1922, 40c. in 1921, and 60c. in 1920.

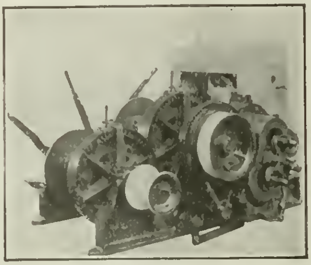
CONVEYORS CORP. OF AMERICA, Chicago, announces the appointment of the Pittsburgh Machine Products Co., Pittsburgh, as district representative. The Pittsburgh organization will handle the sale of American steam jet ash conveyors, airtight doors and cast-iron storage tanks, in western Pennsylvania and the northwestern part of West Virginia.

FORT PITT BRIDGE WORKS, Pittsburgh, announces the appointment of H. B. Speasmaker as assistant to President H. H. Blickle. For twelve years Mr. Spearsmaker served as purchasing agent of the Diamond Alkali Co., Pittsburgh.

Equipment and Materials

Gasoline Hoist with Reversing Elevator Sheave

Portability and independence of outside sources of power are among the advantages claimed by the Clyde Iron Works Sales Co., Duluth, Minn., for its new line of gasoline builders' hoists



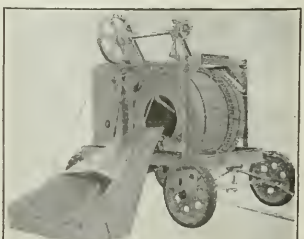
with reversing elevator sheaves. The hoist shown in the accompanying illustration is built with either one or two drums and an independent clutch elevator sheave which permits double cage operation, and in addition, leaves the friction drum free for hoisting forms, reinforcing, etc.

One exclusive advantage claimed for this hoist is that while the driving gear of the friction drum is non-reversible, the elevator sheave, by means of two separate clutches, may be reversed at will, independently. Patents covering this feature have been applied for. Motive power is supplied by a four-cylinder gasoline engine and transmitted to the drum through a silent belt chain drive.

Two New Models of Portable Building Mixer

Two new models of Rex mixers have been announced by the Chain Belt Co., Milwaukee, a ½-bag mixer known as the 234-S, and a 1-bag machine, the 237-S. Both are low-charging types and can be equipped with either a hinged platform or charging skip. In its new models the company's aim is to bring to the portable building mixer field the speed and low mixing cost of the larger paver.

In the drum of the new models the mixing blades and buckets have been



arranged to decrease the time required for discharging the batch, no matter what mixing proportions are used. The opposite side discharge control is of a new design to make the operation of the chute easier. The power charging skip has been constructed so as to reduce the time of charging the drum.

By mounting the countershaft up out of the dirt line and using a vertical engine, the new mixers have been made compact and sturdy. A short wheelbase makes them more readily portable, especially in close quarters. The front axle of the truck is built up of cold-rolled shafting and trussed channels to give it great rigidity. An adjustable malleable jack placed on the charging end of the axle gives the mixer four point suspension while mixing concrete.

The superstructure is of heavy steel angles gussetted in both directions. The main countershaft is mounted on self-aligning bearings high up on the machine, where it is accessible. An asbestos disc type of clutch which has a greater gripping area and is smoother in operation has superseded the old wood-block type of clutch. Self-oiling bushings are provided in the drum rollers which are of malleable iron construction.

The Rex 237-S is equipped with an 8 h.p., two-cylinder vertical, hopper-cooled Le Roi engine having a high-tension magneto, an automobile type carburetor and a throttling governor. On the Rex 234-S a 4 h.p. vertical gasoline engine is used. Rubber-tired disc wheels or built-up wheels are optional equipment. The disc wheels are equipped with phosphur bronze bushings to allow faster traveling over city streets.

Air Spring Seat for Drivers of Trucks or Tractors

To protect the health and insure the comfort of drivers of tractors or trucks an air spring seat has been designed which, according to its manufacturer, the Seibel Air Spring Co., Inc., San Francisco, eliminates vibration and jolting even over rough ground. The seat, which may readily be attached to a tractor or truck, involves an adaptation of the principle of the pneumatic tire. The cushioning effect is secured by means of a cone of heavy fabricated rubber in which is placed an inner tube inflated with air to suit the weight of the driver. The cone and inner tube are placed in a steel air box upon which is set a bucket seat. The whole presses upon a metal knob known as a deflector. The use of the new seat, it is claimed, increases the driver's efficiency.

Publications from the Construction Industry

Steel Joist Construction—TRUSCON STEEL CO., Youngstown, Ohio, has just published a 32-page illustrated data book on the application of and specification for its steel joists. The joists are shown in relation to Hy-Rib lath for floor and ceilings for both wooden floor and cement floor finish. The book contains a considerable amount of tabular

matter on safe uniform loads with various joist spacings, coefficients for deflection, weights of building materials, etc. About a dozen pages are given over to drawings of floor and partition details, balconies, grandstands, roofs, stairways, and framing around openings and in connection with the installation of pipe. Accessories, such as joist clips, screed clips, and hook staples, are shown in application.

Road Graders—Russell Grader Manufacturing Co., Minneapolis, has just published a 64-p. illustrated catalog of its line of road-building equipment, including graders ranging in size from the 5 to the 12-ft. blade type, dump wagons, elevating graders, road drags, scarifiers, wheel scrapers, plows, screens, and crushers. For each type of equipment specifications are given and the various parts, such as blades, wheels, back-slope attachments, etc., are described and illustrated in detail.

Motor Trucks—International Motor Co., New York, in a 44-p. illustrated pamphlet, presents information on the chain-driven type of Mack truck. These trucks are made with capacities of 1½, 2 and 2½ tons.

Culvert Pipe and Drain Tile—W. S. Dickey Clay Manufacturing Co., Kansas City, Mo., features its culvert pipe and drain tile for highway and road purposes in a 55-p. illustrated booklet, recently published. The information given includes results of a number of tests of vitrified pipe and special emphasis is given to the company's triple-strength pipe, which, in the 24-in. size, has a wall thickness of 2½ in. and a crushing strength of 6,000 lb. per linear foot. The text gives a number of useful suggestions on culvert construction with particular reference to head walls. A number of pages also are devoted to the Dickey vitrified salt-glazed segment block for sewers, ranging in diameter from 30 to 66 in.

Belting—Charles A. Schieren Co., New York, has published under the title "Practical Facts About Belting" a manual on power transmission by means of leather belts. The text includes a discussion of different types of drive, belting rules and ratings, horespower, care and operation of belts, joining engine belts, alignment, selection of proper kind of belt for the drive, plant layout and shafting.

Cement Roof Tile—American Cement Tile Manufacturing Co., Pittsburgh, in a 64-p. illustrated catalog, explains in detail the design and uses of its Bonanza "Cementile" for roofing of industrial buildings, theatres, auditoriums, railway stations, etc. The product, which is a cement slab reinforced with galvanized wire mesh, is made in three types, interlocking, flat and channel. The tiles are laid directly upon the open roof purlins which are suitably spaced for the purposes. The dimensions of the standard interlocking tile are 26 x 52 x 1 in.; of the standard flat tile, 24 x 60 x 1½ in.; and of the channel tile 18 x 96 in. with 1 in. width of web and 1⅝ x 3⅜-in. flanges. In addition to a varied selection of photographs illustrating the uses of the tile for roofing, about half of the catalog is given over to data sheets containing drawings of design details for roofs of different types.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Hoover Committee on Seasonal Building Organizes

An immediate survey to determine the facts of seasonal building was laid down as its first task by the Committee on Seasonal Operation of Construction Industries at its first meeting July 11 and 12 at Atlantic City, N. J. It is hoped to have this survey completed and a report prepared this year. As tentatively planned the survey will determine seasonal construction by regions and kinds of structural work, showing the dates of beginning and end of the normal building season for types of work, such as road building, dwellings, apartment and business houses, with the periods of activity and idleness for the different building trades. The survey will also cover seasonal production in building materials, to determine how far this is due to seasonal building operations and trade customs and how far to climatic conditions.

Paving Brick Shipments for June Show Increase

An increase of over a million brick in vitrified paving brick shipments for June as compared with May and a decrease in production are revealed by the monthly report just issued by the National Paving Brick Manufacturers Association from statistics of companies representing 67 per cent of the tonnage of the industry. Shipments in June were 27,251,000 brick as against 26,209,000 for May. June production was 31,105,000 as against 34,382,000 for May. The large number of lettings during the last month and the awarding of many contracts reacted in an increase in unfilled orders of 13,000,000 brick for shipment during the late fall and winter months.

The stock on hand reported shows over 80,000,000 brick.

Of the total shipments in June, 18,630,000 brick went into city streets and 5,631,000 into country highways. The remainder were shipped for miscellaneous uses, such as private drives, factory floors, and general construction.

Ohio led in consumption, closely followed by Pennsylvania, Illinois, Indiana, Minnesota and Texas in the order named.

Construction Materials Contribute to Freight Tonnage

Cement contributed 3,314,168 tons to the freight tonnage of the Class 1 railroads during the first quarter of the current year, figures just made public by the Interstate Commerce Commission show. This tonnage originated as follows: Eastern District, 1,573,435 tons; Pocohontas region, 52,257 tons; Southern region, 361,025 tons; Western District, 1,327,451 tons.

Brick and artificial stone during the first quarter contributed 3,887,171 tons to the amount of freight carried. Lime and plaster contributed 1,214,526 tons. Sewer pipe and drain tile, 424,508 tons.

Structural-Steel Sales

The Department of Commerce announces June sales of fabricated structural steel, based on figures received by the Bureau of the Census in co-operation with the Structural Steel Society. Total sales of 112,735 tons were reported for June by firms, with a capacity of 223,595 tons per month.

Tonnage booked each month by 175 identical firms, with a capacity of 229,575 tons per month, is shown below, together with the per cent of shop capacity represented by these bookings. For comparative purposes the figures are also prorated to obtain an estimated total for the United States on a capacity of 250,000 tons per month.

1922	Actual Tonnage Booked	Per Cent of Capacity	Estimated Total Bookings
April	200,588	87	217,500
May	184,638	81	202,500
June	168,498	73	182,500
July	157,631	69	172,500
August	156,011	68	170,000
September	146,146	64	160,000
October	132,450	58	145,000
November	111,794	49	122,500
December	138,024	60	150,000
1923			
January	172,415	75	187,500
February	183,938	80	200,000
March	218,997	95	237,500
April	185,335*	81	202,500
May	130,828**	57	142,500
June	112,785***	51	127,500

*Reported by 173 firms with a capacity of 229,225 tons.

** Reported by 169 firms with a capacity of 228,850 tons.

*** Reported by 152 firms with a capacity of 223,595 tons.

Canada's Building Permits Decline

According to reports tabulated by the Dominion Bureau of Statistics, there was a decline of 23.6 per cent in the value of building permits issued in Canada in June as compared with May. This decrease, according to the report, is often experienced during June, the largest aggregate of permits granted usually occurring in April or May, when the building season is commencing.

The comparison with June, 1922, also shows less projected activity during the month under review, there being a reduction of 15.9 per cent. Returns received from 56 cities showed that they had authorized building to the value of $14,345,573, whereas in May, 1923, the total had been $18,766,065, and in June 1922, $17,052,582.

Lumber Standardization Progresses

By its action taken at a meeting in Chicago, June 22-23, the Central Committee on Lumber Standards has largely paved the way for a general standardization conference to be composed of accredited representatives from all affiliated organizations interested in the standardization of lumber, to be held at the Department of Commerce in Washington next fall, to take final action on its recommendations, which will be binding on the entire lumber industry.

At the recent meeting in Chicago,

the Consulting Committee on Lumber Standards submitted a number of its recommendations to the Central Committee which were approved with very few changes. Briefly, the recommendations as approved cover standardization of lumber sizes, simplification of grade names, and the guaranteeing of quality and quantity through grade-marking and inspection service. Some of the recommendations are that standard finished yard boards should be not less than 25/32 in. thick, and that standard finished dimension should be not less than 1⅝ in. thick.

Bids Wanted on Big Jobs

Among projects on which bids are either asked or will soon be called for, in Construction News, pp. 43 to 60, are the following:

Railway, 6-mi., Alabama, from Fairfield to Wenonah, for Tennessee Coal, Iron and RR. Co., $4,000,000.

Dam, Merced, Calif., for Merced Irrigation Dist., $3,000,000 to $4,000,000.

Home and infirmary, Wende, N. Y., for Board of Supervisors, Erie Co., $1,500,000.

Coke ovens, Fairport, O., for Koppers Co., $1,500,000.

Foundation, for two story and basement temple, New Castle, Pa., for Scottish Rite bodies, F. and A. M., total cost, $1,000,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 43 to 60, are the following:

Temple, St. Louis, Mo., to Westlake Construction Co., $3,000,000.

Grain elevator, Vancouver, B. C., to Northern Construction Co., $1,600,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, **only** the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the the issue of July 5; the next, on Aug. 2.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb.	$3.64	$4 30	$4 20	$3.40	$3.55	$4.20	$3.60	$4.10	$4 25
Structural rivets, 100 lb.	4 40	5 00	4 90	3.75	4.25	5.40	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3 54	4.25	3.80	3.20	3 45	3.85	3.50	4.10	4 00
Steel pipe, black, 2½ to 6 in. lap, discount	44%	52%	45%	47%	53–5%	36%	35.2@47.6%	40%	42.84
Cast-iron pipe, 6 in. and over, ton	62.30	—56.00	63.00	60.20	60.50	69.00	62.00	70.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.70@2.80	2.85	2.25	2.20	2.50	2.84	2.63	2.90	2.25
Gravel, ¾ in., cu.yd.	2.25	1.90	2.25	2.00	—1 80	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	1.95	2 00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.50	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	63.00	—40.00	—52.25	58.50	42.50@44.75	47.00	41.00	—29.00	70.00
Lime, finishing, hydrated, ton	18.20	23.50	22.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	2.35	1.50	1.50	2.70	2.10	2.80	10.00
Common brick, delivered, 1,000	+24.60@25.70	—13.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.109	.115	.0724	.0816	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1573	.109	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	—1.08	—1.10	—1.24	1.28	—1.16	—1.30	1.23	.86	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.55	.35@.50	.50	.50@.62½	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93½c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.45). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $42.84; 6-in., $108.

Changes Since Last Week

A slight stiffening in the price of common brick at New York, formed the single exception to the general downward trend of materials prices, during the week. Lumber and linseed oil are the two commodities most affected.

Yellow pine timbers dropped 50c. in Dallas and $2 per M. ft. in Atlanta, while Douglas fir declined $2 in Seattle. The lumber movement of the country for the week ended July 14, as reflected by reports from 403 of the larger commercial sawmills, to the National Lumber Manufacturers' Association, gained materially over the preceding week and the corresponding week in 1922, despite the recent recessions in price. Lumber production for the first twenty-eight weeks of the current year, totaled 6,765,076,783 ft., a gain of 1,116,738,035 ft. over the corresponding period last year. Shipments increased 20 per cent and orders over 13 per cent.

Improvement in pig-iron inquiries developed during the week. Lower iron prices for fourth quarter deliveries, have been checked by the growing firmness of the coke market. Steel bars remain firm at $2.40 per 100 lb., Pittsburgh, despite lower pig-iron and scrap spot prices. Slightly better inquiries for structural shapes developed during the last two weeks; quotations remaining firm at the $2.50 base, with few prospects of lowering. New plate orders fell off slightly during the week. Steel mill operations are slowing down gradually, owing to seasonal influences.

Linseed oil declined 2c. in New York and Minneapolis, 4c. in Denver, 6c. in Dallas and 10c. per gal. in Atlanta, since July 19.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, *President*

Engineering News-Record

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, *Editor*
Frank C. Wight, *Managing Editor*

Volume 91 — NEW YORK, AUGUST 2, 1923 — Number 5

The Next Step in Coal

AS THIS is being written it looks as though the leaders on both sides of the anthracite coal industry are going to put to the test the implied threat of government control that was the main feature of the recent report of the President's Coal Commission. Perhaps this is as good a time as any to have this happen. The foresighted consumer, after the hardships of last year's coal shortage, has filled his bins; bituminous production has been heavy and the possibilities of soft coal and other substitutes for anthracite have been given such wide publicity that the user will be more friendly to their use than ever before. If the continued ultimatums and suspensions of conference are merely the usual jockeying of trade and international disputes, the public can wait for a solution without government interference. If, on the other hand, collective bargaining has failed in the anthracite industry, let us proceed at once to the distasteful, but necessary, experiment with government intervention. People are going to get coal when they need it and at a fair price and are willing to try any reasonable scheme which will bring about such a result.

Governmental Accounting

THE net operating deficit of the government-owned and operated Alaska R.R. for the year 1922 was over $1,053,000, and since operation started in 1915 the total operating expenses have been nine and one-half million against a total operating revenue of two and one-half million, leaving a deficit of slightly over $7,000,000. In view of a reduction in operating expense of $100,000 and an anticipated increase in revenue of $200,000, the deficit for 1923 is expected to be reduced to $700,000. But there is an item of annual cost which is not included in this governmental statement. That is the interest on the money expended in building the railroad. According to the Department of the Interior, the average cost per mile of the railroad was approximately $84,000, or a total of something over $40,000,000, which amount at only 4 per cent interest puts the actual deficit for the year 1922 at about $2,600,000. These facts are not necessarily condemnatory of the proposition of a government railway in Alaska for obviously no private capital would have gone into this country to open it up without large government grants, and it is highly probable that such grants in a country of vast possibilities in undiscovered mines and great timber resources would have had a value far in excess of the actual capital expenditure made for the privately built railroad. But they do furnish an example of the government method of accounting to the people for the cost of government operation. The figures made public usually account for the actual annual cost of operation and nothing is said concerning the mounting public debt made up largely of capital expenditures on these government projects. On such undertakings as the Panama Canal and the Alaska R.R. the national benefit forms a large item on the credit side of the ledger but the analogy cannot be carried too far in other prospective government work.

Law Requires Day-Labor Costs

ADVOCATES of force-account contruction have an opportunity in the new Breed day-labor law in California to demonstrate their long-urged claim that work done directly costs less by the amount at least of the contractor's profit. By this new legislation all persons proposing to perform public work by day labor are required to file accurate plans and specifications, to record the names of bidders and the prices bid, and to report complete costs of the work and all changes from the plans and specification on file. In the past most argument for or against force-account work has been inconclusive because no cost measure was available for comparison with contract prices. It has been shown in numerous cases and particularly in the investigation by Leonard Metcalf and Harrison P. Eddy a decade ago into Boston city-force-account construction, that rarely are all cost items included in the records. On the other hand in such undertakings as the Panama Canal and the Los Angeles aqueduct, both built largely by day labor, there is reasonable evidence that the method was as cheap as any other, and, in addition, the adminstration difficulties were greatly reduced. There is such allurement in the thought of eliminating the contractor's profit that popular support can be had to almost any proposal to build public works by day labor. It is hard for contractors to meet this situation by argument because whatever they urge is regarded as prejudiced and, as already said, no costs are available against which they can oppose bidding prices. The new California law puts no obstacles in the way of day-labor methods but it does demand that the people shall be told how much they cost as compared with prices for which contractors were willing to perform the work. Contractors have every reason to be gratified with the new legislation.

"A Passion for Straight Lines"

A FEW weeks ago the New Orleans *Times-Picayune* worked itself into a fine frenzy of protest because in the reconstruction of the East Beach road along the gulf shore at Biloxi, Miss., "stately oaks, growth of hundreds of years, are being sacrificed to an engineering passion for straight lines." To one who knows the beauty of the Biloxi drives, the topography of the gulf coast and the engineering principles that govern modern road construction it seemed unlikely that any such vandalism was being committed but it was thought worth-while to make sure. Now comes word from Edmund Friedman, the resident engineer on the work, that "in a total distance of three miles, eleven trees were cut down, of which only four were sound and of

the four two were directly in the center of the road and the other two so near other trees as to prevent the location of an 18-ft. roadway between." And Mr. Friedman adds: "We realize the beauty of a winding road through trees, especially on a beach front, and have really sacrificed the paving to the trees, instead of the reverse." A small and local matter, perhaps some will say, but it deserves to be emphasized, especially as the *Times-Picayune* has not seen fit to retract or explain its misguided campaign. Every such thoughtless attack makes it harder for engineers to get across to the public that they are solicitous of the amenities of life and not materialists who worship only the practical and who go out of their way to sacrifice beauty to a "passion for straight lines."

Legalizing Licensing

EARLY appeal and a higher court decision on the constitutionality of the Pennsylvania engineer licensing law is most desirable. Judge Shull's interpretation of the law, as outlined on another page, might readily apply to most of the similar laws in other states and if these laws are not in accordance with state or federal constitution, engineers want to know it. The interesting thing in the Shull decision is not that an engineer's licensing law is inherently unconstitutional but that, as written, most of them are. On the basis of the decision a valid law could readily be framed by separating engineers and surveyors and by refusing exemption to any class of engineers. There is a chance for argument as to whether or not an engineer's license law is desirable; certainly there should be no doubt that, with proper provisions, it can be made legal.

Adobe Makes Stable Subgrade

A METHOD of handling adobe soil so as to assure stable foundations for paved roads appears to have been determined with some certainty by the tests of the Pittsburg road near San Francisco. In the final report of these tests, just issued, three of the seven conclusions reached by Lloyd Aldrich and John B. Leonard, engineer in charge and assistant engineer, respectively, relate to results secured from the adobe soil subgrade prepared by sprinkling and rolling the pulverized earth in layers. Not only did this treatment give an unyielding subgrade from the notoriously unstable material of which it was constructed but it is asserted that it gave results superior to broken stone sub-base and also showed remarkable resistance to the absorption of moisture from flooded side ditches. Swelling and cracking, the characteristic behavior of adobe when wet and dry, appear not to have occurred. These determinations are of great practical importance particularly in the light of the statement that the method of preparing the subgrade involved comparatively little increase in cost over prevailing methods. Altogether the determinations at Pittsburg on pavement action were relatively unimportant. Though not negligible the pavement determinations were chiefly confirmatory of the results obtained by the Illinois Division of Highways in testing the Bates road and by the Bureau of Public Roads engineers in the tests at Arlington Farm. On the contrary the adobe subgrade results are original and independent contributions to the research information on road construction.

Some Problems of Negro Migration

THE present migration of negroes from the South to the North is a matter of concern for both sections. Exact figures are not available, but scattered data show that there is going on now a greater movement of negroes away from the South than ever before. That section of the country naturally is alarmed over this depletion of its major labor supply, both for agriculture and industry, while the North, except for those centers that are clearly gaining useful and needed common labor, is not thinking much about the question. To most of those who have given the negro migration any thought at all this movement of population has been considered chiefly, if not wholly, a matter of labor supply; but there are other and possibly more far-reaching effects mainly in the way of public health that both sections would do well to consider.

It would be manifestly ridiculous to rush into any snap opinion as to the proper solution of the negro problem in the South. That is something that the South has been living with for a century and its complications are well known. It can be suggested, however, that this migration menace is only a part of the general problem and it will hardly be solved by the prohibitory legislation some of the states have been considering. The causes spring from economic and social conditions beyond the control of legislative enactment that does not curtail that liberty of movement from state to state that is the right of any and all American citizens. It is to these causes that the South should address its efforts, chiefly by individual and local civic attitude and action.

Consider first and chiefly the matter of health. Many of the negro workers that are coming North bring their families and most of the others will do so earlier or later. That means increase in negro population with its attendant social and health problems. It is a well known fact that, North and South, the general infant mortality rate and the death rate from some of the most dangerous communicable diseases are much higher among the colored than the white. Consequently material additions to the negro population of the North will increase the death rate from all these causes, and some of the mortality causes not merely by the addition of negro population but also by the spread of communicable diseases from negro to white.

By the same means, there will be mortality declines in the South. The actual Southern declines, however, will be affected somewhat by the economic reactions to the northward migration of the negro. Insofar as this migration causes industrial depression in the South and makes living conditions worse than before among the negro residue and the mass of the white population, the depletion of the negro stock will tend to increase mortality; but conceivably the lessened population will not have so hard a struggle for existence as did the original number. At the North, the negro who has migrated there will presumably be under better average conditions than he was in the South. He may find his higher wages largely absorbed by a higher living cost and in general his housing conditions will be far below the ideal, but on the whole he will probably have more, better and safer food, safer water to drink, more chances to bathe, a less polluted soil and far better administration of public health activities, state and local, than in the South.

Aside from its general sociological import, it should be

remembered that this negro migration is only one phase of the present larger matter of immigration restrictions. Both North and South should realize that the American-born colored population is a great national asset, the present value and the future possibilities of which are only beginning to be appreciated. When the negro was the great dividing issue between two sections of the country there was no possibility of a shortage of labor in this country. Foreign white men with potentialities in every field of labor were pouring into the country. There was greater difficulty in finding work for the men than men for the work. Today conditions are the exact opposite. Few potential workmen are coming into the country and the big labor problem is how best to utilize those man resources we already have. The racial and psychological difficulties of the negro problem remain and its historical significance is still great; but with all this it must be remembered that the negro today is an American, with none of the problems of Americanization thrust upon us by that class of foreign born which is so eager to enjoy and yet so ready to abuse American opportunities.

Farm-Bloc Water-Power Economics

GRAY SILVER, the efficient Washington director of the American Farm Bureau Federation—which is the boss of the farm bloc in Congress—has just rendered a report on his year's work. It is a good report, even tempered in the main, mildly and justly prideful of the accomplishments in the way of legislation and worthy of the respect of all who want to see the farmer prosper and get the due which of late years has been largely denied him. So long as Mr. Silver sticks strictly to farming, he follows a straight path; but for a time he wanders in the strange domain of water power and there, under the hypnotic eye of Henry Ford, his steps falter. Interest on investment, according to Mr. Silver, is the curse of water power development. Ford's Muscle Shoals plan leads the way to escape, he says, because by it not only is the interest charge cut in half by the use of government instead of private credit, but by the magic of amortization the whole fixed charge vanishes in time and the user need pay then only for operation. This, says Mr. Silver, is a devoutly to be wished consummation which the farmer must fight for.

Those who see in Mr. Ford just the manufacturer of a good little car wonder why we should confine this idealistic scheme to water power, more particularly to one man's use of one water power. Why not extend it to every line of enterprise? Let any prospective manufacturer, or farmer, or merchant get the government to supply the capital for his plant, or farm, or store, to be paid back in 100 years by his paying 4 per cent interest plus one-tenth of 1 per cent of the capital per year, which latter minute percentage the government each year will invest and continue to re-invest until at the end of 100 years the whole loan has, by magic almost, been repaid.

Except that Mr. Ford, in addition, wants to get for $5,000,000 what cost the government $90,000,000, the analogy between his offer and the hypothetical case is complete. Muscle Shoals, under the Ford offer, would not be a public benefit, except insofar as the public is able to buy more cheaply the products that Mr. Ford may make at Muscle Shoals, and in the event, which he does not promise or contract, that he would be able to manufacture there fertilizer at a lower cost than it is now purchasable. No farmer, or manufacturer, or city dweller under the Ford plan is going to be able to buy power for his own use from Muscle Shoals. It is purely a cheap manufacturing proposition for Mr. Ford plus the possibility—but only the possibility—of a cheap fertilizer.

Mr. Silver's advocacy of this particular scheme is explainable only on the ground that most people believe in a kind of Socialism which extends government aid where it will benefit them and them alone. Or else it is a Utopian conception of this country as another place where people will make a living by taking in each other's washing. Under this scheme the citizens of the United States will divide into two classes, one lending the government money at 4 per cent, the other borrowing the same money back from Uncle Sam at the same rate.

Questions As To Seasonal Building

THE committee organized by the Department of Commerce to investigate seasonal building announced that first it intends to asecrtain facts. In so doing it measurably increases confidence in its usefulness. It is presumable that the periods of active and slack building vary both in duration and in the time of year when they occur. Beyond this little is known of their character. There may be and very probably are different busy and idle seasons in Boston and in New Orleans and they may be shorter or longer in one place than in the other. It seems reasonable that the causes also may be different. Certainly cold weather is less a reason for idleness in New Orleans than in Boston. Are there other weather conditions prevailing in the southern city which offset the frosts of the New England metropolis? It deserves to be repeated that we do not know. Facts are needed. The committee cannot be too insistent on this point.

A great deal of our belief in the prevalence and intensity of seasonal building is based on rather nebulous general opinion. In the few instances in which actual determination has been made it has been found that the peaks and valleys of building activity are not so high and deep as they were; that they show less seasonal regularity than they formerly did, and that the causes are apparently more complex than they were once assumed to be. All the evidence indicates that the committee must be more insistent in exacting real facts and not be contented with eliciting general opinion by a few inquiries directed to building department heads.

It is indeed a rather difficult and complex inquiry which the Hoover committee has undertaken and nothing but serious effort will disclose the information which will command the respect of those who borrow and lend money for building. These are the persons who have to be influenced and not contractors and engineers who are merely the agencies for performing the physical tasks.

To what extent does seasonal building construction prevail? What is the character of the variation? What are the causes? With actual facts to answer these questions the building industry is in some sort of position to devise and apply remedies. It is encouraging, as has been said, that the Department of Commerce committee is disposed to seek facts first. Those to whom it will appeal for information should respond with all the labor required to furnish these facts.

Highway Progress and Problems in the Mid-South—II

South Carolina North Carolina
Virginia West Virginia
Kentucky Tennessee
Missouri

Seven Southern States Contemplate Road Expenditures Approaching a Billion Dollars—Automobile License Fees and Gasoline Taxes Will Provide the Money—Editorial Review Based on Studies in the Field

This is the second article of the series. The first article of the series, on Group Problems and the two Carolinas, appeared in "Engineering News-Record" July 26, 1923, p. 128.

The Two Virginias

HIGHWAY development exhibits quite different aspects in Virginia and in West Virginia. The last named has been one of the most prompt of the Southern states adequately to finance and plan a comprehensive state highway system. It has centralized the administration of highways very completely in a state highway commission. A conservative but active construction program has been commenced with attention to the development of trans-state through routes and interstate connections. Virginia on the contrary has been dilatory in taking action to finance road improvement and is undecided whether to issue bonds or to build with current funds. Correlated and connected system development and particularly through-route development, are delayed by laws putting the selection of state-road routes and their extension in the hands of the Legislature and specifying simultaneous district and county allotment of improvement funds and operations.

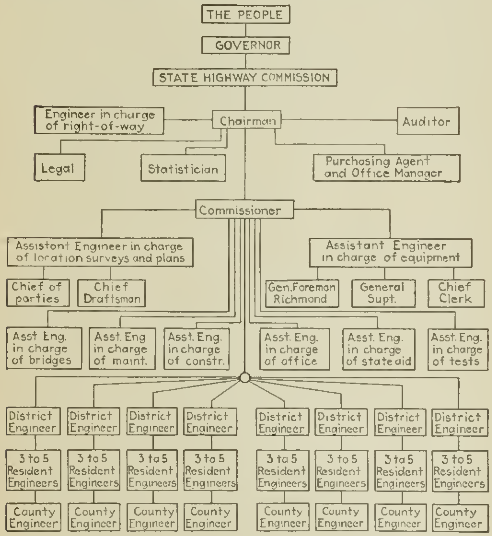


FIG. 3—VIRGINIA HIGHWAY COMMISSION ORGANIZATION CHART

There is a fundamental difference of highway thought in the situations as outlined. West Virginia is thinking primarily toward system development without overlooking local development. In Virginia the thought is primarily toward evenly distributed local improvement out of which, incidentally, system development will slowly come. It will be understood that highway thought, as the term is here used, is thought as manifested by all the acts of the state in highway affairs and not necessarily the thought of the state highway commission or even of the state administration of the moment.

Virginia

Debating Methods of Financing

Highway development in Virginia awaits the decision of a bitter contest over methods of financing road improvement. On one side are the advocates of a pay-as-you-go policy, requiring a construction period of seven to ten years, led by Governor Trinkle. Opposed are the advocates of a $50,000,000 bond issue and a five-year construction period led by the Virginia Good Roads Association, George P. Coleman, president.

From the press and speakers platform last fall, the debate was carried into the Legislature of 1922-23. Securing no action at the regular session, a special session was called. It met the situation by imposing the 3c. gasoline tax asked by the pay-as-you-go party and by authorizing a referendum vote of the people (November, 1923) on a bond issue as proposed by the advocates of that plan. Now again the battle is being waged in the public press and forum.

Virginia has an area of 43,627 square miles and a population less than 2,500,000. The state system consists of 4,200 miles of road designated as to general routes by legislative acts. Of this system some 1,500 to 1,800 miles—the estimates vary—are classified as reconstructed. Not all of this mileage is permanently graded and only a minor part is highly improved; all, however, has had some sort of surfacing which makes it passable to travel except in distinctly bad periods of weather. In general the system is unimproved in the modern sense of the term improved as applied to roads in the older road-building states of the north. Virginia roads are unqualifiedly "in the mud." This is not said captiously but to make it entirely clear what it means to produce a state system of modern improved roads.

It is a task involving organization, legislation and a comprehensive plan of financing, besides the physical problems of construction and maintenance. All of these processes except financing and construction are well advanced. Even maintenance, with commendable foresight, as will appear, has made progress. There is behind all a strong public sentiment for better highway transportation, as indicated by the advantage taken of the Robertson act privately to finance road construction.

By this act, passed in 1920, any county, district, cor-

poration or person desiring improvement of any section of state road is enabled to finance the work on the basis that the State Highway Commission plans and directs it, that the money is loaned to the state without interest and that the state shall repay the loan in some indefinite period as funds are available. In the aggregate some $6,000,000 in funds of this character have been voluntarily loaned to the state to ensure specific new roads which the Commission had no money to build but which the people wanted badly enough to provide the money without interest return for an indefinite period.

This body, recreated by the law of March 24, 1922, which scrapped a mass of confusing legislation, is organized on the basis of the chart, Fig. 3. As stated, little construction has been accomplished. There have been no adequate funds for new work. Maintenance is somewhat adequately provided for by the income of about $2,500,000 from motor-vehicle license fees. At present the 4,200-mile state system is being maintained and this year patrol maintenance will be so perfected that no road will remain undragged 48 hours after rain or snow. In rapidly developing complete-system maintenance the public is being reached everywhere with highway service and with evidence of the efficacy of centralized state direction.

It is recognized, however, that there can be little fundamental improvement of road service by maintenance alone. Extensive new construction is necessary, and for this large funds must be had. With the 3c. gasoline tax law of March 26, 1923, it is considered by the advocates of pay-as-you-go construction that they are assured. Including all sources of income it is computed that, spread over seven years, nearly $64,000,000 will be available at the rate of seven to ten millions a year for new construction. The estimated income is from three sources mainly, as indicated by the statement for 1923:

Three cents per gallon motor fuel tax	$2,835,000
Federal Government allotment	1,457,000
State mill tax	1,735,000
State convict road force	350,000
Appropriation out of general fund:	
For construction	200,000
For overhead expenses	285,000
Amount which can be transferred from automobile license tax, after leaving $2,500,000 out of the $3,000,000 fund from this source for maintenance	500,000
Total	$7,362,000

For 1929 the total, assuming the natural increase in taxable values, is estimated as $10,077,000. In these estimates the only unfamiliar item is the credit of $350,000 for the state convict road force. Virginia's laws provide that convicts shall be employed on road construction on requisition by certain authorities.

The 3c. gasoline tax law was approved March 26, 1923, at the special session of the legislature. At the same session an act calling a bond issue referendum was passed in recognition of the strong faction which considered quick construction with borrowed money a preferable policy to slower construction according to the road money available each year. Between the two plans there is certainty of road construction on an extensive scale compared with anything before known in Virginia. It is the question now whether the people will decide on quantity production with a corresponding saving in construction cost and overhead and earlier returns in highway service or on delayed production with no debt at the end of the production period.

Physically the road construction task is rugged mountain work in the west—the creation of permanent grade from mountain trails. In the Piedmont section, with its higher industrial development, paved and surfaced roads have to be built in rolling, hilly, plateau country. The coastal plain offers a level bottom and swamp-land problem. Broadly the development problem is to open up permanently graded and drained main routes in as large mileages as are practicable. Traffic, except on isolated routes, is light and largely local, and permanent grades lightly surfaced and well maintained are the immediate requirements. With funds provided, the greatest drawbacks to logical system development are the laws requiring simultaneous allocation of funds to construction districts and counties. This makes continuous route development a slow process.

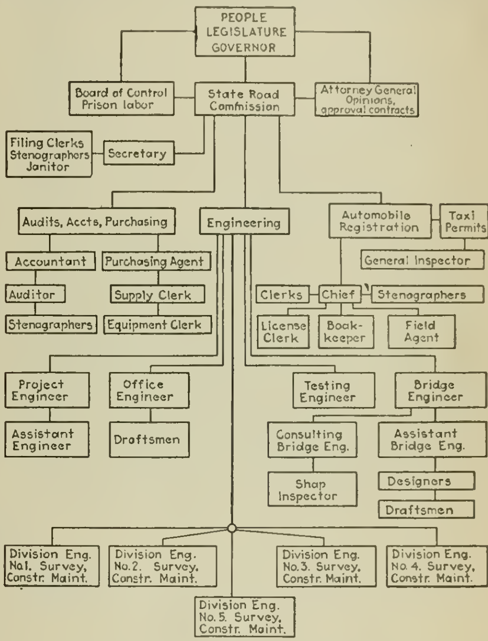


FIG. 4—WEST VIRGINIA HIGHWAY COMMISSION ORGANIZATION CHART

Money will be available for constructing the state road system as now planned. This is the significant conclusion of the situation as it exists. With the sources of income now provided the system can be constructed on a pay-as-you-go plan in perhaps seven years and certainly in less than ten years. If bonds are issued in the proposed amount of $50,000,000 the construction period will be reduced to perhaps five years. The $3,000,000 from motor-vehicle license fees turned over primarily to maintenance also assures that the roads can be kept up reasonably well as fast as they are constructed. In two years Virginia has recorded a distinct advance in her highway affairs.

West Virginia

Pushing System Construction

An advanced stage of construction has been reached on its state highway system by West Virginia. With a bond issue of $50,000,000 provided about the same

time, the state has been more conservative than North Carolina or Missouri in putting mileage under contract but within a year or two it can be crossed on continuous improved roads reaching from state line to state line. These roads are notable for their heavy grading at least half of which is rock. Grading costs run from $9,000 to $45,000 a mile.

Centralized direction is provided to an unusual degree in the general road law—the state road commission has complete control of location, construction and maintenance of state roads. There are about 1,700 miles in the 7 per cent system, and a little over 3,500 miles in the total state system. Fig. 4 shows the commission organization. The problem before the commission now is one of system construction, with proper consideration of the local interests of the whole state whose rugged, mountainous topography makes work expensive.

Road location is rather definitely defined by topographic conditions. The state is traversed by streams and along the river valleys and through the mountain passes the early settlers laid out their trails which later became public roads. Location is largely a task of straightening out the unnecessary kinks in these routes and of cutting down grades. In general it is practicable to keep grades below 7 per cent but maximum grades of 9 per cent are employed.

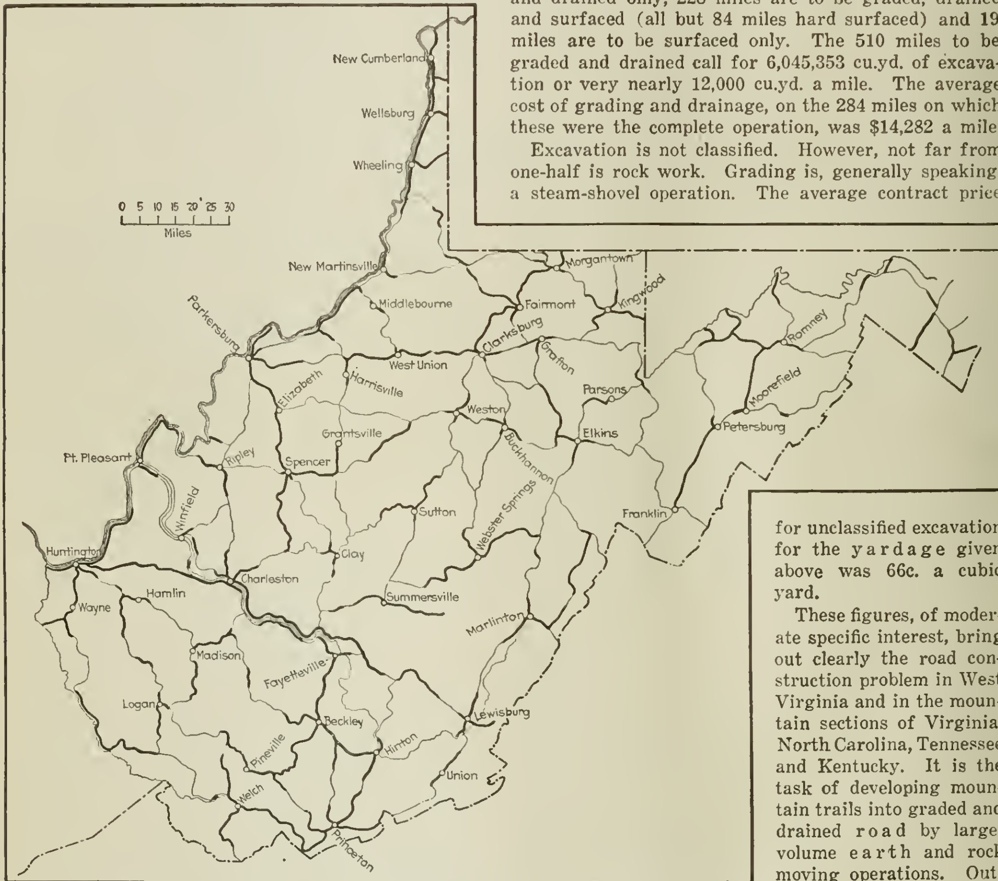


FIG. 5—WEST VIRGINIA ROAD MAP SHOWING PROGRESS OF SYSTEM DEVELOPMENT

Grading is the large construction task. Taking the records as of Jan. 1 this year, which are the latest mileage figures for which all co-ordinate data have been summarized, there are 531 miles for which contracts have been let. Of this total 284 miles are to be graded and drained only, 228 miles are to be graded, drained and surfaced (all but 84 miles hard surfaced) and 19 miles are to be surfaced only. The 510 miles to be graded and drained call for 6,045,353 cu.yd. of excavation or very nearly 12,000 cu.yd. a mile. The average cost of grading and drainage, on the 284 miles on which these were the complete operation, was $14,282 a mile.

Excavation is not classified. However, not far from one-half is rock work. Grading is, generally speaking, a steam-shovel operation. The average contract price for unclassified excavation for the yardage given above was 66c. a cubic yard.

These figures, of moderate specific interest, bring out clearly the road construction problem in West Virginia and in the mountain sections of Virginia, North Carolina, Tennessee and Kentucky. It is the task of developing mountain trails into graded and drained road by large-volume earth and rock moving operations. Outstanding is the policy of system development. Fig. 5 is a diagram map of the state road system. The light lines show unimproved road; the full lines show road completed or under contract for improvement to a condition of permanent grade or better. A glance indicates the advanced stage of formation of continuous through routes.

[*In the next issue the highway situation in Kentucky and Tennessee will be discussed.*]

Motor Vehicle Output Increases by Half in 1923

According to reports made to the Board of Directors of the National Automobile Chamber of Commerce at a recent meeting in Buffalo, the first half of 1923 has shown an increase of 47 per cent over the same period of 1922 when the output was 1,161,000 motor cars.

Concrete Caisson to Close Canal Against Floating Oil

In Manchester Ship Canal Floating Barrier Is Provided as Precautionary Measure in Case of Fire

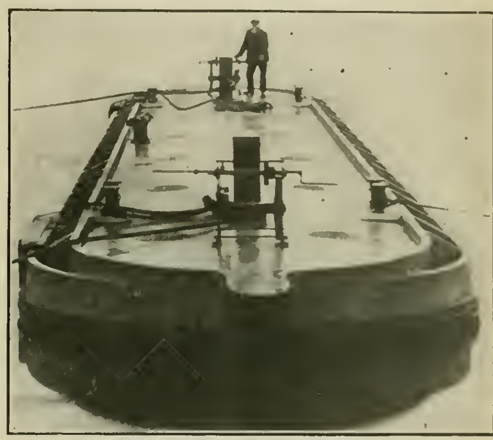
By R. Franklin Mundorff
Kansas City, Mo.

Very large quantities of petroleum and oils of a flash point not lower than 73 deg. F. have been imported into England via the Manchester Ship Canal, during the last few years. Heretofore, however, the canal company has not permitted the importation of oils and spirits having a flash point below 73 deg. owing to the want of a safe place in which to moor the vessels while discharging their liquid cargoes. This difficulty has now been overcome by the provision of a separate dock and discharging equipment in an isolated situation in which the vessel can be shut off from the canal by means of a floating reinforced-concrete caisson, a precautionary measure in case of fire or escape of the spirit.

The dock is on the estuary side of the canal, while the oil companies' premises and land for future developments are on the opposite side, with road and rail facilities adjoining. The principal dimensions of the dock are as follows: length, 600 ft.; width, 100 ft.; depth of water, 30 ft.; and width of entrance 80 ft. The dock is placed at a convenient angle with the canal to give easy access for the ships, and the approach is provided with two reinforced-concrete dolphins on one side, a recess being provided for the caisson when this is not in use. In each of the main concrete piers at the entrance a vertical groove of a modified V-shape, faced with granite, is provided, and into these recesses suitably shaped projections on each end of the caisson fit, one end being secured by a wedge which is raised and lowered by a winch on the quay.

The foundation of the caisson is to act as a fire-stop at the dock entrance by preventing the escape into the canal of blazing oil in the event of a fire occurring within the dock. The caisson is a box-shaped vessel, nearly rectangular in section, with semi-circular ends terminating in substantial stem and stern posts. The length over all is 82 ft. 6 in., the beam is 12 ft., and the depth from crown of deck to keel is 10 ft. 3 in. The deck has a chamber of 4 in. and the bottom is formed with a fall of 6 in. from the bilges to the keel. A fore-and-aft central wall, together with six transverse bulkheads, divide the caisson into fourteen compartments, separate and watertight. At water level the hull is provided with timber fenders bolted to a reinforced-concrete counter carried by wings springing out from the upper parts of the sides. The total weight of the caisson without ballast is about 125 tons, and its draft is about 5 ft. 6 in. As the working draft is 8 ft. a certain amount of ballast, consisting partly of mass concrete and partly water, is placed in the various watertight chambers to give the requisite flotation.

Each of the compartments is provided with an airtight manhole frame and cover on deck for purposes of access, also a scuttle plug and sounding pipe. The deck equipment comprises two deck winches one near each end, and four cast-iron mooring bits, two on each side of the vessel. For the purpose of adjusting the water ballast, and also for pumping out any or all of the ballast chambers, each compartment contains a 3-in. sluice valve connected to a 3-in. diaphragm hand pump fixed on deck. Each valve being operated by a spindle terminating in a watertight box, the various compartments can be dealt with singly or any number at a time as may be desired. The stem and stern posts, and also the portions of the "Samson" posts above deck level are sheathed with steel plates ⅝ in. thick. With the exception of the hull bottom, which is 4 in. in thickness, the concrete throughout the vessel comprising the sides, deck, bulkhead and center wall, is 3 in. thick,



CONCRETE FLOATING CAISSON TO ISOLATE FLOATING OIL

splayed out at the various intersections. The sides and also the center fore-and-aft wall are stiffened by vertical ribs spaced about 3 ft. 6 in. apart.

The reinforcement throughout the whole of the caisson consists of round mild steel bars of ordinary commercial section. No fabric or steel bars of special form were employed. In the case of the walls, bulkheads and bottoms upon which the pressure might fall from within or without, according to the manner in which the chambers might be charged with water ballast, the reinforcement had to be provided near to both surfaces. The deck, however, only required reinforcing in the usual way for downward pressures. The reinforcement in the floors, walls, bulkheads and deck consists of ⅜-in. and 5/16-in. diameter main and transverse bars suitably spaced and wired together at intersections. Heavier reinforcement, consisting of 1-in. and 1¼-in. diameter bars, is introduced in the vertical stiffening ribs, "Samson" posts, stem and stern posts; and also in keel, bilges, gunwales and along the top of the center wall. Whenever necessary, as, for example, in the stiffening ribs, steel stirrups are inserted in order to take up the shearing stress.

The whole of the concrete throughout the caisson is composed of portland cement, sand, and ⅜-in. (Dalbeattie) crushed granite, mixed in the proportion of 224 lb. cement, 3¾ cu.ft. sand, to 7½ cu.ft. granite.

The concrete floating caissons were built by B. Morton & Sons, Manchester, for the Manchester Ship Canal Company of Manchester, England.

Reconstruction of Grandstand at Chicago Ball Park

Winter Work Necessitated Precast Concrete Slabs for Deck—Steel Frame—Old Building Shifted and Enlarged

IN THE improvement of the baseball grounds of the Chicago National League Ball Club (known as the Cubs' Park) for the 1923 season the principal features were: (1) cutting and moving a section of the steel and concrete L-shaped grandstand; (2) building new sections of the grandstand and extending its lower end by fourteen rows of seats; (3) building a deck of precast concrete slabs for the new work; (4) building two bleacher stands 36 x 235 ft. with steel framing and precast slab decks; (5) lowering the grade of the playing field about 7 ft. in order to accommodate the extension of the grandstand. A general view of the work is

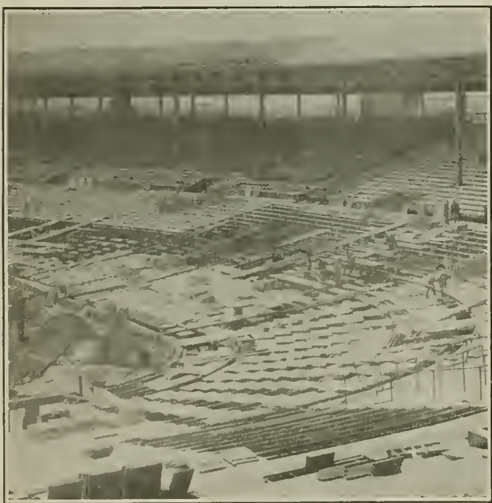


FIG. 1—ENLARGING BASEBALL GRANDSTAND AT CHICAGO

shown in Fig. 1, with a layout plan in Fig. 2 and a typical section of the enlarged grandstand in Fig. 3. The additional seating capacity thus provided is 11,000 for the grandstand and 4,600 for the two bleachers, the total capacity being thus increased to 29,300 persons.

Grandstand Design—The original grandstand, erected in 1914 has a structural steel frame with reinforced concrete slab deck, the concrete being poured in place. Columns of steel H-beams spaced 18 ft. 9 in. c. to c. carry inclined 10-in. to 18-in. I-beams, the size of beam depending upon the span. Between the beams are stringers of 12-in. channels, to carry the individual slabs of the stepped floor. These old slabs have Hy-rib steel reinforcement with 2 to 3 in. of concrete above the steel and a ½-in. protective coat of cement mortar on the underside. This type of construction was adopted partly with a view to future enlargement and it is reported to have proved very satisfactory in moving, as the structure was very light but yet rigid enough to permit of easy handling.

Transverse steel cantilever trusses carrying the wood

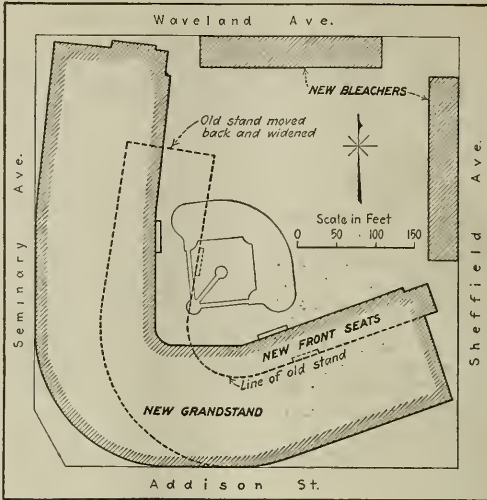


FIG. 2—PLAN OF CHICAGO NATIONAL LEAGUE BASEBALL PARK

roof construction are spaced 18 ft. 9 in. c. to c. and are 90 ft. long, 64 ft. between supports and with an overhang of 26 ft. The rear supports of these trusses are the extended columns of the grandstand. Each alternate truss has a column at the 64 ft. point, the intermediate trusses being supported by longitudinal trusses having a span of 37 ft 6 in. between columns.

In the new parts of the grandstand the steel design is practically identical with that of the older structure. For the 40-ft. extension along the lower side of both the old and new portions the framing consists of inclined 9-in. I-beams spaced 9 ft. 4½ in. apart, supported on concrete posts and carrying stringers of 6-in. channels. The upper portions of the grandstand are reached by means of ramps 10 ft. wide and having a grade of about 12 per cent. The lower portions of the stand are served by stairways 9 ft. wide and spaced an average of 80 ft. apart at two different levels. Those at the lower level are for the additional fourteen rows of seats and the upper ones are at the level of the main aisle, which separates the front or box seats from the grandstand seats. All steel was given two coats of paint after erection. Expansion joints are provided at intervals of about 100 ft. This whole structure, as well as the separate bleachers, was designed for a live-load of 100 lb. per square foot and in accordance with other requirements of the Chicago building ordinance.

Precast Slab Deck—In remodeling the grandstand, practically the entire work had to be done in freezing weather, since the date of the opening game of the season would not permit of any delay. It was decided, therefore, to make the deck of precast concrete slabs which could be handled and placed as required. This arrangement made it necessary to standardize the tie-rod and rivet spacing so that the slabs could be made with the necessary notches and recesses. Close cooperation of the designers of the steel frame and concrete slabs was required in order to secure the correct matching and fitting of the parts.

For the sake of appearance it was not desirable to place the ⅝-in stringer tie-rods below the slabs. Since

the slabs for the greater part of the work are in 2-ft. lengths the tie-rods were spaced 4 ft. c. to c., measuring from the center of each panel, the ends of alternate slabs being recessed accordingly, as shown in Fig. 4. The rivets securing the 2x2x$\frac{3}{16}$-in. angles on the top flanges of the stringers were spaced 12 in. c. to c. and the underside of the slab was made with recesses to fit over the rivet heads, except at the connections to the I-beams, where countersunk rivets were used. With the slabs in 2-ft. sections and laid in elastic cement no additional provision for expansion and contraction was considered necessary, and the expansion joints in the steel frame are not continued through the deck. Typical construction of the slab deck is shown in Fig. 4.

For covering an area of about 90,000 sq.ft. in the new work a total of nearly 16,000 slabs was required, and these were of 626 different shapes and dimensions, owing in part to the wedge-shaped spaces over the radial stringers and the different spacing of the stringers. These slabs are 2 in. thick for spans up to 3 ft., and 2½ in. up to 4½-ft. span all reinforced with No. 12 to No. 9 galvanized wire netting. The majority of the slabs were 2 in. thick and 24 in. wide, weighing 25 lb. per square foot or approximately 150 lb. each.

Each slab has its rear end resting on the lower flange of a stringer, or on a shelf angle riveted to the web in cases where the stringers are laid with flanges turned inward. The outer end rests on an angle riveted to the top flange of the next stringer, the upstanding leg of the angle protecting the face of the slab for its entire depth. To give the necessary slope for drainage a lug or heel is formed under the rear end of the slab. Elastic oil cement was used as a joint filler and was also placed on the angles as a seat for the slabs, the slabs being so placed as to form a squeeze joint. In this way the deck is made practically waterproof, which is particularly desirable in view of the fact that the deck is washed down with streams of water from a hose after every game. Folding seats of theater type are used on the grandstand, the iron legs being secured to the slab deck.

Casting the Slabs—Forms for the slabs were composed of steel frames having two 4x4-in. angles 11 ft. long, connected at each end by a flat bar secured to the horizontal legs by loose rivets so that the angles could be moved together or apart like the bars of a parallel ruler. Bottom boards were placed on the angles, with partition boards or dividers set on edge between them

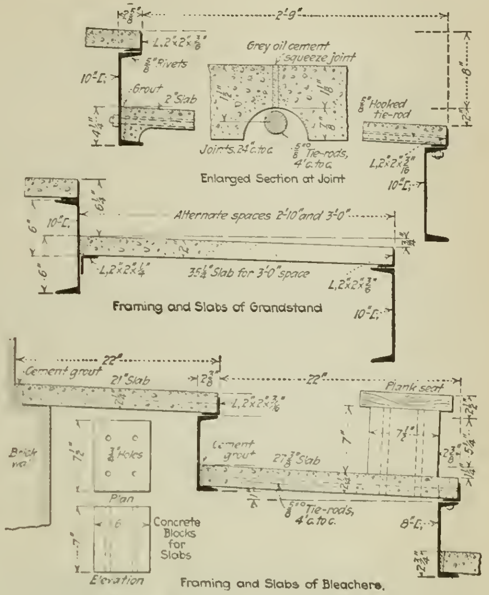
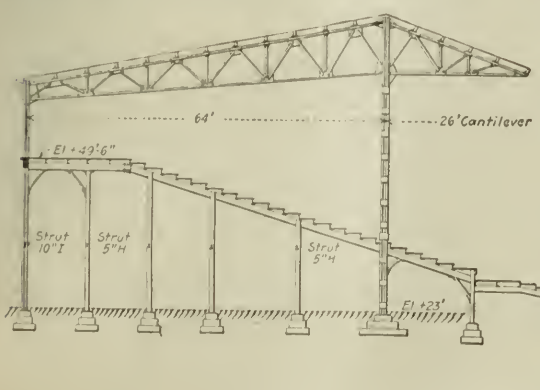


FIG. 4—DETAILS OF DECK CONSTRUCTION

at the required spacing and level with the tops of the angles. The boards were then wedged tightly in place by shifting one of the angles lengthwise. Sheets of the steel reinforcement were then set in place and held at the required height by small concrete blocks. Wet concrete of 1:3 mix, made with gravel of ½-in. maximum size, was poured into the forms, sprinkled with dry cement and then struck off with an iron bar, giving an even but slightly rough or granular finish.

To form the lug or heel under the higher end of the slab, the bottom board was cut away to the depth required. Special forms were needed for the numerous wedge-shaped slabs of various dimensions. Every slab was numbered to conform to its position as marked on the plans. The slabs were shipped to the park in railway box cars and distributed on warehouse hand trucks. Fig. 6 shows the handling and placing of the slabs. Manufacture was begun Jan. 15 and completed March 3; placing of the slabs was begun Feb. 27 and completed March 28.

Bleachers—For the steel framing of the bleachers, inclined 12-in. I-beams spaced 15 ft. c. to c. are supported by a front footing, a rear wall and two H-beam columns; upon these beams are stringers of 8-in. channels spaced 26 in. c. to c. and carrying the precast concrete slabs. The 4-in. concrete walk at the foot was poured in place, the concrete encasing the lower part of the first stringer. This construction is shown in Fig. 5. For the seats in the bleachers, Fig. 4, single planks



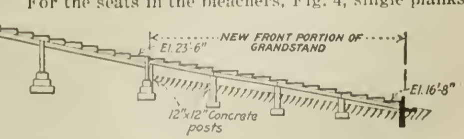


FIG. 3—TYPICAL CROSS-SECTION OF GRANDSTAND

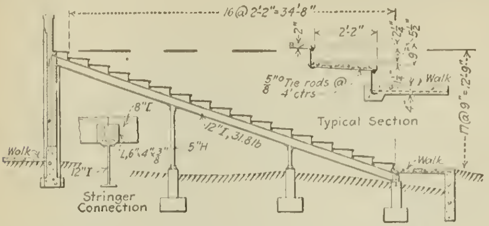


FIG. 5—STEEL AND CONCRETE BLEACHERS

2x10-in. are supported on rectangular concrete blocks spaced about 4 ft. c. to c. Each block has four ¾-in. cored holes, as shown, two for ½-in. anchor bolts holding the block to the slab and two for bolts to fasten the seat boards.

Moving the Grandstand—Preparatory to moving the two main sections to their new location, the stands were cut crosswise at the proper section and lengthwise just in front of the main aisle. This gave the moving contractors four sections to handle, the largest rectangular section being 80 x 244 ft. All cutting of steel was done with acetylene burners and the light concrete slabs were cut with chisels. The rear northwest section

FIG. 6—PLACING PRECAST DECK SLABS

was moved first, being moved north as far as required, 120 ft., and then west to its new location. By the time the stand section reached this position the lower courses of the footings had been placed. The upper courses with anchor rods and masonry plates were poured after the stand section was in place and before the blocking was removed. The same procedure was followed in the other portions of the stand. After the moving was concluded, an examination of the structure failed to show any cracking of the slabs, or any defects due to moving. For this work each section of the structure was raised by jacks and rolled along tracks of steel rails laid on top of blocking, being moved by means of cables and horse capstans.

Grading the field to its new level was done by a revolving steam shovel. Drainage of the field at its new grade is provided for by a main tile drain starting at the home plate, extending under the second base and across the outfield and emptying into a 9-in. drain at the far end of the field. Lateral drains of 4-in. tile, spaced 12-ft. apart are placed beneath the diamond and infield, and 4-in. laterals, 25 ft. apart are placed in the outfield.

Speed of Construction—Actual moving of the first section commenced Jan. 10; on Jan. 11 it was in its northern position, a distance of 120 ft.; movement 120 ft. west was started Jan. 14 and concluded Jan. 16. The record time was made on Feb. 8 when the main curved center section, about 80 x 275 ft. in plan, was moved to its new location, a distance of about 90 ft., in two hours. As soon as the first or northwest section was in place, erection of the new steel framework was started, and the old center section was in its new position by the time the erectors were ready to connect to it. Directly after the steel erectors came the cement slab erection crews, which dropped the slabs into place as they moved southward along the stand. The first slab was laid Feb. 27 and by March 15 the grandstand was practically completed. On March 29 the slabs for bleachers as well as for the grandstand were in place, the placing of 14,600 additional seats having been done in 30 days.

Engineers and Contractors—The architect for this work was Zachary T. Davis, with the Westcott Engineering Co. as consulting engineers and designers of the steel framing and concrete work. Lanquist & Illsley were the general contractors; L. P. Friestedt & Co. did the moving of the old structure and erected the steelwork; the Vanderkloot Steel Works fabricated the steel and the Federal Cement Tile Co. made and placed the concrete slabs. All these are Chicago firms.

Some Fallacies on Power Development

Abstract of a paper read before the Southern Appalachian Water Power Conference by O. C. Merrill, executive secretary, Federal Power Commission.

THE popular fallacy that since water costs nothing and runs downhill it can be used to develop power cheaply under any conditions has resulted in proposals to build many water-power plants and in the construction of some that are not economically justifiable. The estimates for many of such developments stop at the generator switchboard, and overlook or ignore the cost of transmission and distribution, and of auxiliary steam reserve. Many also fail to consider the accessories to the actual construction of the dam and power house such as camps, roads, railways, construction equipment, and overhead organization.

Another popular fallacy is that any state can permanently gain at another state's expense through monopoly of its power resources by placing embargoes on the export of electric energy. Such a fallacy overlooks the fundamental fact that we are first a union of states and that our prosperity must be mutual or it does not exist. The federal government as an agent of all the people does not acquiesce in this policy. It has full control over public lands, interstate trade, transportation as an agency of such trade, and over river improvements as needs of transportation. It can construct such improvements at its own expense but prefers to delegate such construction through the agency of the Federal Water Power Act wherever such developments affect public property, which condition applies to most major water-power resources of the country.

Efforts to prevent the development of water-power sites under the Federal Water Power Act on the score of public interest are ill advised. Rates, service, and the issuance of securities and the disposition of excess profits are under federal control and the people are consequently well protected. Moreover the development of water power on many streams by private capital will produce important navigation improvements which would otherwise require large expenditures by the government itself. These items should be considered in any state legislation tending to restrict development under the Federal Water Power Act.

International Navigation Congress Held at London

Meeting Postponed by War Well Attended—Papers Excellent but Discussion Limited—Conclusions Unanimous

By Frank T. Chambers
Captain, C. E. C., U. S. Navy, Washington, D. C.

Special Correspondence

UNDER usual conditions International Congresses of Navigation are held at intervals of three years. The last congress was in Philadelphia in the spring of 1912, so the world war has caused a delay of eight years and an interval between the twelfth and thirteenth congresses of eleven years. This fact and the title of the congress, which would lead the casual reader to the hasty conclusion that the subject matter is only of indirect interest to engineers, justify a brief foreword.

The congresses are in fact of particular interest to all engineers engaged in waterfront construction and river and harbor improvement. They are held under the auspices of the Permanent International Association of Navigation Congresses, which has its headquarters at Brussels, Belgium, and which is supported by contributions from some 36 countries or dependencies, more than 200 corporations or institutions and over 1,500 individual members. The United States, through congressional act of June 28, 1902, became a maximum contributor with an annual appropriation of $3,000. It thus results naturally that the United States delegates this year to London were selected largely from those departments of the government which are most directly concerned in port development, aids to navigation, etc. Those commissioned by the State Department were Col. J. C. Oakes, Corps of Engineers, U. S. A., vice-chairman, Inland Navigation Section; Capt. Frank T. Chambers, C. E. C., U. S. N., vice-chairman Ocean Navigation Section; Capt. C. L. Hussey, U. S. N., naval attaché, American Embassy; Maj. O. N. Solbert, Corps of Engineers, U. S. A., military attaché, American Embassy; Rear Admiral William E. Reynolds, Commandant U. S. Coast Guard; George R. Putnam, U. S. Commissioner of Lighthouses; Col. E. Lester Jones, director, U. S. Coast and Geodetic Survey; John C. Hoyt, hydraulic engineer, U. S. Geological Survey; Walter Tower, commercial attaché, American Embassy; Capt. W. F. Purdy, operating manager, U. S. Shipping Board at London; Huntington T. Morse, European manager, U. S. Shipping Board, Emergency Fleet Corporation, and W. W. Atterbury, vice-president, Pennsylvania Railroad. Messrs. Jones, Hoyt and Atterbury did not attend.

The program was divided into two sections: the first, Inland Navigation; the second, Ocean Navigation. Each section was subdivided into "Question" and "Communications," the first being given the place of honor, the second, such time as could be spared after disposing of the first. The topics were:

Inland Navigation

Questions—1. Utilization of waterways for the production of power; its consequences and applications.

2. Dispositions or arrangements to be adopted for locks, elevators, inclined planes, and other means of overcoming differences of level with a view to facilitating the operations.

Communications—1. The influence of surface waters and subterranean sheets of water on the flow of rivers. Regime of mixed canals; estimation of the water consumed for navigation and irrigation uses; the portion returned to the subterranean sheet of water.

2. Unification of statistics of inland navigation with a view to facilitating the comparison of the results of the working of navigable waterways in various countries.

Ocean Navigation

Questions—1. The accommodation to be provided for ships in connection with the construction of new works at ports in order to satisfy the future dimensions of ships.

2. Types of works for berthing ships of great draft in tidal seas.

3. The relative advantages of ship equipment and port equipment for loading and discharging ships. Mechanical equipment of ports. Mechanical handling of freight. Loading, discharging and carrying between ships and the various depositing points whether covered by sheds or not.

Communications—1. Concrete and reinforced concrete. Their applications to hydraulic works; means to insure their preservation and their watertightness.

2. Use of liquid fuel for navigation and its consequences.

3. Utilization of tides for the production of power for the working and lighting of ports and for maritime works (working of lock-gates, etc. . . .).

4. Principal advances made recently in lighting, beaconing and signaling of coasts. Standardization (unification) of the languages of maritime signals.

Contributions of papers from the United States were:

First Section — Question 1. Col. William Kelly, Corps of Engineers, U. S. A., chief engineer, Federal Power Commission.

Question 2. Col. Edward H. Schulz, Corps of Engineers, U. S. A.

Communication 1. Prof. Daniel W. Mead, University of Wisconsin.

Communication 2. Dr. Grover G. Huebner, University of Pennsylvania.

Second Section—Questions 1 and 2. Capt. F. T. Chambers, C. E. C., U. S. N., consulting engineer on port facilities, Board of Engineers for Rivers and Harbors, War Department.

Communication 2. Commander Urban T. Holmes, U. S. N. (Ret.), M. Am. Soc. Naval Engineers.

Communication 4. G. R. Putnam, commissioner of lighthouses, Department of Commerce.

Procedure—The meetings of the congress were held in the splendid building of the Institution of Civil Engineers of Great Britain, under the patronage of the King of England. The proceedings were opened with great ceremony, Lord Desborough, President of the Thames Conservancy, presiding and introducing the Duke of York who made the welcoming address. Replies were made by a chief delegate for each principal country or principality represented at the Congress. Col. Oakes responded for the United States. There were delegates from twenty-six subscribing states and four representatives from non-subscribing states, inclusive of Soviet Russia. The Suez Canal company delegated M. Quellennac, consulting engineer, and M. Felix, chief of the technical service. Official delegates were actually present from French West Africa, Belgium, Brazil, Chile, China, Czecho-Slovakia, Denmark, Finland, France, Great Britain, Greece, Holland, Hungary, India, Irish Free State, Italy, Japan, League of Nations, Monaco, Norway, Persia, Poland, Portugal, Rhine Commission, Rumania, Saar Territory, South Africa, Spain, Sweden, Switzerland, Tunisia, United States of America and Uruguay. There were twenty

British corporations represented, individual members bringing up the total attendance to about four hundred people.

After the opening ceremonies were concluded the registration book was opened, the first signature being that of the Duke of York. Immediately thereafter the sectional meetings were begun and continued throughout the week, the Inland Navigation Section considering and debating the general conclusions, prepared in advance by general reporters, on thirty-nine papers; the Ocean section, eighty-eight papers. The Ocean section attracted about twice the number attending upon the Inland section.

With so many papers it was impossible to read any and resort was had to the conclusions of the general reporters, who, under the rules of the International Association, made definite findings for discussion. The presiding officers, Lord Desborough for Inland Navigation and Sir Ernst Glover for Ocean Navigation, gave the members ample time for discussion, then appointed executive committees to recommend the final conclusions. The system worked well and although it is impossible to say that any new fact was disclosed in these conclusions, it is gratifying to know that whereas methods of construction and equipment, particularly of seaports, differ widely in different parts of the world, these delegates, many of them of international reputation, were practically unanimous in their opinions as to the general principles upon which engineering practice should be based.

Conclusions—The conclusions for Question 1 of the first section dealt upon the necessity for the development of all available water power, under a single control for each country, the development for power to be made in conjunction with and never neglectful of navigation, but bearing in mind also flood control, irrigation, drainage, domestic water supply and fisheries.

For Question 2, the dispositions for overcoming differences of level on canals, etc., it was decided that no precise indications were possible but certain general principles were laid down, scarcely worthy of repetition.

In treating of the first and second questions of Section 2 it was wisely decided that these questions were so intimately related as to require no separate discussion. It was concluded that while there is a general tendency for ships to increase in size due solely to cost of ship operation, without reference to increased cost of port facilities, the depths of the natural harbors and waterways of the world and the cost of providing harbor facilities for quick dispatch of the largest ships should tend to check increase of draft beyond thirty feet; that there will be an increase in the average tonnage of ships between 5,000 and 8,000 tons but not in the tonnage of the largest pre-war ships, in the near future; that while 40 ft. of water has been provided recently for Atlantic liners, the provision for cargo ships has been much more modest; that it will be difficult to justify more than 35 ft. of water at lowest tide for many years to come for other than Atlantic passenger liners, while a port providing 30 ft. of water would be considered first-class.

Concluding the third question the congress expressed a preference for port equipment such as cranes and conveyors rather than to depend upon ship equipment but declared it necessary that ships be equipped with winches, cargo masts and booms, both for use in ports unequipped with booms and hoists and for safety of the ship itself in cases of grounding or of shifting cargo at sea.

Under the rules no conclusions were drawn on the "communications."

Many of the papers submitted were excellent. Strangely, most of them dealt with only one or two features coming under the particular head, as for instance, types of quay walls under the subject of facilities to be provided for ships. Few took the subject as a whole and analyzed it. Among the papers dealing with one phase only may be mentioned that by Sir Robert Hadfield who, under "Concrete and Reinforced Concrete," took for his actual subject "The Corrosion of Ferrous Materials with Special Reference to Their Resistance to the Action of Sea Water," furnishing not only an interesting paper but a valuable bibliography of his subject. An interesting paper by L. H. Savile, civil engineer in chief, British Admiralty, gave detailed figures to prove his contention that the cost of harbor works increases as the cube of the draft provided. While this can scarcely be possible as a general rule, the paper is well worthy of attention. In fact, while many of the papers are of little value from the standpoint of American practice, there are many good ones and the engineer who possesses a set will prize it highly.

The congress was closed with much the same ceremony with which it opened. Representatives of several countries were called upon to speak. The writer spoke for the United States and was delighted to have the opportunity to thank the British Organizing Committee and the other organizations and agencies who made us all feel at home and otherwise contributed to our profit and pleasure. The way the two chairmen and their secretaries handled our unwieldly convention of representatives of so many nationalities is worthy of all praise.

The social side of the congress was indeed most enjoyable. We were lunched and dined and given receptions and the ladies were taken sightseeing. Particularly charming were the visits to Taplow Court, the beautiful home of Lord Desborough on the Thames, and to Windsor Castle, while the railways and dock authorities were most generous in providing instructive excursions to Southampton, Bristol and South Wales ports, as well as to the Victoria and Albert and King George docks at London.

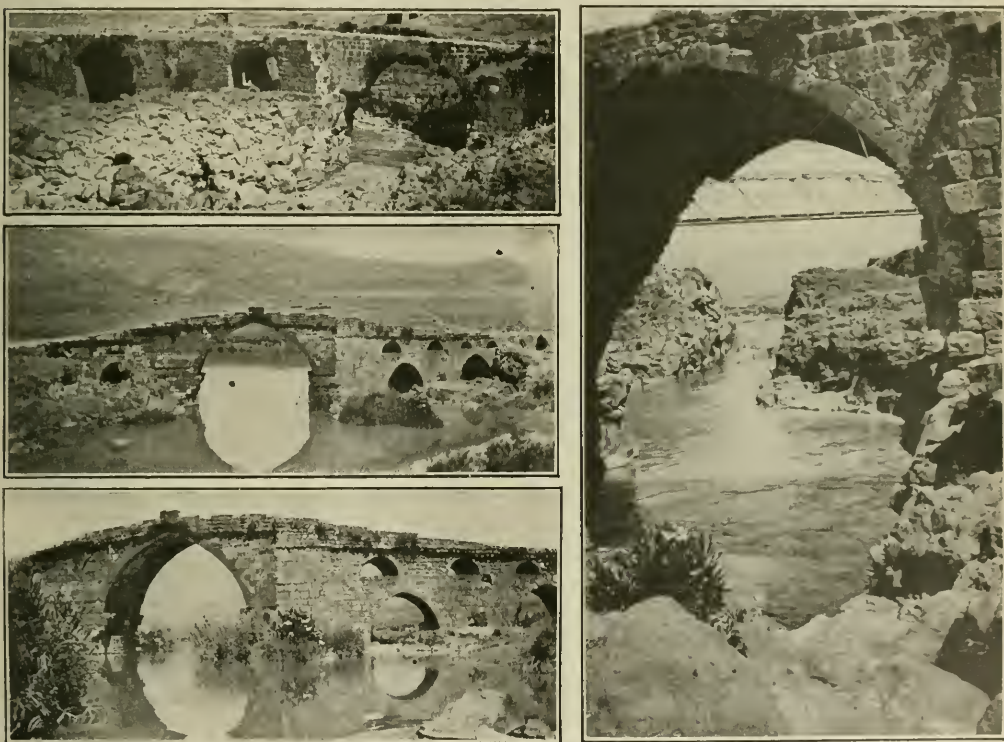
To Fill Bed of Abandoned Canals in Syracuse

Under a tentative plan agreed upon by the city administration of Syracuse, N. Y., for the disposition of the land pertaining to the abandoned portions of the Erie and Oswego Canals within the city, none of the land will be sold except that upon which there are permanent encroachments. As funds permit, an intercepting storm-water sewer will be built in that portion of the Erie Canal from Onondaga Creek to the easterly line of the city. As fast as the sewer is built the canal will be filled above the sewer to the grade of intersecting streets and the bridges will be removed. A portion of this intercepting sewer work will be carried out at once. The sewer will have a rectangular cross-section above a curved invert, the dimensions being about 10x12 ft. and the grade 2 ft. per thousand. The Oswego Canal will be filled as rapidly as funds are available. A portion of it will be used for an extension of the city market.

Bridges Antedating Christian Era Still in Service

TWO BRIDGES that rank among the very oldest in existence, certainly among the oldest that are still carrying traffic, were recently photographed by P. W. Etkes, assistant district engineer of the Northern District of the Public Works Department of Palestine, resident at Haifa. Both bridges lie on the old highway from Galilee to Jerusalem, and cross the Yarmuk and Jordan Rivers respectively. They were built many years before the Christian era, according to the best available information, but were repaired in later years by the Romans and the Saracens successively. Only a few weeks ago, Mr. Etkes says, he crossed these bridges "in a Buick seven-seater with eight people in it," obvious proof that they are still giving service. New bridges are planned, but the old ones will be preserved for their historical importance. The modern steel bridge near the Saghir bridge, which may be seen in one of the views, is the railway crossing of the Yarmuk in the direction of Damascus.

As may be judged from the pictures, both the foundation conditions and the climate are favorable to long life of masonry arches, and the long preservation of these structures may be in part credited to this fact.



PALESTINE BRIDGES OF GREAT ANTIQUITY, REPAIRED IN THEIR LATER YEARS BY THE ROMANS AND SARACENS

These structures are still in service. They are to be preserved by the Department of Antiquity of the State of Palestine. The upper view and the view at the right show the Saghir bridge over the Yarmuk River, the two lower views the "Jisr Mujamia" over the Jordan River. The former has a span of 24 ft., and the height from keystone to water level is 39 ft., while the water is about 28 ft. deep. The Mujamia bridge, which, by the way, has an angle in its alignment just beyond the right end of the main arch, has a main span of 41.3 ft. and a clearance height of 30 ft. The water under this span is about 33 ft. deep. The Saghir bridge (upper view) is reported to be 3,000 or more years old.

Port Officials Act on Equipment Design

THE American Association of Port Authorities, at its meeting of June 12 at Montreal, adopted a resolution the substance of which was that in view of the international character of ocean transportation an effort should be made to bring about greater co-operation in the design of port equipment with the object of making it all as nearly uniform as is possible so that ships calling at strange ports would not encounter cargo-handling equipment unsuitable to their loading and discharging arrangement. A committee consisting of Captain F. T. Chambers, of Washington, D. C., Dr. Brysson Cunningham, of London, and A. D. Swan, of Montreal, was appointed to communicate the substance of this resolution to the principal port authorities throughout the world, and to report their findings to the association at its next meeting. At the time Capt. Chambers received this resolution he was attending the thirteenth international navigation congress at London and he took the opportunity to communicate it to the large number of representatives from the various ports of the world assembled at that congress. The association realizes the many difficulties to be overcome in carrying out such a plan of international co-operation but it expects to get a great deal of valuable information thereby.

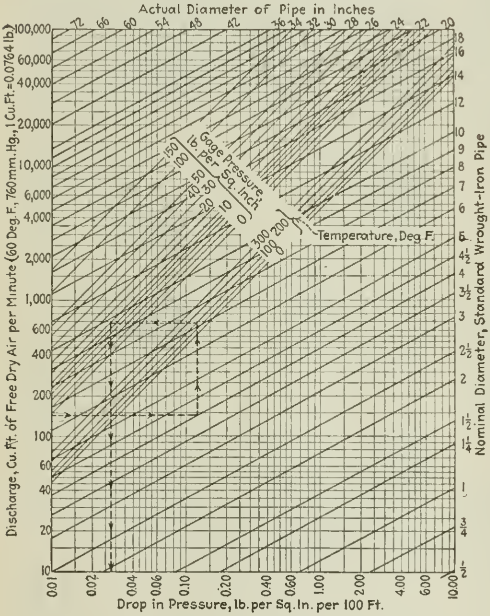
Air-Pressure Losses in Piping of Activated-Sludge Plants

Comparative Study of Seven Formulas with Particular Reference to Pipe Layout of Large Plant for Chicago Sanitary District—Relation of Pressure to Pipe-Capacity

By H. L. McMillan
Assistant Engineer, Sanitary Division, Sanitary District of Chicago

In preliminary studies of air mains and piping for a contemplated large activated-sludge plant for the Sanitary District of Chicago the formula of Fritzsche was used, results being easily determined for various lengths, sizes and flows from a chart of losses of pressure per hundred feet of pipe, prepared by Arthur B. Morrill (reproduced herewith). To compare the Fritzsche with six other recognized formulas the accompanying table of comparative pressure losses under certain

FLOW OF AIR IN CIRCULAR PIPES-FRITZSCHE FORMULA



FLOW OF AIR IN CIRCULAR PIPES BASED ON FRITZSCHE FORMULA

assumed conditions was prepared. The other six formulas are: Wilson & McAdams, Unwin, Harris, D'Arcy, Rix-Johnson, Sturtevant. The last, adapted for ventilation work from the old Weisbach formula, was used in determining pipe sizes for the Milwaukee plant.

Of the seven formulas here considered, only the Wilson & McAdams formula deals with viscosity, through the friction factor f, as a function of z/dvs, when z = the viscosity.

Only the Fritzsche and the Wilson & McAdams formulas deal with the absolute temperature, the Fritzsche directly, as t deg. abs. F., and the Wilson & McAdams through velocity v, specific gravity s, viscosity z, and hence the friction factor f, all of which are affected by the temperature. The Sturtevant fan formula also deals with the temperature, if the velocity v is considered as affected by the temperature, which was not intended to be the case, evidently, by those who developed the formula for ventilating work. The pressure, or the unit weight of compressed air, is dealt with directly in all of the formulas but the Sturtevant, and that one may be considered to have compression factors, as velocity is affected by compression.

All of the formulas, except the Fritzsche, deal with the velocity or quantity of air flowing, raised to the second power, when rearranged in the form $p_1 - p_2 =$ func. $\frac{v^2}{d}$, or func. $\frac{Q^2}{d^5}$, while Fritzsche uses $Q^{1.852}$, similar to the results of Williams and Hazen in their hydraulic studies, in which they found $v^{1.85}$ as a controlling element, instead of v^2, and the results of many other investigators on air who found that the exponent varied between 1.75 and 1.95 for air, depending on the kind of pipe used and the quality of its interior surface. (See Mr. Eason's book, mentioned in footnote to table.)

The variation of results of computations by these seven formulas is chiefly due to the coefficient, fixed in some cases and varying in others. The Fritzsche coefficient is fixed, but as he found the pressure loss varied with the 1.852 power of the volume flowing, an average between 1.848 and 1.856, the fixed coefficient is admissible.

The exponent 1.852, compared with the exponent 2, makes a considerable difference in result, especially with large volume of flow.

When developed into terms used in the Fritzsche formula, in which Δp = drop in pressure, lb. per sq.in.; t = abs. temp. F.; L = length in ft.; Q = cu.ft. per min., free air at 60 deg. F.; p = abs. pressure, lb. per sq.in.; and d = diam. in in.; the comparison is:

Fritzsche, $\Delta p = \frac{1.268\ t\ L\ Q^{1.852}}{1{,}000{,}000\ p\ d^{4.973}}$

Wilson & McAdams, $\Delta p = \frac{1.046\ f\ t\ L\ Q^2}{10{,}000\ p\ d^5}$

Unwin,* $\Delta p = \frac{5.43\ f\ L\ Q^2}{100\ p\ d^5}$

Harris, $\Delta p = \frac{4.2\ L\ Q^2}{10{,}000\ p\ d^{5.31}}$

D'Arcy, $\Delta p = \frac{1.125\ L\ Q^2}{C^2\ p\ d^5}$

Rix-Johnson, $\Delta p = \frac{2.5\ L\ Q^2}{10{,}000\ p\ d^5}$

Sturtevant, $\Delta p = \frac{1.86\ t^2\ L\ Q^2}{100{,}000{,}000\ p^2\ d^5}$

Sturtevant, if temperature is not considered, $\Delta p = \frac{5.05\ L\ Q^2}{1{,}000\ p^2\ d^5}$

It should be recognized that the Sturtevant fan formula was developed for ventilating work, etc., at or close to atmospheric pressure, and that the Unwin, Harris, D'Arcy, and Rix-Johnson formulas were developed for compressed air practice, seldom less than 60 or 70 lb. gage pressure, and therefore these five formulas are not strictly applicable to the problem of the moderate pressure of air for activated-sludge plants.

AIR-PRESSURE LOSSES IN ACTIVATED-SLUDGE PLANT PIPING COMPUTED BY VARIOUS FORMULAS

Slide-rule computations for various diameters, capacities, gage pressures, air temperatures and pipe lengths.

Diameter, in.	60	48	16	12	6	4	3
Capacity, cu.ft. per min. free air	90,000	60,000	5,000	2,250	525	150	120
Gage pressure, lb.	7	7	7	7	2.8	1.9	7
Temperature, deg. F.	150	150	100	100	113	104	60
Length, ft.	1,300	910	416	444	164	213	111
Fritzsche	0.100	0.100	0.100	0.100	0.100	0.100	0.100
Wilson & McAdams							
Cast-iron pipe	0.150	0.147	0.118	0.114	0.103	0.099	0.096
Copper pipe	0.111	0.110	0.088	0.087	0.083	0.084	0.081
Unwin	0.097	0.093	0.083	0.080	0.077	0.079	0.098
Harris	0.073	0.075	0.080	0.080	0.080	0.077	0.091
D'Arcy	0.127	0.128	0.127	0.122	0.105	0.094	0.108
Rix-Johnson	0.156	0.148	0.112	0.104	0.084	0.070	0.076
Sturtevant fan at 60 deg. F.	0.145	0.139	0.108	0.098	0.095	0.083	0.071
At temp. spec.	0.200	0.189	0.125	0.111	0.116	0.100	0.071

The pressure losses shown in the table are not for the exact lengths of the various sizes of pipe or conduit, as found in the plant proposed, but are for lengths of each size selected to give results by the Fritzsche formula equal to 0.1 lb. per square inch loss of pressure, so that easy comparison may be obtained. The sizes selected are suitable sizes for the plant, and the amounts of air flowing are approximately maximum amounts for each size of pipe in the plant.

The 60-in. size represents a main from the compressor room; the 48-in., a main header feeding many tanks; the 16-in. and 12-in. are branch headers in aeration tanks; the 3-in., the little branch pipes supplying air to the filtros-plate boxes. The 6- and the 4-in. are smaller branch headers supplying mixed liquor and sludge channels with air at lower pressure and lower temperature than that in the 48-in. header, such air being drawn from the 48-in. header at various points, and cooled by adiabatic expansion.

The high temperature selected for the large mains is due to probable adiabatic compression with centrifugal compressors, plus friction in compression. The temperature selected for the 16- and 12-in. mains is an approximate average due to cooling within submerged pipes, and that for the 3-in. pipes due to further cooling.

A gage pressure of 7 lb. per square inch is taken for simplicity, representing the pressure of 15 ft. depth of water, plus a small plate loss and pipe friction. Lower pressure in the 6- and 4-in. sizes is due to their supplying air to shallow troughs and conduits.

The Fritzsche Formula, $\Delta p = \frac{1.268\ t\ L\ Q^{1.852}}{1{,}000{,}000\ p\ d^{4.973}}$, is developed from Hütte (d. Ing. Tasch.), where it is given in metric equivalents. In the above form, Δp = drop in pressure, lb. per sq.in.; t = abs. temp. F.; L = length in ft.; p = abs. pressure, lb. per sq.in.; Q = C.F.M. free air at 60° F.; d = diam. in in.

Wilson & McAdams, $p = \frac{0.323\ f\ L\ s\ v^2}{d}$, in which p = pressure lost, lb. per sq.in.; f = a friction factor depending upon the value of the ratio $\frac{z}{dvs}$; L = length in ft.; s = spec. gr. referred to water at its greatest density; v = velocity, ft. per sec.; d = diam. in in.; z = viscosity, relative to water at 68° F. This formula is given in *Engineering News-Record*, Oct. 26, 1922, p. 690, in which article curves are given, showing values of f, depending upon $\frac{dvs}{z}$ and of z, depending upon temperature.

Unwin, $p_1 - p_2 = \frac{0.1005\ f\ M^2\ L}{D^5\ m} = \frac{32}{\pi g} \times \frac{f\ M^2\ L}{D^5\ m}$, in which p_1 and p_2 = initial and final abs. pressures, lb. per sq.ft.; f = friction factor, depending upon the diameter; M = weight of air in lb. flowing per sec.; L = length in ft.; D = diam. in ft.; m = average density of compressed air in lb. per cu.ft. This formula is given in "Flow and Measurement of Air and Gases," by Alec. B. Eason (J. B. Lippincott Co., 1919). Mr. Eason gives a table of values of the factor f for diameters from ½ to 36 in., and also gives the formula $f = 0.0027\left(1 + \frac{0.3}{D}\right)$, where D is in feet.

Harris, $f = C\frac{L\ V^2}{d^5\ r}$, in which f = loss of pressure in lb. per sq.in.; L = length in ft.; V = cu.ft. per sec. of free air; d = diam. in in.; r = ratio of compression in atmospheres; and C = coefficient containing all constants. This formula is given in "Compressed Air," by Elmo G. Harris, 1917, p. 50, as a fairly approximate formula, not as an exact one, however. Prof. Harris finds that the coefficient C depends upon the diameter, as $\frac{0.1025}{d^{0.31}}$, hence the equation can be written $f = \frac{0.1025\ L\ V^2}{r\ d^{5.31}}$. Harris gives values of the coefficient for sizes up to 12 in., which could be developed further, but the computations do not require it if the latter form of the formula is used.

D'Arcy, $D = C\sqrt{\frac{d^5(p_1 - p_2)}{w_1\ L}}$, or, $p_1 - p_2 = \frac{D^2\ w_1\ L}{C^2\ d^5}$, in which D = cu.ft. per min. of compressed air at final pressure p_2; C = a coefficient depending upon diam.; p_1 and p_2 = intial and final abs. pressures, lb. per sq.in.; L = length in ft.; d = diam. in in.; w_1 = density of air in lb. per cu.ft., at initial pressure p_1. This formula is given in "Air Compression and Transmission," by H. J. Thorkelson, 1913, p. 173, and values of the coefficient C are given for 1- to 12-in. pipe. By plotting values of $\frac{\;}{C^2}$, as the coefficient is used, and smoothing up the curve a little, and extending it, values of C were obtained for the 16-, 48-, and 60-in. sizes, approximately, of course. The formula is also given in "Compressed Air Plant," by Robert Peele (John Wiley and Sons, 1913), p. 251, and in Kent, 1903 Ed., p. 489, as "a common formula for flow of air, gas, or steam in pipes," but is there given without any values of the coefficient C. Thorkelson makes no comment on the derivation of the formula. Peele specifies it as D'Arcy's formula.

Rix-Johnson, $p_1^2 - p_2^2 = \frac{0.0005\ V^2\ L}{d^5}$ in which p_1 and p_2 are initial and final abs. pressures, lb. per sq.in.; V = cu.ft. per min. free air; L = length in ft.; d = diam. in in. This formula is given in "Compressed Air Practice," by Frank Richards, 1913, p. 174, as Johnson's development of Church's formula, modified by Rix. Richards states that this formula gives results which are approximately correct in practice, and advises limiting the velocities of compressed air to 25 ft. per sec.

Sturtevant, $p = \frac{L\ v^2}{25{,}000\ d}$, in which p = pressure lost in oz. per sq.in.; L = length in ft.; v = velocity, ft. per sec.; d = diam. in in. This is the old Weisbach formula, revised, used by the B. F. Sturtevant Co. as a fan formula for ventilation work, etc.; it is given, as such, in Kent, 1903 Ed., p. 487, and in Prof. Thorkelson's book in a quotation from a lecture on ventilation by H. deB. Parsons. It was developed for ventilating work rather than for compressed air, and has no compression or temperature factors, except as introduced by the user in order to obtain the real velocities in the pipes.

The Fritzsche formula was developed from extensive tests in which the air velocity varied from 8.2 to 190 ft. per sec., temperature from 57 deg. F. to 239 deg. F., and pressure from 2.9 lb. per sq.in. absolute to 164 lb. per sq.in. absolute; but unfortunately the tests were made with small pipes only.

The Wilson & McAdams formula was developed for any fluid, from data on flow of air, steam, water, various oils, etc., under conditions where the diameter varied from capillary tubes to 36-in. pipes, velocity from 0.1 to 100 ft. per sec., density from 0.075 to 62.3 lb. per cu.ft., and viscosity from 0.02 to 3,000 times as viscous as water at 68 deg. F.

From the curves shown in the table for the values of f in Wilson & McAdams' article, it may be ascertained that for turbulent flow in cast-iron pipe the values of f conform closely to the formula $f = 0.0036 + 0.0063\sqrt{\frac{z}{dvs}}$, and from the curve for air viscosity the values of z change from 0.0207 at 150 deg. F., to 0.0158 at 60 deg. F., so that from the above equation the value of f would change but slightly with this viscosity difference, showing that, in the case of air, the element of viscosity has slight effect upon the loss of pressure, especially in the large pipe sizes.

Considering the question of varying the pipe diameters to get the same computed pressure loss by each of the seven formulas, in the case of the largest flow considered in the table below, the Fritzsche formula, for 0.100 lb. loss, requires 60-in. size; Wilson & McAdams would require 65-in. for cast-iron pipe, 61½-in. for copper pipe; Unwin, 59.6-in.; Harris, 56¾-in.; D'Arcy, 63-in.; Rix-Johnson, 65.6-in.; and Sturtevant, 64.6-in. at 60 deg. F., and 69-in. computed at 150 deg. F.

In view of the great cost of pumping air for large activated-sludge plants, it is important to save all of the loss of pressure possible, to make a proper balance between economy of construction and economy of operation. It has been estimated that for each 0.1 lb. per sq.in. of pressure saved, at the proposed plant of the Sanitary District of Chicago, a saving of about $3,000 per year in cost of power will result, which would

warrant considerable increase of size of piping to decrease the pressure loss.

Investigators can do considerable service in checking up pressure losses in large piping, within the range of pressures used in activated-sludge practice, with the view of establishing the correctness of the formulas, or proper variations due to roughness of pipe surface.

Declares Pennsylvania Licensing Law Unconstitutional

Violates State Constitution in Treating Two Subjects and Federal Constitution in Being Discriminatory

IN THE Court of Quarter Sessions of Monroe County, Pennsylvania, Judge Samuel E. Schull on July 2 rendered an opinion that the Pennsylvania state engineering licensing act was unconstitutional. The case came before the court as the interpretation of a special verdict rendered by a jury in the complaint against George E. Stevenson, of the long-established engineering firm of Stevenson & Knight, of Scranton, Pa., who was arrested in June, 1922, charged with practising the profession of land surveying in Pennsylvania without having first obtained a license as required by the act of the Pennsylvania Assembly of May 25, 1921, Public Laws 1131. The procedure in the case was that the jury was instructed to render a special verdict which returned the decision to the judge on the question of the constitutionality of the act. The judge declared the act unconstitutional on three grounds.

He said it was in violation of Article 3, Section 3 of the Constitution of Pennsylvania, which provides "No bill, except general appropriation bills, shall be passed containing more than one subject, which shall be clearly expressed in the title." In this case the act bears the title "An act to Regulate the Practice of Professions of Engineering and Land Surveying, etc." The judge said that in view of the article of the constitution of Pennsylvania quoted, the question now was whether the professions of engineering and land surveying are distinct and independent or cognate branches of one subject. In considering this he quoted the section of the act which includes in its control "any person practising or appearing to practise the profession of engineering or land surveying." Thus, according to the judge, in the very beginning of the act the two professions are recognized as separate and distinct and throughout the entire text they are so recognized and treated, the professional engineer and the land surveyor being defined separately. The judge said that under the provisions of the act a registered engineer may not practise as a land surveyor nor may a land surveyor practise engineering, thus again marking or recognizing the distinctiveness of the two professions. Further than this, the judge called attention to the fact that the avowed purpose of the act is "to safeguard life, health, and property," and said "The relation of engineering to this purpose is, of course, apparent, but how it is related to the dissemination of area of land, the establishment of boundary lines of land and the subdivision or plotting thereof is beyond our conception."

The judge further notes that even in the profession of engineering the act makes certain exceptions, particularly as to officers and employees of the government of the United States and of the State of Pennsylvania and the officers and employees of a corporation engaged in interstate commerce. Thus, said the decision, "the qualification of the engineers who plan our railroad projects is left to the discretion of the office of the railroad company employing them, while, on the other hand, a land surveyor who runs a line and figures the area of a town plot on which the public has not the right of entrance must submit his qualifications to the board of engineers and be subject to their caprice as to whether or not he may engage in that character of business." In view of these contentions the judge decides that the act violates the state's constitution on account of dealing with two professions and the fourteenth amendment of the federal constitution in that it is discriminatory in the exemption of certain classes.

Further than that the judge contends that the section of the act which states that it shall be unlawful for the commonwealth, or for any county, city, borough, town, township, school district, or poor district to engage in the construction of any public works involving engineering unless the plans, specifications and estimates have been approved by and the construction supervised by a registered professional engineer, is in effect an act regulating public works and has no business in an act relating to the regulation of engineering.

In view of these facts he held that the act was unconstitutional and therefore prosecution under it cannot be sustained and on the special verdict of the jury he found the defendant not guilty.

Railway Improvements Cost 1½ Billions

Railway expenditures for improvement work and new equipment during 1922 and 1923 will represent a total of $1,540,214,000 according to figures compiled by the Bureau of Railway Economics and submitted at a conference of the American Railway Association with the Interstate Commerce Commission. Of this great total, 60 per cent is for equipment and 40 per cent for improvement works. In the latter class, track expenditures are far in the lead with a total of $237,429,000; shops, enginehouses, machinery, stations and docks come next with nearly $123,000,000; bridges and tunnels, $70,458,000; freight yards and water and coaling stations, $46,764,400; grade reduction, line revision and grade crossing elimination amount to $42,204,400. The itemized figures are given in the accompanying table:

Track	$172,564,398
Heavier rails	44,032,531
Additional ballast	16,378,947
Roadway machinery and tools	4,453,200
Bridges, trestles and culverts	60,010,400
Tunnels, subways and viaducts	10,448,000
Shops, enginehouses, machinery and tools	70,997,120
Stations and office buildings	33,365,500
Storehouses, elevators, coal and ore docks	14,411,500
Wharves, docks and piers	4,093,300
Classification yards	25,517,500
Water stations	13,537,300
Coaling stations	7,709,600
Grade crossing elimination and protection	21,781,700
Grade and curve reduction	20,422,700
Signals and interlocking plants	14,193,400
Telephone and telegraph lines	5,701,600
Electric power plants and transmission lines	5,592,900
Purchase of land and buildings	10,778,500
Miscellaneous	61,203,116
Total improvements	$617,194,218
Locomotives	$238,615,936
Freight-train cars	593,201,891
Passenger-train cars	68,819,005
Other equipment	22,383,369
Total equipment	$923,020,201
Total improvements and equipment	$1,540,214,419

Depreciation; a Definition

By Charles Hansel
Consulting Engineer, New York City

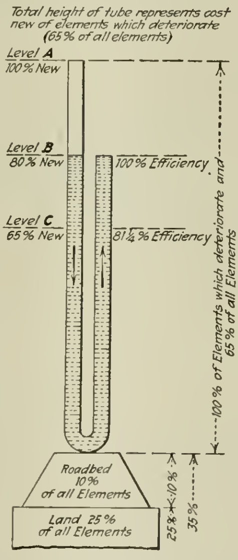
A *Composite Property* is one composed of two or more *simple properties* each of which can be replaced independently.

A *Simple Property* is one complete in itself—though in some cases possible of repair, which cannot be replaced practically by piecemeal but which should be replaced as a whole.

Depreciation as applied to a composite property, such as a transit company, is only that part of *deterioration* of the physical elements, if any, which has not been but which should have been restored seasonally or periodically in order to maintain an appropriate standard of operating efficiency.

Deterioration is the lessening of the useful life of a simple property due to impairment from any cause. It is subdivided into *permissible deterioration* and *depreciation*.

Permissible Deterioration or *Decretion* is that part of deterioration which has not been and which should not be made good because it has not reduced the property below an appropriate standard of operating condition.



The elements of the physical property of a traction property subject to deterioration are shown in the diagram attached, as in a state of flux, in a "U"-shaped tube, open at both ends, resting on the non-depreciable elements.

The solid portion of the tube shows the elements which deteriorate, kept at 100 per cent efficiency. The left leg above level *B* represents appropriate "*deterioration*." To keep a level of 100 per cent operating efficiency above 80 per cent of new would be economic waste; for, as illustrated by the right leg of the tube, the putting in of elements (money) at *A* will, so long as the level *B* is maintained, result in wasting at the level *B* without increasing operating efficiency. The deterioration from level *A* to level *B* should not be recouped by appropriate maintenance, but should be included in Rate Base.

Level *B* (20 per cent below level *A* or 80 per cent new of the elements which deteriorate) is the constant average condition above which it would be economic waste to attempt to maintain. It is the level of 100 per cent efficiency and stable condition. Unless this level is permanently lowered, no deduction should be made from condition new in fixing the amount upon which the owner should receive a reasonable return.

Level *C* is shown 35 per cent below condition new or 65 per cent new of the elements which deteriorate. This level *C* may properly be temporarily reached during the cycle of seasonal or periodical periods and does not necessarily indicate insufficient maintenance. If, however, this level is not seasonally or periodically raised to *B*, then the operating efficiency falls.

If level *C* is allowed permanently to remain, the owner having received in payment for service a sum sufficient (1) to give him a reasonable return on the value new, (2) to maintain the property at 100 per cent efficiency—i.e., level *B*; then, the owner should, at his own expense, bring the property back to level *B* and this cost should not be included in the Rate Base.

In using 80 per cent of new as the level of 100 per cent operating efficiency for the purpose of illustration, it should be understood that this per cent varies according to the requirements of operation. Some properties may be above and some below 80 per cent of new and yet be in 100 per cent operating condition for the service required.

Sacramento Paid for One-Third Weight-Gain of Garbage-Fed Hogs

Pending the construction of an incinerator, the city-collected and delivered garbage of Sacramento is being fed to hogs on a 10-acre city-leased tract, 2½ miles from Sacramento, by a contractor who pays the city for one-third the net-weight gain of the hogs while they are being fed on garbage.

The wagons dump the garbage on the feeding ground, where it is spread out for the hogs by one or two attendants. Combustible residue is burned from time to time. The contractor must put the land in shape after hog feeding is abandoned. H. C. Bottorff, city manager of Sacramento, states that in June of this year about 700 hogs were being fed and that the city was receiving an average of some $450 a month as its share of the net weight-gain of the hogs. The hogs are weighed in and out, and monthly payments to the city are based on the public weighmaster's slips. This feeding plan was practiced about six weeks in the fall of 1922 but was stopped temporarily when wet weather made the road to the hog farm impassable. Feeding was resumed April 15 and will be continued until this fall, when it is expected that a new incinerator will be in operation. The amount of garbage ranges from some 60 tons in winter to 80 in summer. The population of Sacramento was 65,908 in 1920 and 44,696 in 1910.

Despite the fact that hog feeding is believed to be the most profitable form of garbage disposal, Sacramento city officials believe that it would be impracticable to continue this method of disposal long in view of the rapid settling up of territory adjacent to the city, which would make the operation of a hog farm objectionable at any point within economical hauling distance.

Appeal to Builders to Buy Out of Season

Franklin D. Roosevelt, chairman of the American Construction Council, has appealed to the building construction industry to buy as much material off season as possible, so that the railroads will not be swamped with building materials during the early part of the building period each year. He called attention to the practice of the American Radiator Co. of offering special discounts for deliveries made during off months, and recommends that this policy be followed by other concerns.

Tests of Five Models of Draft Tubes for Turbines

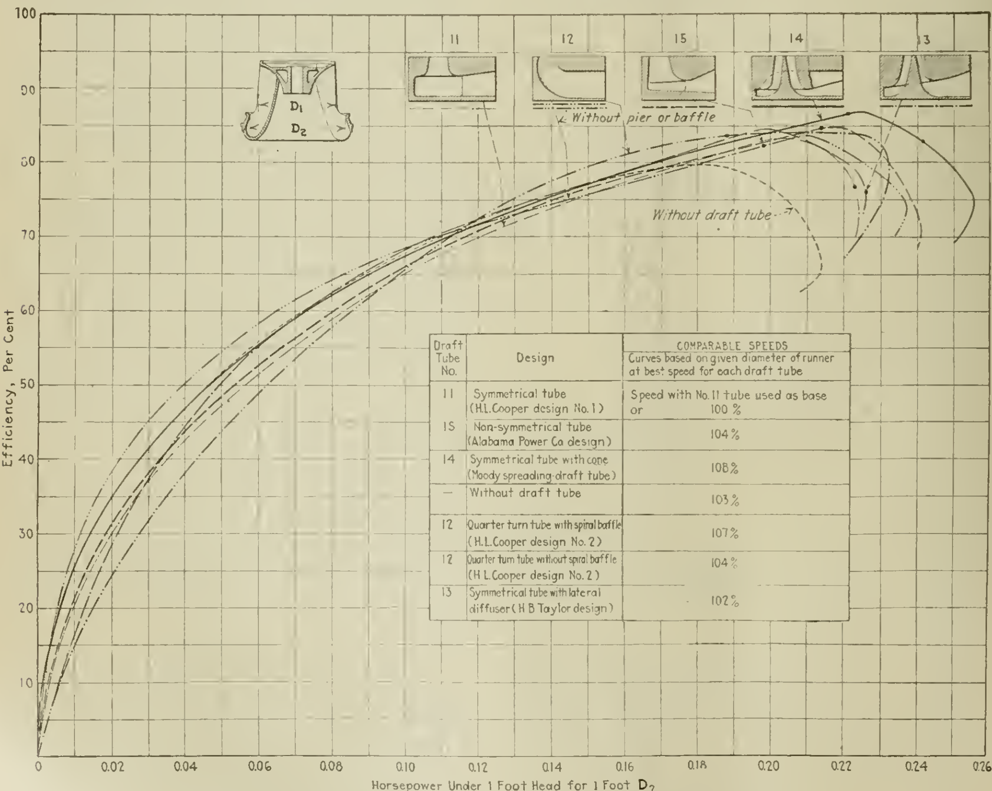
Made with Turbine and Tubes Geometrically Similar to Full-Sized Ones—New Symmetrical Type Superior to Older Forms

ONLY within recent years has it been realized that the setting of water wheels is almost as important as the design of the wheel itself in obtaining a maximum efficiency over a wide range of loads. In 1900 the largest wheel installed was of 5,000 hp. capacity and had an efficiency of about 63 per cent at 50 per cent of its rated power and an efficiency of 80 per cent at 100 per cent of its rated power, with the efficiency curve inclining sharply upward, indicating that the maximum would be obtained at considerably above the rated capacity of the machine, a point where the turbine was not intended to operate. Since that time improvements in the design of the runner as well as in the method of setting the wheels have made such strides that the efficiency of the 37,500-hp. unit installed by the Niagara Falls Power Company in 1919 and 1920 was 90 per cent at about 50 per cent of the full load, and also at the full load, and obtained a maximum efficiency of 93 per cent between 70 and 85 per cent of the rated load.

The straight-type draft tube was one of the developments which took place during the study of the turbine setting, but it was soon found that the cost of excavation necessary for such draft tubes was excessive. This led to the adoption of a bent type of tube. These bent tubes materially reduced the cost of installation, but were found to be seriously defective when efficiency was considered. In view of this fact and the fact that a gain of only a fraction of one per cent in efficiency of the output of the great modern turbines gives a large increase in output for a given amount of water, a great deal of careful study has recently been given to the development of symmetrical types of draft tubes that would regain both the axial and tangential components of the flow, and do so without excessive excavation cost.

The tests are reported in detail as follows in *Power*:

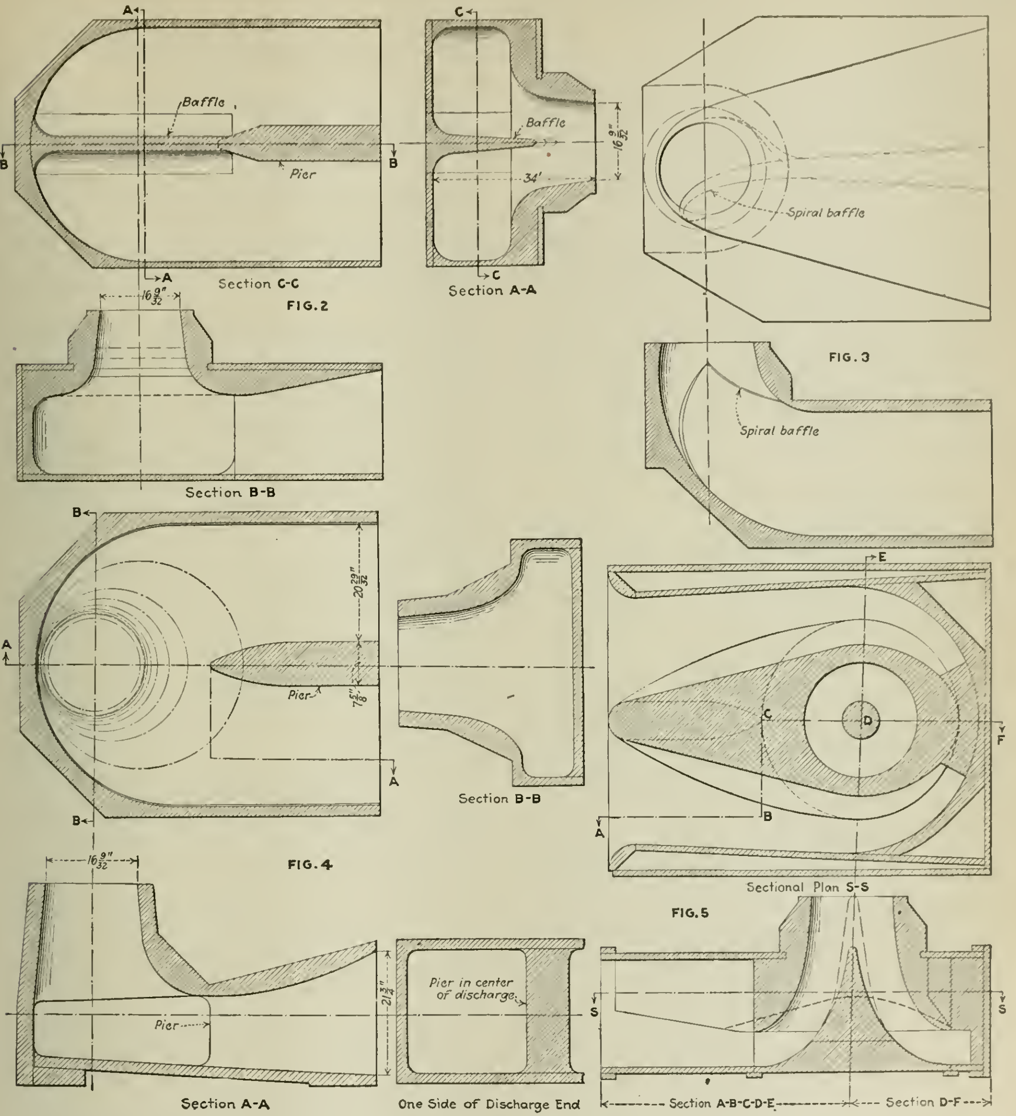
One of the symmetrical types is the hydraucone regainer developed by William M. White, manager, Hydraulic Department, Allis-Chalmers Co. Another type is the so-called spreading draft tube developed by Lewis F. Moody, consulting engineer, I. P. Morris Department, William Cramp & Sons Ship and Engine Building Co. In the latter the water passage is an annular space between an outer flar-



Draft Tube No.	Design	COMPARABLE SPEEDS Curves based on given diameter of runner at best speed for each draft tube
11	Symmetrical tube (H.L.Cooper design No.1)	Speed with No. 11 tube used as base or 100 %
15	Non-symmetrical tube (Alabama Power Co. design)	104 %
14	Symmetrical tube with cone (Moody spreading-draft tube)	108 %
—	Without draft tube	103 %
12	Quarter turn tube with spiral baffle (H.L.Cooper design No. 2)	107 %
12	Quarter turn tube without spiral baffle (H.L.Cooper design No. 2)	104 %
13	Symmetrical tube with lateral diffuser (H.B.Taylor design)	102 %

FIG. 1—RELATION BETWEEN EFFICIENCY AND HORSEPOWER OUTFIT

These curves represent the complete turbine under a given head at whatever speed is secured under the best conditions with each draft tube. They were approved and signed by H. Birchard Taylor, vice-president, Cramp Co.; Hugh L. Cooper; and Maj. Gen. Lansing H. Beach, Chief of Engineers, U. S. Army. The cross-section of the runner shown on this figure is not the Muscle Shoals, but has about the same specified speed and indicates the D_2 dimension.



FIGS. 2 TO 5—FOUR OF THE DIFFERENT TYPES OF DRAFT TUBES TESTED

Fig. 2—Sections through a symmetrical type of tube indicated as No. 11 on the curves. Fig. 3—Sections of a bent draft tube with a spiral baffle shown as No. 12 on the curves. Fig. 4—Sections through new type of bent draft tube and shown as No. 15 on the curves. Fig. 5—Sections through spreading type of draft tube indicated as No. 14.

ing wall and an inner core, in which the axial components of flow are gradually turned in the radial direction and at the same time are continuously reduced in magnitude.

When the designs were laid down for the government hydro-electric development at Muscle Shoals, a draft tube of the Moody spreading type was adopted from this particular installation by Hugh L. Cooper & Co., consulting engineers on this project. This type at that time was shown by tests on models to be the most economical from both an engineering and a financial viewpoint. Since then the development in draft-tube design has brought out other types that merited consideration, since under test for certain conditions they apparently showed the possibilities of a reduction in cost of construction sufficient to offset the difference in efficiency, as compared with the type adopted for the first four units to be installed at Muscle Shoals. This led to a series of tests being ordered by Maj. Gen. Lansing H. Beach, Chief of Engineers, U. S. Army, to be conducted on various types of draft tubes in the I. P. Morris laboratory for the War Department, under the supervision of Hugh L. Cooper & Co., consulting engineers. The purpose of the test was to secure a comparison of performance between types of bent tubes of simple design and comparatively easy and cheap to construct and some of the more

recent types which are highly efficient but involve expensive reinforced-concrete construction.

Model of High Specific-Speed Runner Tested—Tests were made of a model of a complete turbine equipped with a high specific-speed runner of the usual mixed flow, or so-called Francis type, similar to the 35,600-hp. units to be installed at Muscle Shoals, and with draft tubes geometrically similar to those that would be used in this installation. All parts of the turbine, testing flume and testing equipment remained the same in each test with the single exception of the type of draft tube provided, and each tube was designed to come within the same space restrictions. Tubes of five types were tested. These are shown on the curve sheet, Fig. 1, and in Figs. 2 to 5. No attempt was made to prove that one type was more efficient than another except for the condition in question.

Fig. 2 shows sections through a symmetrical type of tube indicated at No. 11 on the curve. As indicated by section *AA*, this tube had a vertical baffle that extended well up into the neck of the tube, otherwise the construction was similar to a short conical type with a vertical pier in the center of the horizontal discharge section. As might be expected, this tube showed up poorly in efficiency, probably owing to the short length of the tube and the baffle directly under the discharge from the turbine, causing turbulence which prevented the water from flowing readily from the tube.

COMPARABLE SPEEDS—FROM CURVES BASED ON THE SAME MAXIMUM CAPACITY OF TURBINE

Draft Tube No.	Design	Speed With No. 11 Tube as Base or 100 per Cent
11	Symmetrical tube (H. L. Cooper design No. 1)	100 per cent
15	Non-symmetrical tube (Alabama Power Co. design)	108 per cent
14	Symmetrical tube with cone (Moody spreading-draft tube)	115 per cent
—	Without draft tube	101 per cent
12	Quarter-turn tube with spiral baffle (H. L. Cooper design No. 2)	109 per cent
12	Quarter-turn tube without spiral baffle (H. L. Cooper design No. 2)	107 per-cent
13	Symmetrical tube with lateral diffuser (H. B. Taylor design)	103 per cent

In Fig. 3 are given sections of a bent tube with a baffle in it. This baffle might be considered as an extension of the vertical pier in the horizontal section of the tube, which is given a 90-deg. turn as it approaches the bottom of the turbine's casing and extends up to within about three inches of the runner. At this point it is reduced to a thin edge at right angles to the pier in the horizontal section of the tube. This type of tube with its 90-deg. spiral baffle showed considerably better results than design No. 11, between 50 per cent load and normal rated power of the turbine. However, below 50 per cent load the efficiency fell off rapidly and showed a lower efficiency at light loads than any of the other types tested. Tests were made on this tube with the spiral baffle and the pier removed, which made the tube similar to the ordinary bent type. Under this condition from about 60 per cent full load to normal rated capacity the efficiency is lower than with the baffle. Below 60 per cent load the efficiency holds up better than with the baffles and from 50 per cent load down shows a better efficiency than any of the other types tested.

Design No. 15 is of a type similar to that developed for the Mitchell Dam project of the Alabama Power Co. and is shown in section in Fig. 4. The curve of this type falls in an intermediate position in regard to those of the other types. Although in these tests this tube shows a lower turbine efficiency by about 2 per cent than model No. 14, which is the Moody spreading type, on a prior test made at Worcester, Mass., on a tube of a design similar to No. 15, and under conditions similar to those at Mitchell Dam the difference in efficiency was not so great. In fact, the results of the Worcester tests led to Hugh L. Cooper & Co.'s carrying on the tests at the direction of the War Department to make sure that the advance in draft-tube design had not produced a type more economical than that available at the time the Muscle Shoals project was first decided upon.

Two sectional views of a model of the type of spreading tubes to be used at Muscle Shoals are shown in Fig. 5. Between 40 per cent and 100 per cent load, or throughout the usual operating range, this tube shows better turbine efficiency, does this with the turbine operating at a higher speed, and the turbine develops from 6 to 14 per cent more power than with any of the other types.

A test was also made on a model tube having a lateral diffuser as shown at 13, Fig. 1. This arrangement gave an efficiency inferior to some of the other models. Each curve represents the run secured under the best conditions for that tube.

Referring to Fig. 1, the curves represent the relation between the total efficiency and the horsepower output of the complete turbine under a given head at whatever speed is secured under the best conditions with each draft tube. The curve shown in dotted lines represents the performance of the turbine without any draft tube. In this test the runner discharge passed into a wide chamber, the discharge from this chamber being submerged below the tailwater surface so that there was no loss of static head on the turbine. The difference in turbine efficiency of 7 per cent and over 19 per cent in power capacity shows clearly the effects of equipping the turbine with an efficient type of draft tube.

The curves show that with a turbine designed for a suitable power output and a suitable speed, the spreading draft tube would exceed the others not only with respect to peak efficiency, but also for efficiencies at powers throughout the ordinary operating range; namely, from 40 to 99 per cent of the rated full load.

It might be mentioned that draft tube No. 14 was tested both with a high cone, as indicated on the curve, and with a somewhat lower cone, and the comparison resulted in favor of the high cone, although the difference was not great in this case. The advantage, however, of the higher cone in most installations is that it results in higher efficiency and also produces quieter and steadier conditions of flow. In the ordinary types of draft tube the center is occupied by turbulent water not partaking of the general stream-line flow, and under extreme conditions there may be a cavity filled with air or vapor at this point, a condition which is removed by filling this region with a solid core. This arrangement not only eliminates certain internal conditions, but also, through the removal of inertia effects in the center of the draft tube, prevents them from being transmitted to the penstock, which in some installations has resulted in water hammer or surging involving pressure rises as high as 25 to 35 lb. per sq.in. The 70,000-hp. units being built for the Niagara Falls Power Co. will be equipped with draft tubes with the cone extending to the runner. The same remark applies to the new 58,000-hp. unit No. 6 for the Queenston station of the Hydro-Electric Power Commission of Ontario. The use of a cone even of moderate height in the draft tube has shown a marked effect in producing steady conditions and in preventing inertia effects, and apparently the logical procedure is to run the cone to the runner.

These tests represent a contribution to a phase of turbine design which in the past has been neglected. When we consider the effort that has been expended on the part of the hydro-electric industry to secure increases in turbine efficiencies of fractions of one per cent by improvements in runner design, it is manifest that improvement in the efficiency of the turbine as a whole by improving the draft tube is equally important. The draft tube of a turbine must be designed to take care of a complex condition of flow, and each installation requires special treatment and study, and it cannot be said that results arrived at in one condition are applicable to another without giving the particular flow involved in the draft tube due consideration.

Waltham Reservoir Waterproofed by a New Lining

Disintegration of the Reinforced Concrete Due to Seepage and Frost Action Makes More Waterproofing Necessary

By M. W. Fisher
Engineer, The Texas Co., Asphalt Sales Department, New York City

IN SPITE of the elaborate precautions taken at the time of construction to make the concrete in the Waltham, Mass., reservoir watertight, both by careful proportioning and the addition of integral waterproofing compounds, it has since developed so much seepage that it has been necessary to resort to additional waterproofing to save the structure from disintegration due to frost action. This has been successfully accomplished by relining the sides of the reservoir.

The standpipe was built in 1906. (*Engineering Record*, Jan. 12, 1907, p. 32.) It is 100 ft. in diameter, 43 ft. high, and has a capacity of 2,000,000 gal. The side walls are of reinforced concrete 18 in. thick at the bottom, rising with a constantly battered outside face to a 12-in. thickness at the top. The concrete was carefully proportioned to obtain the best mechanical mixture for the filling of the voids, and hydrated lime in the proportion of five per cent of the weight of cement was added to it. The first 10 ft. of the inside wall was plastered with mortar containing an integral waterproofing compound, and the remainder received at least two brush coats of a similar mixture. (*Engineering News*, Sept. 19, 1907, p. 310.)

In 1914, an ill-advised attempt was made at waterproofing by the application of a coat of pitch to the inside wall. This amounted to very little and another attempt was made shortly afterward by the application of cement, using a cement gun, on the outside. Neither of these methods proved satisfactory, the seepage continued and successive frost action caused several large areas of the outside wall to disintegrate, the surface breaking in several places to such an extent that the reinforcing rods were exposed.

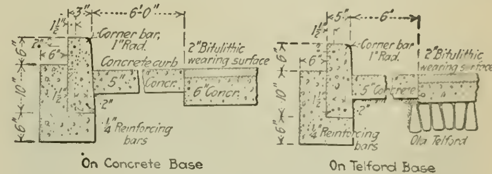
During the summer of 1922 it was decided to reline the reservoir. After the contract for the waterproofing had been let and all details arranged, the standpipe was emptied and the inside wall thoroughly cleaned and dried, a number of salamanders being used to hasten the drying. When the walls were thoroughly dried, the waterproofing was started. It consisted, first, of a mop coat of Texaco No. 56 waterproofing material applied hot to the inside face of the wall. Immediately over this was applied a coat of waterproofing felt, the surface of the same being mopped with another coat of Texaco No. 56 waterproofing asphalt. This operation was repeated for five layers, the outside layer, however, being of six-ounce saturated duck fabric, and the outside surface of this finally mopped with the waterproofing asphalt. Immediately following this, a 4-in. brick facing was constructed from the floor to the top of the wall, great care being taken to obtain a one-half-inch mortar course between the outside asphalt course and the inside face of the brick work. All of this work was started at the bottom and built up for the entire inside circumference of the wall in 6-ft. sections.

The work was started Nov. 20 in spite of the inclement weather and was completed and the reservoir refilled on Dec. 23. As the stagings on the side of the wall were taken down, the whole inside face of the brickwork was thoroughly cleaned by washing.

Simpson Brothers of Boston were the general contractors on the work, W. A. Murtfeldt Co. of Boston, sub-contractor on the waterproofing, and M. F. Stankard of Waltham, sub-contractor on the brick work. The engineer's estimate on the whole of this work was $16,500, while the low bid of the contractor was $16,543.

Concrete Parking Strips on Asphalt Streets

CONCRETE side strips on widened gutters are being employed at St. Louis, Mo., in pavement reconstruction on streets where asphalt or other bituminous surfacing is adopted. These strips are 6 ft. wide and permit an automobile to be parked parallel to the curb and entirely clear of the bituminous roadway. It has been found on asphalt streets that the parts next to the curbs, due to the hindrance of parked cars, do not get the traffic needed to keep them ironed down in the best



CONCRETE PARKING STRIPS FOR BITUMINOUS PAVEMENT

condition. Also the traffic traveling a narrow center lane intensifies the danger of rutting and shoving. With the concrete parking strips, the full width of asphalt is clear for traffic and the distribution of traffic is reasonably uniform. Standing water is kept pretty well off the bituminous surface. The construction of the side strips corresponds closely to the regular city requirements for concrete curb and gutter.

The design is shown by the illustrations from an improvement on Russell Ave. A detail to be noticed is the use, where it was a part of the old pavement, of the Telford base as a sub-base for the new pavement. By carefully cleaning the surface of the old Telford a very satisfactory bond of the new concrete base and the stone sub-base is secured. W. W. Horner is engineer of the Board of Public Service of St. Louis.

Accelerations in Airplane Maneuvering

Measurements of the accelerations of an airplane in various complex maneuvers, recently made at Langley Field by F. H. Norton and T. Carroll for the National Advisory Committee for Aeronautics, are summarized in Report 163 of the committee. The plane used was of SE5A type; a three-component accelerometer and a recording air-speed meter were used. The maneuvers were a loop, a spin, a roll, a right and left wing-over turn, a side slip and a skid. The maximum normal acceleration (vertical for plane in usual position) was 3.80 times the acceleration of gravity, and occurred in a loop. The greatest lateral accelerations occurred in a spin and a side slip, reaching 0.35 and 0.40 times the acceleration of gravity respectively. The greatest longitudinal accelerations were 0.50 in a loop and a roll, and 0.60 in a wing-over.

Earth Moving Methods and Costs, Bronx Parkway

Record of Dragline, Steam Shovel and Heavy Tractor Operations Covering Four Years of Miscellaneous Earth Moving

By Gilmore D. Clarke
Superintendent of Construction, Bronx Parkway Commission, New York

APPROXIMATELY 1,500,000 cu.yd. of earth moving, with a variety of machines, has been accomplished largely during the last four years in building the Bronx River Parkway north from New York City. Construction by force account made close cost records possible and the variety of operations and the special character of the work give these records exceptional interest. They represent a quite different situation than exists in normal drainage ditching and railway grading operations.

The lands in the Bronx River valley were acquired by the Bronx Parkway Commission, first for the purpose

WALKING DRAGLINE WIDENING RIVER CHANNEL INTO A LAKE

of preventing the pollution of the Bronx River, which before public ownership was virtually an open sewer, and second as the route for a parkway connecting the New York city park system with the watershed lands in upper Westchester County. The reservation is approximately 16 miles long and varies in width from 200 to 1,200 ft., terminating at the Kensico Dam. Work was begun in 1916 and continued until the war, little being accomplished during 1918. Operations were resumed in the summer of 1919 and during 1920, 1921 and 1922, general grading work was brought very nearly to completion.

Outline of Operations—The engineer's studies showed that it was necessary to lower the water level of the river throughout a greater part of its length in order to build a drive which would require a minimum amount of fill to bring it at all times of the year above flood level. To obtain enough material to bring the driveway to subgrade, and to grade adjacent areas to conform to proper landscape treatment, it became necessary in places to build lakes by means of which a large amount of fill was obtained. Most of the material for the drive and adjacent grading was taken from river and lake excavation and inasmuch as wet material was to be handled, machinery adapted for that particular kind of work was obtained. Conditions in the valley were at most times unfavorable for the type of machinery used by contractors in this part of the country and after canvassing the situation thoroughly it was decided that the work could be most economically prosecuted by force account.

The parkway parallels a line of the New York Central R.R. and in many places the river is close to the railroad embankment. Where this was the case the river was moved away to permit trees and shrubs to be planted to screen out the railroad right-of-way. The old river varied in width up to 30 ft.; the new channel was made 40-ft. wide at the lower end, narrowing to about 20 ft. toward the upper end near the Kensico Dam.

Dragline Performance—In 1917 a walking dragline excavator was purchased. This machine was adapted for excavation from below water level and was capable of standing upon rather soft marshy ground. It was equipped with a 40-ft. boom, a 1-cu.yd. bucket, a 45-hp. gasoline engine and a device for "walking" which it was believed would make it possible to work where no other excavating machine could work. It had a circular base about 12 ft. in diameter and when ready to move, two large pads, one on each side, were lowered to the ground and by means of revolving cams the machine was raised, took a step of about 4 ft., and assumed working position again. This outfit had its limitations, however. The gasoline engine caused constant vibration and when standing upon soft ground, the machine gradu-

TABLE I—RECORD OF DRAGLINE EXCAVATION, BRONX PARKWAY

Year	Cubic Yards Excavated, Rehandled, or Loaded													Total Cost	Unit Cost
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total		
							Walking 1 Cu.Yd.								
1917	Total for year											71,717	71,717	$11,967.00	......
1918	Total for year											44,657	44,657	7,659.00	......
1919	1,170	4,500	3,938	6,391	7,875	3,870	6,367	6,840	6,926	10,584	4,946	2,183	65,590	10,836.82	......
1920				5,792	10,220	10,305	9,054	9,923	9,936	2,474		2,026	59,730	19,103.29	......
1921	4,368	1,468	6,913	5,151	7,166	5,889	939	7,567	7,137	3,834	6,057		56,489	11,959.46	......
1922	973		3,169	5,012	2,277	2,423	2,433	2,926					19,213	5,969.19	......
													317,397	$67,494.76	$0.212
							Walking 2 Cu.Yd.								
1920					6,255	21,710	27,227	23,566	22,462	22,594	13,821	10,957	148,592	22,309.29	......
1921	2,250		11,943	4,414	14,583	9,932	10,052	13,437	20,590	14,513	11,498	10,485	123,697	19,020.48	......
1922			7,985	8,955	12,534	13,590	4,725	10,935	12,875	14,895	8,910	6,930	102,334	17,057.30	......
													374,623	58,387.07	$0.155
							Traction ¾ Cu.Yd.								
1920											2,085	7,222	9,307	1,521.75	......
1921	3,187			7,738	912	7,879	7,003	13,066	6,600	5,819	5,962	4,940	63,106	11,154.43	......
1922			5,026	8,564	7,526	4,953	6,972	11,221	9,408	9,542	7,678	4,991	75,881	10,738.20	......
													148,294	$23,414.38	$0 157
							Traction ¾ Cu.Yd.								
1921	1,549	1,307	2,943	4,242	3,749	5,157	6,582	6,657	5,154	5,397	3,282	6,726	52,745	12,365.99	......
1922	3,565			4,221	2,927	3,566	3,172	5,914	6,327	1,704	371	405	32,172	10,115.12	......
													84,917	$22,481.11	$0.264
Totals	17,062	7,275	41,917	60,480	76,024	89,274	84,526	112,052	107,415	91,356	64,610	173,236	925,227	$171,777.32	$0.185

DRAGLINE ON CRAWLER TRACTIONS DEEPENING RIVER

ally worked itself into the mud, and if operated in such a position the weight of the bucket and load often caused one side to settle. When this occurred, the cams were brought too low to engage the pads and the machine was unable to "step." Then quantities of brush or heavy plank were used on the soft places to provide a bearing.

Excellent service was given by this dragline, it having excavated, rehandled, and loaded in five years (Table I) 317,397 cu.yd. at a cost of $67,494.76, or a cost per cubic yard of $0.21. This included the cost of the machine, fuel, oil, repairs, overhauling, operators, and two helpers necessary for each shift. When one considers that there is from one to three months' shut-down in winter; that, during the spring, work proceeds slowly on account of the condition of the ground, and further the unavoidable delay of loading teams through a hopper, this cost seems very favorable. The given yardage is computed from the bucket loads, not from yardage in place.

Early in 1920 a larger walking dragline was purchased as one of the sections to be developed in New York City and which the commission desired to complete in one year, required that approximately 140,000 cu.yd. of material be moved. Also there were no trees in the section to interfere with the operation of a large machine. The specifications were: Weight, 80 tons; boom length, 60 ft.; power, one 70-hp. Charter engine, single horizontal cylinder; fuel, kerosene; traction, the same as for the small dragline previously described, and bucket, 2 cu.yd. This machine was placed on two eight-hour shifts and in eight months during 1920 it excavated and rehandled 149,562 cu.yd., which cost $20,105.56, or $0.135 per cubic yard.

Steam Shovel Operation—Until the fall of 1919 no shovels for loading had been purchased and the dragline loaded teams through a hopper. This process was uneconomical; it was difficult to move the hopper and the output of the dragline was cut down due to the delay of the teams. It was also found impossible to load wet material excavated directly from river and lake and placed into the hopper and the dragline therefore rehandled material previously excavated and spoiled in piles, this material having had a chance to dry.

Realizing the necessity of a more economical means for loading teams, a revolving shovel, equipped with a ¾-cu.yd. bucket and with caterpillar traction, was purchased. This machine worked three years and during the time loaded 155,661 cu.yd. for a total cost of $36,370.13, or $0.233 per cubic yard. This machine has also been used in the construction of dry rubble retaining walls and when engaged on such work the shovel boom was removed and replaced with a 30-ft. lattice boom.

Supplementing the work of the 2-cu.yd. walking dragline were two revolving shovels with ⅞-cu.yd. buckets, used to load teams or trailers drawn by tractors, for the final placement of the excavated material. These shovels, together with another shovel of a similar type and two small draglines, were received from the Bureau of Public Roads, being engineer equipment declared surplus by the War Department in 1919 and made available to the states for road construction work.

During a period of 7 months in 1920 the two shovels, working with the 2-cu.yd. dragline, loaded 93,761 cu.yd. of material from spoil piles made by dragline. The total cost of operation, depreciation, fuel, etc. was $14,497.27, the cost per cubic yard to load being $0.154.

Tractor Haulage Operations—As operations moved north through the reservation, hauls became longer, much too long to use teams economically. Motor trucks could not be used on account of the soft ground and the nature of the material to he hauled. In some places the best kind of sand and gravel for road fill were found

TRACTOR TRAINS HAULING SPOIL TO FILLS

and in other places a heavy blue clay, which when compacted was impervious to water. This clay was used to build the long flat slopes from the driveway to meet the existing grade, and the sand was saved for road fill.

The long-haul problem was solved when in the spring of 1920, eight 10-ton artillery tractors were received from the government. These machines were new and were placed in service immediately. Fifteen 1½-cu.yd. bottom-dump wagons were arranged into five trains of three wagons each and each wagon was loaded to full capacity and hauled by tractor. These tractors are ordinarily capable of hauling four trailers, but due to the heavy drag through wet clay three were all the tractors could haul economically. The following year, 1921, when hauling conditions were more favorable due to better ground, four trailers were used.

During two seasons' work seven 10-ton tractors hauled a total of 130,573 cu.yd., the total cost of operation being $46,456.12 and the cost per yard $0.355. The operating cost includes winter overhauling, a total expenditure

for parts and supplies of $8,523.86 and overhead charges of eight per cent. Seven tractors travelled a total of 13,771 miles and required a total of 42,380 gal. of gasoline, giving a total of 3.07 miles per gallon of gasoline. The average cost of gasoline over two seasons was $0.246. The cost per mile to operate the tractors was $3.37. Spare parts and supplies made up about one-sixth of the operating cost.

The high cost of spare parts was due partly to the fact that the workmanship and materials on war made machines were inferior to those in the product on the market today, and due also to the high prices charged for spare parts. The tractors were subjected to hard usage, however, and hauled material through soft clay where no other vehicle could operate. Teams would have been out of the question in places where tractors operated successfully. In places where the ground was particularly soft, limbs of trees were placed across the tractor as a sort of corduroy, thus enabling the machines to keep on the surface and providing better traction. Often when the trailers sank deep into the mud it became necessary to uncouple the tractor and have it pull the trailers out by means of a cable 30 ft. or more in length. By this means, the tractor was often able to pull on ground giving better traction and was prevented from grinding itself deeper into the mud. For long hauls, those over ¼ mile, the tractor has proven the most economical method for hauling large quantities to fill.

Small Dragline Performance—The two steam draglines which were received from the government were equipped with 45-ft. booms and ¾-cu.yd. buckets and were suitable for the work of widening and deepening the river channel, stripping topsoil, and lake excavation. These machines have small cabs and are more suitable for work around trees where working space is limited.

Due to the swampy nature of the ground over which one of these machines was required to travel a set of six pontoons was built, each being 4 ft. 8 in. x 6 ft., of 3 x 8-in. oak plank spiked together and having a cable loop in the center to make handling easy. With these pontoons these draglines were capable of excavating through soft undrained swamp where it was thought no excavating machine could travel until the swamp was drained. These two draglines have excavated and rehandled a total of 233,211 cu.yd. in two years at a total cost of $45,895.49, the unit cost being $0.196.

General Summary—In a period of six years over 1,500,000 cu.yd. of material were excavated, rehandled, or loaded, in the construction work on the Bronx Parkway Reservation. The tables herewith show the number of cubic yards each machine handled, the total cost, and the unit cost. It will be noted that the average unit cost for shovel and dragline excavation is the same, 18½c.

The yardage does not represent the number of cubic yards measured in place, but a count of buckets of each machine given daily by each operator who was supplied with a counter for the purpose. The total yardage thus obtained was reduced by 10 per cent, the result being accurate enough for purposes of comparing the performance of one machine with another.

In considering the unit costs it should be kept in mind that in landscape development a certain amount of fussy work is necessary which adds materially to the cost. It is necessary to strip topsoil before cuts and fills are made and pile it in storage piles to be saved for replacement after subgrading work is done. Shallow cuts and fills are necessary and trees must be preserved.

The reader must take these facts into consideration before comparing the costs presented herewith with the costs for drainage ditch work, railroad cuts and fills and other heavy grading of a similar nature. Naturally the costs on these projects of a purely engineering nature are considerably lower. Altogether, however, the results show that the commission was amply justified in its decision to accomplish the large amount of grading work by force account rather than by contract.

The Bronx Parkway Commission consists of Madison Grant, W. W. Niles and Frank H. Bethell. Jay Downer is chief engineer and L. G. Holleran the deputy chief engineer.

TABLE II—RECORD OF STEAM SHOVEL EXCAVATION, BRONX PARKWAY

Year	Cubic Yards Excavated and Loaded													Total Cost	Unit Cost
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total		
							[illegible]-Cu.Yd. Shovel								
1919										2,084	5,003	1,058	8,145	$3,325.25	
1920	561				620	11,477	7,017	7,731	11,573	9,986	5,581	4,948	59,494	$11,392.06	
1921	5,655			1,965	1,738	8,164	6,471	7,211	5,059	6,702	6,653	5,516	55,134	11,810.61	
1922			1,788	2,378	1,976	3,153	7,758	8,243	5,950	1,642			32,888	9,842 21	
													155,661	$36,370.13	$0.233
							[illegible]-Cu.Yd. Shovel								
1920						1,551	3,066	8,036	7,735	6,908	10,489	9,950	47,735	7,200.14	
1921	5,723			2,392	3,524	3,516	4,055	4,587	5,239	6,971	4,764	1,382	42,153	12,401.04	
1922			499	3,157	3,760	5,420	4,494	9,596	4,479	6,096	12,827	4,182	54,510	8,120.93	
													144,398	$27,722.11	$0.192
							[illegible]-Cu.Yd. Shovel								
1920						1,897	7,430	5,836	4,846	11,936	7,863	6,218	46,026	7,297.13	
1921	8,147		258	1,269	4,964	10,417	4,452	6,977	6,412	7,581	6,227	5,961	62,665	10,945.66	
1922	5,789	786	2,169	5,910	10,122	857	6,149	4,587	8,362	9,273	11,801	6,545	72,350	8,448.97	
													181,041	$26,691.76	$0.147
							[illegible]-Cu. Yd. Shovel								
1920														780.38	
1921					2,332	10,912	7,961	10,577	6,179	4,454	10,287	8,324	61,026	7,994.37	
1922	2,545	197		5,591	7,759	5,000	2,865	3,839	8,496	4,107	4,319	2,869	47,587	10,560.94	
													108,613	$19,335.69	$0.177
							All Shovels								
Totals	28,420	983	4,714	22,662	36,795	62,364	61,718	77,220	74,330	77,740	85,814	56,953	589,713	$110,119.69	$0.186

Forestry on New England Water-Works Lands

Reforestation of lands owned to protect public water supplies in five of the six New England states (Rhode Island not included) covers 12,220 acres and 15,261 acres more are available for planting. The total area of water-works lands owned by the eighty-odd works reporting the foregoing figures is 98,020. Details are given in paper by Philip W. Ayres, forester of the Society for the Protection of New Hampshire Forests in the *Journal* of the New England Water Works Association for June.

Federal Valuation of Railroads in the United States

Railroad Engineers Must Keep Valuation Records Up to Date—Value Affects Various Phases of the Railroad Problem

BY EDWIN F. WENDT
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Abstract of a paper presented at the Annual Convention of the American Society of Civil Engineers, at Chicago, July 11-12.

The success of federal regulation of railroads will depend in large measure upon the valuation of the properties engaged in the service of the public. The Valuation Act, Section 19a of the Interstate Commerce Act, approved March 1, 1913, provides that: "The commission shall investigate, ascertain and report the value of all the property owned or used by every common carrier subject to the provisions of this act."

Engineering Board—The commission promptly within the sixty days prescribed, organized a Bureau of Valuation in charge of a director. The engineering board, appointed May 1, 1913, consisted of five members, and the United States was divided into five districts: Eastern, Central, Southern, Western and Pacific, each including approximately 50,000 miles of railroads. This board held its first meeting on May 6, 1913, and the last on Sept. 22, 1920. Each district had a technical staff including a civil engineer in charge of roadway and track; bridge engineer in charge of structures; architect in charge of buildings; mechanical engineer in charge of locomotives, cars and shop machinery; electrical engineer in charge of power plants and electric traction; signal engineer in charge of signals and interlocking plants; telegraph and telephone engineer in charge of telegraph and telephone work. There was also a complete office organization for the assembling of all the data into final engineering reports.

The engineering board during its existence of 8½ years to Oct. 31, 1921, supervised the work of inventorying the entire 250,000 miles of railroads in the United States. This work was done in great detail. The length of every road, including the various main tracks, spurs and sidings, was measured by engineering corps. All excavations and embankments were cross-sectioned and computed. Bridges, buildings, signals, water stations, fuel stations, shops, roundhouses, turntables, cars, locomotives, shop machinery, signals, interlockers, telegraphs, telephones, gas plants, power plants, and all appliances of every kind and description were inspected, measured, enumerated and computed in accordance with the standard practices of the engineering profession.

The field work of making the inventory measurements, and the office work in connection with the computations, collections and assembly of the quantities of the different classes of property was done with such care and thoroughness that both the carriers and the public have been well satisfied with the results of the work. Great care was exercised in the preparation of the instructions which regulated the work of the field engineers. The maximum force of engineers, accountants and land appraisers engaged at one time on this work was 1,500, and the engineering profession may well feel proud of the accomplishment of the great task of collecting the fundamental data required by the Valuation Act.

Date Basis of Prices—Having completed the essential engineering data, the commission proceeded to price the engineering works on the basis of prices as of June 30, 1914. The selection of this date was in some respects accidental, since the valuation forces were assembled in 1913-1914, the World War had not begun, and it was thought that the economic level of prices at that time would constitute a fairly stable basis upon which to determine the value of railway property so far as rate making was concerned. But the war radically changed the situation and even after five years of peace the economic level of wholesale prices is 60 per cent above that of 1914. The Supreme Court has pointed out in the Southwestern Bell Telephone Case, 1923, that proper weight should be given to present prices.

Final Value—The Interstate Commerce Commission has issued a large number of tentative final valuations, and the valuation work has reached a stage where it is possible to precast the relation of final value to the investment accounts. Obviously the present value of some carriers is higher and of other carriers lower, than the investment account. However, speaking generally, it is highly probable that the aggregate values of the railroads, as found by the Interstate Commerce Commission, will substantially equal the capitalization. The commission in 1920 held that the tentative final aggregate value of the steam railroads is $18,900,000,000, and this value, which is the rate-making value, is very close to the investment shown on the books. When the final aggregate value of all property of the railroads has been determined, the prospects are that the "present value" will be substantially the present total capitalization.

This being the case: What will be the effect of federal regulation upon the future development of railroad? The commission controls the issuing of future railroad securities, the regulation of car supply and distribution, the joint use of terminals, the construction of new lines and the abandonment of old lines. The commission is required to prescribe rates so as to enable the carriers to earn an aggregate annual net railway operating income equal to a fair return on the aggregate value of the railway property used in transportation. The commission decided in 1922 that 5¾ per cent is a fair return. Thus the value of the property is fundamental, whether the question is a schedule of rates, capitalization, consolidation, depreciation, recapture of excess railway operating income, joint use of terminals, construction of new lines or division of joint rates.

Future Valuation Work—All regulation is to be based upon a consideration of the property, its nature, classification extent, use and value. The railways will find it necessary to maintain adequate technical staffs for constantly studying the value of the property in its relation to the above items and other phases of the regulatory problem. It will be necessary for them to do more work in the line of scientific research, and to submit the data to the commission. Thus there is a large field of usefulness for the engineer, accountant, statistician and economist.

The effect of future regulation will depend, in large measure, upon the thoroughness of the study of the various phases of the railway problem. The commission is obliged by law to predicate its decision upon the record developed at hearings, but the Transportation Act places such a great burden upon the commission that it will not be possible for its forces promptly to prepare the data needed. Therefore it will be necessary for the railways to furnish information essential for proper decision in the various issues which will grow out of the interpretation and enforcement of the Transportation Act. These issues involve the prosperity of one of the three greatest industries in America, the railway business with a capitalization of $20,000,000,000.

The public interest requires a reasonable regulation of the transportation business, and the people are well satisfied with private ownership of railways under public regulation.

Rural Whole-Time Health Officer Service

Of a rural population of 51,406,017 in the United States, 5,957,616 or 11.58 per cent have the services of whole-time health officers, according to figures given in a paper by Dr. W. F. Draper, assistant surgeon general, U. S. P. H. S., in *The American Journal of Public Health* for June. Nineteen states have no such officers, including New York, New Jersey, Michigan and Minnesota. Vermont has 100 per cent, Ohio has 53.37 per cent. North Carolina has 39.75 and Alabama 36.50 per cent of its rural population under the care of whole-time health officers.

St. Louis Tests Three Water-Main Joint Materials

Cement and Leadite Superior to Lead for Resistance and Deflection, While Lead and Leadite Are More Readily Worked

By Leland Chivvis
Engineer-in-Charge, Distribution Section, Water Division, St. Louis, Mo.

Water-works engineers have, in general, attacked the problem of electrolysis by devising either methods of preventing the return current from leaving the circuit over which it is intended to travel, or means by which the return current, once it had leaped to the pipe line, could be induced to leave it in an orderly manner at the end of its journey. In the first class are such devices as welded rail joints and insulated negative returns, and the effort to keep the potential gradient as low as possible by restricting the area supplied by any one power station. In the second class is the familiar expedient of bonding the pipes to the rail or direct to the negative bus bar. Most of us have neglected the obvious course of discouraging current flow on our pipes by making them as near nonconducting as the available materials will permit. We have continued to use a material in the joints which is a better electrical conductor than the cast iron itself when there were available a number of other jointing materials which are very fair insulators.

The purpose of this paper is to describe tests made by the St. Louis Water Division to show the comparative electrical resistance of lead, cement and leadite in a bell-and-spigot joint and to determine their ability to withstand deflection. Three 50-ft. lines of 3-in pipe were laid on supports and capped at the ends. Corporation cocks were inserted for filling and draining. One line was jointed with lead, a second with leadite and after waiting a month for weather suitable to making cement joints, the three lines were brought indoors as shown by the accompanying sketch. The cement joints were made by driving in two strands of regular oiled jute filling with stiff neat cement and ramming this home with a follower of a third strand of jute, finishing with the jute flush with the bell. A beveled collar of neat cement was added partly for appearance and partly to aid in permeating the third jute ring. The lead and leadite joints were made according to standard practice.

After about two weeks' time a six-volt automobile battery was coupled up with a resistance, a voltmeter and an ammeter (see sketch), contact points were filed on each side of the joints, the pipes were filled with water and the tests shown by the table were made.

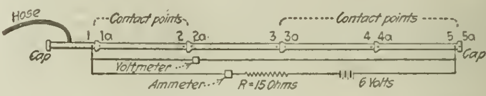
The resistance of the pipe body between the joints is negligible as it is equivalent to a copper cable ⅜-in. in diameter. It will be noted that some of the overall resistances (joints 1 to 4 inclusive) do not check the sum of joints 1, 2, 3 and 4 taken individually under the same conditions. This can only be explained by assuming faulty contacts where the resistances seem unduly high. If work of this kind is ever attempted again we intend to drill and tap the pipe and solder all wires. The results show that on a leadite or cement line most joints have 500 or 600 times the resistance of a standard lead joint.

After the electrical tests were completed the lines were again put under pressure and some very severe deflection tests were made by alternately hoisting and lowering at the mid-section and again at one end.

The cement and leadite joints stood this treatment very well, the leakage being practically nothing although the visible part of the jointing material cracked and even spalled off in the case of the cement. Lead joints 2 and 3 leaked badly and had to be recalked before the test had gone very far. Joint 3 finally squeezed out of the bell about an inch and would have blown out if the volume of water behind it had been anything larger than the capacity of the ¾-in hose used for filling.

ELECTRIC-RESISTANCE AND DEFLECTION TESTS ON CEMENT, LEADITE AND LEAD-JOINTS IN CAST-IRON PIPE

Three-parallel lines of 3-in. pipe, each 50 ft. long, with electric contact points, as shown in the sketch immediately below, were tested (1) with the pipes full, under pressure, and then (2) with pipes empty but otherwise under same conditions as (1). The results of (1) indicate that the water conducts very little current around the joints.



Contacts on Points	Current Flow Amp. (I)	Potential Difference Volts (E)	Joints	Resistance Ohms (R=E/I)
Pipes Full and Under Pressure				
Cement Line				
1, 5	0 08	5.0	1, 2, 3,	4,62.5
3, 5	0 27	2.4	3, 4	8 9
1, 1a	0 2	3.2	1	16 0
2, 2a	0 22	3.2	2	14 5
3, 3a	0 28	1.6	3	5 7
4, 4a	0 42	0 45	4	1.1
5, 5a	0.31	1.6	5	5 2
Leadite Line				
1, 5	0.10	4 3	1, 2, 3, 4	43 0
3, 5	0 23	3.1	3, 4	13 5
1, 1a	0.22	3.1	1	14 0
2, 2a	0.41	0 01	2	0.02
3, 3a	0 11	3.0	3	27 2
4, 4a	0 42	0 2	4	4 8
5, 5a	0.23	3.1	5	13.5
Lead Line				
1, 5	0 45	.05	1, 2, 3, 4	.11
3, 5	0 45	.01	3, 4	.02
1, 1a	0 45	.01	1	.02
2, 2a	0 45	.01	2	.02
3, 3a	0.45	.01	3	.02
4, 4a	0.43	.01	4	.02
5, 5a	0.44	.01	5	.02
Pipes Empty				
Cement Line				
1, 5	0.08	5.2	1, 2, 3, 4	65.0
3, 5	0.26	2.6	3, 4	10.0
1, 1a	0.18	3.8	1	21.1
2, 2a	0.19	3.6	2	19.0
3, 3a	0.26	2.6	3	10.0
4, 4a	0.46	0.01	4	0.02
5, 5a	0.30	2.3	5	7.7
Leadite Line				
1, 5	0.05	5.5	1, 2, 3, 4	110.0
3, 5	0.23	3.1	3, 4	13.5
1, 1a	0.15	4.2	1	28.0
2, 2a	0 14	4.4	2	31.4
3, 3a	0 23	3.0	3	13.0
4, 4a	0 46	0.01	4	0.02
5, 5a	0.18	3.9	5	21.7
Lead Line				
1, 5	0.46	0.02	1, 2, 3, 4	0.04
3, 5	0.46	0.02	3, 4	0.04
1, 1a	0 46	0.01	1	0.02
2, 2a	0.46	0.01	2	0.02
3, 3a	0.46	0.01	3	0.02
4, 4a	0 46	0.01	4	0.02
5, 5a	0.46	0.01	5	0.02

The lines were now leveled on supports and time taken for the removal of the jointing material. The six lead joints were burned out by one man with an oxy-acetylene flame in ½ hr.; the leadite was burned out by the same man in 1 hr., the increase in time being due to the sulphur fumes. The six cement joints were gouged out by two men in 3½ hr. of very tedious work.

A summary of the results follows:

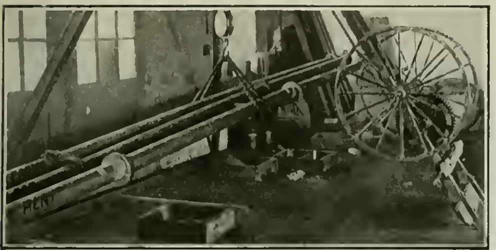
1. *Cement and Leadite* are far superior to lead as insulators. The insulating value of these materials is not vitiated by the water in the pipe.

2. *Cement and Leadite* will stand far more deflection than lead without serious leakage.

3. *Lead and Leadite Joints* can be made in any season and under adverse conditions, while cement is under a disadvantage in winter and in wet trenches.

4. *Lead and Leadite Joints* permit the water to be turned on and the line put in service immediately, while cement requires a period of preliminary setting.

5. *Cement Joints* are very hard to gouge out.



CEMENT, LEAD- AND LEADITE-JOINTED 3-IN. CAST-IRON PIPE UNDER DEFLECTION TEST

6. *The Sulphur Fumes of Leadite* might become very oppressive in a confined working space.

These tests were made by men thoroughly conversant with the use of lead who were staunch in its support until the rising price made the substitutes look attractive. St. Louis is now preparing to lay a considerable amount of small pipe with cement joints and if lead does not drop appreciably before winter we will probably try leadite during the freezing weather.

Cantilever Bridge of Concrete

Monolithic Structures Supported on Piers—Heavy Abutments Not Required—Clear Channel Span of 51 Ft.

By Paul M. Henry

Bridge Engineer, Ohio State Highway Department

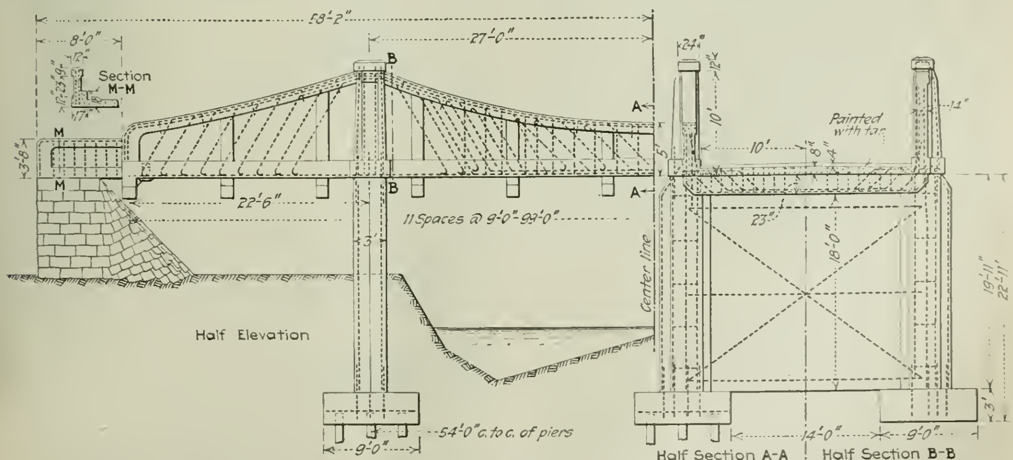
In connection with the improvement of the Newark-Mt. Vernon intercounty highway in Ohio, two reinforced-concrete bridges of an interesting design have been built. One is over the Clear Fork and the other over the Lake Fork, in Licking County. Both bridges are of the reinforced-concrete cantilever type of 54-ft. span, the only difference in them being in the height of their piers.

The bridges were designed to carry a 15-ton truck. The floor-beams carry the floor and load and transfer it to the girders at the floor-beam points as concentrated loads. Influence lines were used to determine loadings for maximum stresses. To avoid the use of construction joints in the main structure the floor and two main girders of each bridge were poured in one

CANTILEVER CONCRETE BRIDGE FOR OHIO HIGHWAYS

operation. The approach slabs at each end of the structures were poured later. The top of the floor-beam at each end of the cantilever was provided with a half-round groove 4 in. deep, for the entire width of the roadway, to support the approach slab. This groove was painted with a coat of bituminous material before the slab was poured. The design called for the outer end of this slab to rest on the fill, but in construction it was provided with a shallow foundation 3 ft. deep and 1½ ft. thick.

The Newark Paving & Construction Co. which had the contract for the entire improvement, both road and bridges, sublet the bridges to B. C. Patterson at approximately $13,000 each.



ELEVATION AND CROSS-SECTION OF CONCRETE CANTILEVER BRIDGE AT LAKE FORK, LICKING CO., OHIO

Undiscovered Substratum of Peat Complicates Foundation Job

Shallow Foundations Settle During Construction—Original Borings Inaccurate—Unusual Method of Underpinning

SETTLEMENT of the foundation during the construction of a ten-story building due to the use of inaccurate borings which presumed to indicate the character of the material underlying the site, has forced the builders to resort to an unusual method of underpinning the foundation of the Westinghouse Electric & Manufacturing Co. building in Philadelphia. At the time the property was purchased by the present owners they received from the former owners a series of borings which indicated that a loose fill 8 to 10 ft. deep and a uniform bed of clay and sand was all that overlay the rock, which was about 45 ft. below the surface. These borings were accepted by them as being accurate and a shallow pile foundation was put in.

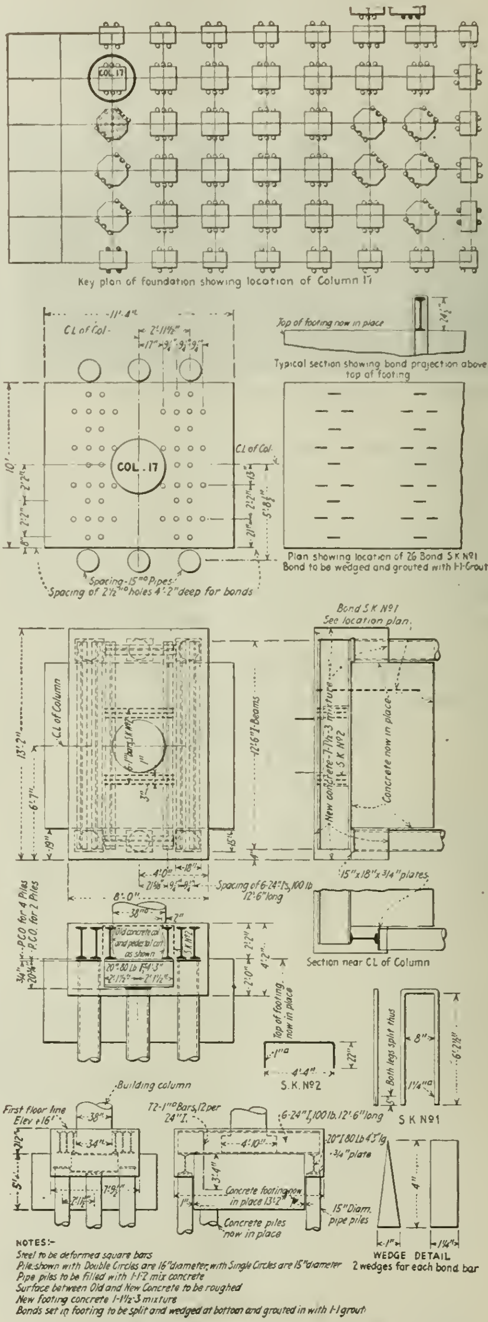
When construction work was started the Raymond Concrete Pile Co., subcontractors under the Hughes-Foulkrod Co., drove test rods to determine the length of piles required. The test rods were driven to a depth of from 25 to 30 ft. at which depth the penetration of the test rods indicated that piles would sustain the contemplated loading. When the actual piles were driven, their length and resistance closely agreed with what was to be expected from the driving of the test rods and the boring records.

The driving of the piles for the footings was completed and eight of the stories of the building had been erected when a considerable settlement over a large part of the foundation area was noted. The building construction was immediately stopped and core borings were taken. These borings showed that, except under the two rows of footings at the west side of the building, the first 25 to 30 ft. of material was about as indicated in the original boring record, but that underlying this layer of clay and sand was a very compressible layer of peat and silt. Under these circumstances each individual pile developed sufficient resistance to carry its assumed loading, but when the weight of the building was put upon all of them it developed compression in the stratum of peat which resulted in a settlement varying from about 4 in. at the east side of the building to nothing at the west side. The piles at the west side where there was no substratum of peat carried their load without settlement.

In order to further verify the result of these core borings, the contractors had an open-end reinforced-concrete caisson with an inside diameter of 4 ft. sunk to bedrock and completely excavated. The excavation disclosed the following layers of sub-soil:

27 ft. of fill
4 ft. of peat
1 ft. of gravel
15 ft. of silted peat
8 ft. of silt
2 ft. of coarse sand and gravel on top of very hard mica schist

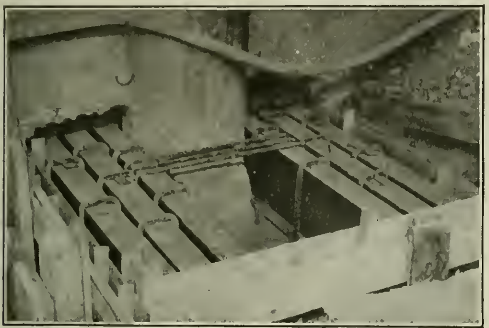
In the meantime, in order to avoid undue settlement during the underpinning operations, each column was shored up. It was necessary to take the shores up several times a day to compensate for the continuous compression of the soil on which they bore.



FOUNDATION PLAN AND DETAILS OF ONE FOOTING

Showing location of the new piles in relation to the original footings and method of transferring the load to them.

The method of underpinning the foundation is shown in the accompanying drawing. Each footing is supported on a group of 15-in. or 16-in. concrete filled steel pipe driven to rock outside the original footing. These pipes were sunk without removing any of the floors of the building which had already been placed. When each pipe had been firmly bedded on the rock it was cleaned out with compressed air blown through a 2½-in. nozzle at 110 lb. pressure, sealed with neat cement, and con-



SETTLING FOUNDATION CARRIED BY CROSS BEAMS

creted up to the cutoff elevation. These pipes were then capped with short steel I-beams. Steel beams with their outer ends resting on these caps were placed across the top of the original footings. The footings were then suspended from these overlying girders by means of 1¼-in. deformed U-bars which were split and wedged at the bottom and securely grouted in place. After this concrete had been allowed to set for ten days steel wedges and shims were placed between the U-bolts and the I-beams, and between the caps and the top of the concrete-filled pipes. The whole footing was then completely encased in concrete.

The underpinning described was designed and executed by the Raymond Concrete Pile Co., following the requirements of the Philadelphia building department. Percival M. Sax acted as consulting engineer to the contractors. Application has been made for patents on this method of construction.

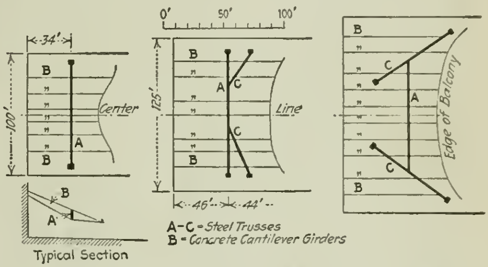
Engineering Charges on Local Improvement Work

A bill permitting municipalities to include engineering and inspection as items in the cost of local improvement work has been passed by the Illinois state Legislature, largely through the efforts of the Illinois Society of Engineers. No percentage is fixed by the law, but this is left to the decision of the municipalities. According to a statement in the 1923 *Proceedings* of the society this bill was the outcome of a decision by the Illinois Supreme Court in 1922 to the effect that engineering and inspection during the construction of improvements by special assessment are not a part of the cost of the work. This decision operated to the disadvantage of many improvements in the smaller municipalities, few such municipalities having corporate funds out of which to pay these expenses. It operated also to the serious disadvantage of engineers for such work. Since nothing more could be accomplished through the courts, the next step was to get the legislature to amend the statute so as to provide specially for these items, and this has now been done.

Truss Supports for Cantilevers of Theater Balconies

IN THE structural design of large modern theater buildings a typical feature is the introduction of long steel trusses as fulcrum bearings for inclined concrete girders supporting the balcony floor. This arrangement eliminates intermediate columns in the main floor and provides an unobstructed view. Difficulties in location and design of the trusses are encountered, especially the difficulty of combining long span and shallow depth in the steel trusses, a condition involving heavy members.

Three different arrangements of balcony trusses are shown in the accompanying drawing. Plan No. 1 shows the simplest arrangement, as used in the Keith Theater at Euclid Ave. and 17th St., Cleveland, the anchor span single steel truss, *A*, of 87-ft. span, supported on interior columns, carries the six inclined concrete girders, *B*, which have a maximum cantilever length of 33 ft. and an anchor span of about 34 ft. Owing to the limited



TRUSS AND CANTELEVER FRAMING OF BALCONIES

depth of truss the necessary amount of material for the required strength is obtained by using a twin truss, with parallel double chords and web members.

In plan No. 2, which represents the Palace Theater at Euclid Ave. and 17th St., Cleveland, the anchor span of the concrete girders, *B*, is about 46 ft., while the maximum projection beyond the truss, *A*, is about 44 ft. Since this distance would be excessive for a cantilever, two diagonal trusses *CC*, are introduced, having their inner ends framed into the main truss, *A*, and their outer ends supported by side columns. Owing to the interior arrangement these diagonal girders are not symmetrical, one being 39 ft. and the other 49 ft. long. In this way the cantilever lengths of girders *B* are only from 27 to 30 ft. This theater construction was described in *Engineering News-Record*, June 22, 1922, p. 1036, and the truss arrangement is like that of the State-Lake Theater, Chicago (see July 24, 1919, p. 178.)

A more complicated arrangement was required to meet the conditions of architectural design in the Chicago Theater, Chicago, as shown in plan No. 3. In this case columns could not be placed at suitable points for supporting the truss *A*. Two 76-ft. diagonal trusses, *C*, were therefore placed on side columns, and the 88-ft. truss, *A*, was framed between them. This is a twin truss, similar to that in plan No. 1, but a more effective distribution of metal is effected by the use of an H-section for each of the four chords, thus permitting the use of as many vertical cover plates as desired.

The architects for the three theaters were C. W. and George L. Rapp, Chicago, and the structural designs were by Lieberman & Hein, engineers, Chicago.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Trial of Acid in Dewatering Imhoff-Tank Sludge at Plainfield, N. J.

Sir—Experiments on sludge dewatering with sulphur dioxide gas were mentioned by J. R. Downes, superintendent, Plainfield sewage-works, in your issue of July 5, p. 29. The sulphur dioxide conditioning process is controlled by this company and has been in successful operation on activated sludge for some time at the Houston, Texas, and Gastonia, N. C., plants.

The process was installed experimentally at a small sedimentation plant in the Borough of Brooklyn, New York City, and produced favorable indications. This plant was moved to the Plainfield, N. J., sewage-works in the late fall of 1922 with the understanding that one of the Imhoff tanks would be cleaned out for the purpose of delivering an undigested sludge to the experimental dewatering plant. Due to lack of sludge bed facilities, the Plainfield people were unable to clean out a tank and deliver fresh sludge, so we were compelled to attempt to handle digested Imhoff sludge with a high proportion of colloidal solids. Despite the fact that the particular machine set up at Plainfield was not designed to handle this type of sludge, fairly good indications were developed, although the experiments had to be discontinued before any conclusive data could be collected, due to cold weather with attendant difficulties.

This company has issued no data on results produced with any other sludge than activated, but feels that this brief statement covering the Plainfield experiment should be forthcoming in view of the possibly misleading communication from Mr. Downes.

R. H. Eagles,
Sanitary Engineer, Maclachlan Reduction Process Co., Inc.
New York City,
July 10.

State Highways in Small Towns

Sir—I disagree with the editorial entitled "Off Into The Mud" in the June 14 issue of *Engineering News-Record*, in which you state that the small towns in the Northeastern states are conspicuous for their poor pavements, and that these pavements should be brought up to the standard of the state highways.

I am a resident of one of the small towns in question, in which the pavements are generally in the condition you refer to, particularly on the street where I live, which, although a side street as far as the town is concerned, is now a connecting link in the state highway system. A few years before the highway was built this street was paved with a waterbound macadam and of recent years it has been frequently oiled to keep it in shape.

Under normal conditions this pavement would have served us for a good many years, but with the vast stream of automobile traffic, including large trucks of a number of apparently very prosperous concerns now in the business of handling freight over the state highways, the pavement of this street has been almost entirely broken down. Quite naturally we are not inclined to spend more money on rebuilding this street, particularly as the estimated life of the original pavement is not up yet, and bonds are still in existence. Also, from a selfish point of view, the present condition of the pavement insures a safe rate of speed for the passing automobiles, in a street where we have no money to provide traffic policemen, and conseouently have to cross at the risk of our lives.

In view of all this I do not see why we should be called upon to repave this street for the benefit of this state and interstate traffic, and particularly for the benefit of the trucking concerns that are getting rich competing with the railroads that have to maintain their own "running lines" as our British friends would say. It seems to me that it would be more fair to the people of the small town, who get little benefit from this traffic, if the state highway pavements were carried through such towns with only a small percentage of the cost assessed against them.

"Engineer."

Balanced Bids—Duty of the Engineer

Sir—I have read with interest and approval the letter from E. T. Thurston of San Francisco, in *Engineering News-Record*, July 5, regarding "Unbalanced Bids," and the reason therefor, and wish to concur with him in his statement urging the engineers and architects of the country to base all estimates on experience of such work as is being estimated.

If every engineer and architect would write his specifications with due regard to the actual operations necessary to perform the work, and make the plans for such work conform in every respect to the shape and finish of the completed work, he would not only save his client money but would make his own position more secure with both the owner and the contractor; for an honest and competent contractor will do better work and can do it for less money when the man in charge is just as experienced in the actual operations of the work to be performed as is the contractor himself, and there will be very little chance for differences to arise as to the interpretation of the specifications when they are written with both technical and practical knowledge.

To-day the majority of the contractors are, or have employed as their superintendents of construction, graduate engineers, so it behooves the engineer to wise himself up on the "way to do" as well as "how to do" every kind of work on which he proposes to write the specifications and supervise the construction.

As Mr. Thurston so aptly states, every engineer and architect who undertakes conscientiously to give his client the same degree of responsible service as he demands that the contractor give such client, must secure himself in the position to provide that contractor with as nearly perfect plans and specifications as is humanely possible.

Amarillo. Texas
July 16, 1923.
W. D. Howren,
Consulting Engineer.

Seek Apprentices in the Field Operations

Sir—Your editorial, "Who Restricts Apprentices," p. 45, issue of July 12, 1923, while exonerating the labor unions would have been more to the point if suggesting to the contractors to look for the fault in the field operations.

The writer, who for the past fifteen years has been connected with the largest contractors of Philadelphia and Washington, D. C., has never been discouraged either by the contractors or labor unions from trying out intelligent boys as apprentices.

Generally the plan followed when employing large or small forces of common laborers was to hire a few well developed boys as laborers and, if found industrious and capable of holding down a common laborer's position, after a few weeks they were allowed to try out as apprentices. This plan generally succeeded, for the boy had to have the grit to stand up under a constant fire of being hurried under a labor foreman which helped to weed out the laggard and find the boy who was fit to keep pace with the mechanics foremen.

Further the boy was allowed to assist in the engineering work that each operation required. If the boy was found exceptional he made the grade of foreman in a shorter time than the average slower mechanic, thus developing a supply of mechanics who could always make good when called upon to shoulder some of a field operations responsibility.

Personally I feel that a little propaganda at the field operations will produce more apprentices—as when boiled down to facts the boys are available—if the job superintendents would go a little out of their way to produce them and to oversee their progress.

Thomas F. MacDevitt,
Construction Superintendent,
Washington, D. C.
July 23, 1923.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

A survey of the New York elevated railways is to be made by George F. Swain, professor of civil engineering at Harvard University. This work has been authorized by the New Municipal Transit Bureau. Prof. Swain was chairman of the Boston Transit Commission for five years and is a past president of the A.S.C.E.

To Mark the Completion of the Alaska Ry., President Harding recently drove a gold spike at the Tanana Bridge. The citizens of Anchorage presented the spike to Col. Frederick Mears in appreciation of his work as builder of this 471-mile line between Seward and Fairbanks.

A New Traffic Ordinance for New Orleans has been compiled by Commissioner Ray of the Department of Public Safety and will be presented to the Commission Council for adoption. This new traffic code includes regulations needed by local conditions and those successfully tried out in other cities, and will relegate to the discard many antiquated ordinances.

The Indiana State Highway Department Must Have, according to John D. Williams, director, 10 more engineers, 20 more state road inspectors and 30 more county road inspectors on the construction of 235 miles of roads of which 170 miles will be hard surface, 35 miles of secondary type and 30 miles improved by grading and building structures. State inspection is in force on forty-one county projects, consisting of 125 miles of road improvements, to cost approximately $2,254,000.

Authority to Construct 380 Miles of Railroad from Tucumcari, N. M., to Seymour, Tex., and from Perrin to Fort Worth, with a possible addition of 100 miles to the above has been asked of the Interstate Commerce Commission by the Texas, Panhandle & Gulf Ry. Co. The company has also applied for authority to buy or lease the tracks of the Gulf, Texas & Western R.R. Co. from Seymour to Salesville in Palo Pinto County.

An Application for a Rehearing in the assigned car case has been made to the Interstate Commerce Commission by the various subsidiaries of the U. S. Steel Corp. The petition points out that none of the coal mined by the applicant mining companies is sold in competition with coal mined in the same or adjacent districts, that the nature of the manufacturing process requires a continuous operation of a steel plant, and that the distance between the plants and their coke ovens on the one hand, and the mines on the other, requires the use of private cars to insure continuity of the coal supply.

Moffat Tunnel Bids Wanted

The Moffat Tunnel Commission will receive bids Aug. 25, 1923, for the excavation work on the main and pioneer tunnels for the Denver & Salt Lake R.R. under James Peak in Grand County, Colo. The tunnels will be 6.04 miles long and at 65-ft. centers. The main tunnel will be 16x 24 ft. and the pioneer tunnel will be 8x8 ft. Cross headings between the tunnels are to be cut at as many points as the contractor finds desirable. The $6,750,000 bond issue has been sold at a substantial premium, the contract for supplying electric power to the two portals has been let, and the installation of equipment is now in process. R. H. Keays is chief engineer, and V. A. Kaufman is resident engineer.

Bridge Design Dispute Initiated by Architects

Supplementing the statement published last week (p. 155) as to the controversy over the design of the three new Allegheny River bridges which are to be constructed in Pittsburgh, it is reported that the controversy originated with demands on the part of architects that the board of county commissioners turn over the design and supervision of the bridges to them. John W. Beatty, director emeritus of the Department of Fine Arts, Carnegie Institute, appeared before the board and made such a demand. Subsequently a committee of the Pittsburgh chapter of the American Institute of Architects came before the board to support the Beatty demand. As a result of this meeting the commissioners asked the committee to supply a list of the names of local architects competent to take charge of such bridge construction. The controversy incidentally has included such misleading statements as that an architect designed the Manhattan bridge over the East River at New York.

Penn State College to Train Industrial Executives

Pennsylvania State College, through its industrial engineering department, offers a special summer course of two weeks to industrial executives. For seven years, under the leadership of such engineers as Hugo Diemer, a group of industrial executives have met for two weeks at State College and through intensive study, lecture and laboratory work have gone into the field of costs, rate setting, personnel, planning and production with a view to training in executive co-ordination. Each year about twenty-five leading plants have been represented. This summer the course is given in the industrial engineering laboratory from Aug. 27 to Sept. 8. Information may be secured from J. O. Keller, Head, Industrial Engineering Dept., State College, Pa.

Bids Received for Steelwook on Philadelphia-Camden Bridge

Bids were opened by the Delaware River Bridge Joint Commission on July 18 for construction of the two inclined steel bents carrying the cable saddles at the anchorages of the Philadelphia-Camden suspension bridge. Two bids were received as follows:

	Steel Lbs.	Bethlehem Steel Co.	American Bridge Co.
Silicon Steel	2,030,000	9.1 c.	9.3 c.
Carbon steel	650,000	8.7 c.	9.3 c.
Cast steel	950,000	15.0 c.	11.7 c.
Steel supports for bents.	200,000	7.9 c.	8.1 c.
Total		$399,580	$376,590

Although underbid on every item except that for cast steel, the American Bridge Co. was low bidder and its proposal was accepted by the commission.

The bents are inclined steel supports to hold the cables in position and to deflect them downward for their anchorage into the masonry. Each bent has two columns, 7 x 8 ft. in section, of cellular construction, braced together by diagonal and cross members, and carrying saddles in which the cables will rest. Saddles and column bases are cast steel. The columns are silicon steel, of the same grade as that being used in the main towers of the bridge, (yield point 45,000, ultimate strength 80,000 to 95,000, pounds per square inch). The column bases rest upon inclined surfaces of concrete at the river end of each anchorage. Bearing on the concrete will be effected by grouting. The total force to be carried by each bent, under maximum conditions, amounts to 48,400,000 lb.

The contract time for completion of the bents is nine months, but the contractor is required to have them in condition to permit stringing of the cables in eight months.

Federal Judge Rules City Cannot Extend State Traffic Law

Judge Robert S. Bean, U. S. District Court, sitting at Portland, Ore., has decided that a city or municipality has no right to add to or extend a state law on any subject. The opinion arose from a situation wherein A. F. Davidson, a motorcycle policeman, sued Walnorth & Co. because of injuries suffered in a collision with an automobile owned by the defendant company. The policeman charged that he had the right-of-way because of an emergency while in the discharge of his duty. The state law lists certain vehicles and occupations which are given rights-of-way so far as traffic is concerned but motorcycles are not included in the state law. However, the city of Portland's ordinances do include motorcycles as well as other fire and police vehicles as having special traffic privileges.

The court decided that the complainant based his suit upon an extension of a state law and therefore the case was thrown out of court on a technicality.

Rapid-Transit Agreement in Philadelphia

City and Traction Company Work Out Subway and Elevated System Costing 60 Millions

After discussions extending over more than a year, agreement has virtually been reached on plans for rapid-transit development in Philadelphia. These plans are in effect changes in the Taylor Plan, adopted by the city in 1916. Work on certain portions of the subways included in that scheme had been started when increasing costs caused by war time conditions forced postponement of construction.

Recent discussions have centered principally upon the number of tracks to be constructed in Broad St., the terminal points for that line, and the disposition to be made of the loop subway for delivery of Broad St. subway traffic in the center of the city. Injected into the discussions has been the political feud between the mayor and the majority faction in city council.

The plans upon which agreement now seems likely provide for a comprehensive scheme of development, and for a first step in that scheme. A four-track subway is provided in Broad St. from Olney Ave. south to Spruce St., approximately eight miles, with a two-track subway extending south from Spruce St. to the Navy Yard at League Island. A two-track subway is provided in Ridge Ave., leading from the Broad St. line to Eighth St. and then by way of Walnut and Chestnut Sts. to a point in West Philadelphia near 42nd and Chestnut Sts., continuing from that point as an elevated line to the southwestern portion of the city and to Darby. A surface-car subway is provided in Chestnut St., in which it is proposed to run all surface cars now operating on Chestnut and Walnut Sts., thus leaving those streets free for motor traffic. This feature is one of great importance in view of present congested conditions on these streets. Subway lines are provided in Arch and Filbert Sts., with connections to the Delaware River bridge (under construction) to Camden, and with extensions as elevated railways to Overbrook and to Roxborough.

The first step in the plan, which is designed for immediate construction, comprises the Broad St. subway from Olney Ave. to Spruce St., together with the Ridge Ave., Eighth St. and Walnut-Chestnnut St. subways, and the elevated railway to the southwest and Darby. The estimated cost of this portion of the work, as computed by engineers of the Philadelphia Rapid Transit Co., is given in the table.

	Structure	Trackwork	Equipment	Cars	Total
4 Track Subway—Broad. Olney to Spruce	$34,240,000	$2,900,000	$4,440,000	$9,220,000	$50,800,000
2 Track Subway—Ridge. Broad to Eighth	3,540,000	210,000	330,000	670,000	4,750,000
2 Track Subway—8th. Race to Walnut	2,580,000	110,000	160,000	350,000	3,200,000
2 Track Subway—Walnut, Chestnut 8th to 23d	6,110,000	310,000	480,000	1,000,000	7,900,000
2 Track Bridge and Approaches—Chestnut, 23d to 30th	1,400,000	60,000	90,000	200,000	1,750,000
2 Track Subway—Chestnut, 30th to 42d	3,960,000	280,000	410,000	850,000	5,500,000
2 Track Elevated—42d. Woodland, Chestnut to Darby	4,880,000	820,000	1,270,000	2,630,000	9,600,000
Totals	$56,710,000	$4,690,000	$7,180,000	$14,920,000	$83,500,000
Terminal Yards and Shops					6,500,000
GRAND TOTAL					$90,000,000

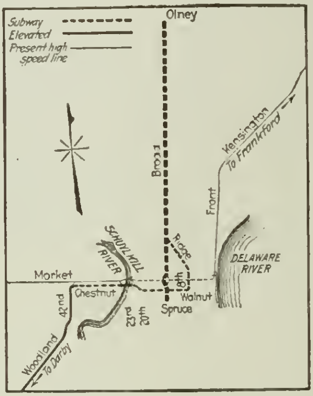


FIG. 1—PROPOSED FIRST STEP

City council special transit commission has indicated approval of this plan. Suggestions have been made for minor changes on the Darby line, one plan being for a continuation of subway construction in the 42nd St. portion from Chestnut St. to Woodland Ave., and another being for extending the Chestnut St. portion to 46th St. and then turning south to Woodland Ave.

This portion of the plan was incorporated in an ordinance which was passed by the city council at a special meeting held on July 27th. The ordinance also provides for the reapportionment of the funds already voted for subway construction. The special session was held in order that there may be time to repass the measure, in case it is vetoed, in time to submit it to vote at the primary election in September.

The Philadelphia Rapid Transit Co. has offered to pay sinking fund and interest charges on the money required for the Chestnut St. surface car subway so that its construction will not encumber the borrowing capacity of the city. An ordinance covering the construction of this subway is being prepared for submission to the people at the general election in November.

The contract for the construction of 1529 ft. of two track subway in Arch St. between Eighth St. and Thirteenth St. was awarded on July 27th to the Keystone State Construction Co. for $1,198,555. This section of subway under Arch St. is a portion of the "delivery loop" and is not included in the first step of the council's construction program.

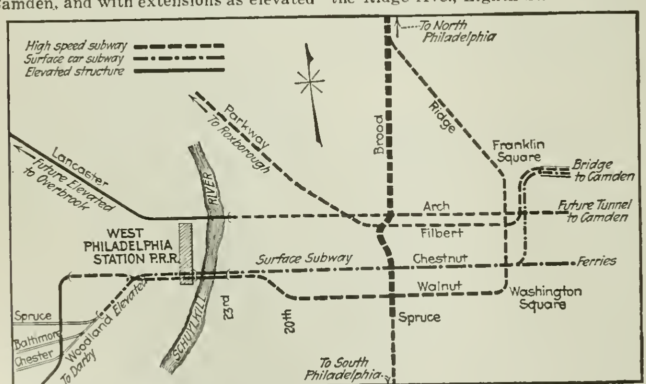


FIG. 2—PROPOSED COMPREHENSIVE PLAN FOR PHILADELPHIA TRANSIT DEVELOPMENT

This plan includes the following changes from the plans adopted by the city in 1916; (1) Inclusion of surface subway and high-speed connection to the Delaware River Bridge, which had not been started at the time the 1916 plans were developed; (2) abandonment of the plan for a "delivery loop" in the central section of the city as a terminal for the Broad St. line, and (3) the construction in its place of the Ridge Ave. line. This arrangement permits of through routing on all lines.

New Orleans Zoning Ordinance Legal Says High State Court

The right of New Orleans to exclude business enterprises from residence districts through zoning was upheld by a unanimous decision of the seven judges of the Supreme Court of Louisiana in a decision handed down on July 11. Brief excerpts from the decision, given in the New Orleans *Item* of July 12, indicate that the court went so far as to hold that the exercise of the police power in zoning may be extended to esthetic considerations in so far as these include eyesores in residential districts that affect the comfort and happiness of the residents and the value of their property.

Port Authority Elects Officers

Eugenius H. Outerbridge has been re-elected chairman of the Port of New York Authority; DeWitt Van Buskirk as vice-chairman succeeds J. Spencer Smith, whose term as a commissioner expired on July 1. Julian A. Gregory has been appointed a commissioner, vice Mr. Smith. William Leary has been re-elected secretary, Julius H. Cohen, counsel and Gen. Geo. W. Goethals, consulting engineer.

No Justification For Davis Dismissal Revealed

All Evidence Still Shows Reclamation Service Reorganization Due to Politics

Washington Correspondence

Nothing to justify the abrupt dismissal of A. P. Davis from his position as director of the Reclamation Service has developed since the Secretary of the Interior took that action. Such justification as has been proffered on his Alaskan trip by Secretary Work and by his assistants at Washington seems to have been refuted as the facts became available.

One of the reasons put forward for the summary character of Mr. Davis' dismissal was that the situation of the water users is so desperate as to make necessary drastic action. That the farmers on the reclamation projects are in any such plight as that described at Secretary Work's office, seems to be contradicted by the Secretary of Agriculture who is authority for the statement that "the financial distress among farmers on these projects is no greater than the financial distress of farmers not on reclamation projects throughout the region from the Missouri River west. In that region there are large sections in which I have no doubt agricultural distress is greater than on the reclamation projects."

As the situation is being analyzed more thoroughly, those who are looking into the matter are more convinced than ever that the motive behind the change was an endeavor to secure a partisan political advantage. During the entire time Arthur P. Davis was at the head of the Reclamation Service, he did all in his power to prevent attempts to dilute the reclamation fund. He feels that there are too many projects as it is, and that successes must be made of those before attempting to take on more. This policy aroused bitter complaint from those who are anxious to have Uncle Sam undertake further development. There is reason to believe that no small part of the influence which resulted in the ousting of Mr. Davis came from those who are anxious to interest the federal government in the Columbia Basin project. To this, however, must be added the influence of those who wanted to see Mr. Davis removed from the path along which their various schemes must advance, to say nothing of those concerned with existing projects who would repudiate obligations.

Action Doubtless Hasty

Whenever a new secretary takes over the direction of the Interior Department, he is at once the target for hundreds of letters from those who are disgruntled and from those who want to depart from established policy. While these protests probably represent the opinion of only one-tenth of one per cent of those concerned, they do make an impressive pile when they converge on the desk of a new secretary.

Being inexperienced in the handling of large affairs and being a man with an explosive disposition, Secretary Work is thought to have rushed to a decision in regard to the conduct of the Reclamation Service, without consulting the very capable men in his department who are in a position to counsel him wisely.

There is reason to believe that Secretary Work brought up at a cabinet meeting the need for changes in reclamation policy. The cabinet is thought to have agreed that something should be done, but the clumsy way in which the idea was carried out is not likely to meet with approval of the President or any of Dr. Work's ministerial associates.

Despite the fact that Mr. Davis was active in the effort to secure the transfer of river and harbor work from the Corps of Engineers, the consensus of opinion in that organization appears to be strongly condemnatory of political interference with the conduct of a technical bureau and of the sweeping indictment of the engineering profession in Secretary Work's announcement that the Reclamation Service should be in charge of a business man and not an engineer. Engineer officers point out, however, that this incident constitutes striking proof why river and harbor work should be left in their department. Since the army engineer can not be discharged, he is in a position to be entirely independent of political influence by the proponents of some project which he did not approve.

All Acquitted of Conspiracy in Phillipsburg Sewage Case

All of the defendants in the charges for conspiracy to defraud the town of Phillipsburg, N. J., of some $23,000 of extras for the construction of sewage-works were acquitted by the trial jury of Warren County on July 26. The grand jury indictments were brought against the Municipal Disposal Co. (now the Direct Oxidation Disposal Corporation) of Philadelphia, contractors for the work, H. Jerome Hirst, president and Charles E. Parry, engineer, of the company; C. E. Tilton, town engineer of Phillipsburg while the work was under construction; and Edward and Francis Korp of the Korp & Korp Construction Co., of Phillipsburgh, the last-named company being the subcontractor for part of the sewage-works.

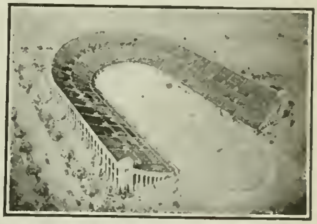
The contract price for the entire plant was $147,980, of which $122,000 was for the machinery and equipment and $25,980 for other material and labor. The Municipal Disposal Co. subcontracted with Korp & Korp for all the work outside the plant and machinery, the contract agreement being for cost plus 15 per cent. Mr. Tilton, as town engineer, certified to extras on the subcontract work totaling $26,556 and his certification was approved by the town commissioners. The Grand Jury held that the greater part of the extras allowed should have been included in the contract price, but to this the trial jury did not agree.

The town commissioners were not indicted but four of the five commissioners (the fifth was not in office at the time the certificates were approved) were censured by the Grand Jury for disregard of state laws in letting contracts and in authorizing contract payment, and for various other sins of omission and commission — some of which, however, had nothing to do with the sewage-works contract.

Mr. Tilton is still under indictment for malfeasance in office. Further particulars regarding the original indictments may be found in *Engineering News-Record*, April 22, 1922, p. 710.

Contract Let on Indiana Stadium

Contract has been let for about half the reinforced-concrete stadium which will be built soon by the University of Indiana. The structure is of reinforced concrete with an ultimate seating capacity of about 50,000, though the contract recently let covers only about half the depth of the structure shown herewith or at the line indicated by the middle aisle running entirely around the stadium. This construction will be twenty-eight rows of bench seats with two rows of box chairs in front having a capacity of about 22,000. Considerable grading will be necessary in the construction inasmuch as there is no level piece of ground anywhere on the campus sufficiently large for an athletic field. The Osborn Engineering Co. who designed the structure was able to select a location in a hollow where advantage could be taken of the grading and the larger portion of seats constructed on ground either excavated or filled. A contract was awarded to the Bedford Steel Construction Co., Bedford, Ind., at a price slightly over $4 per seat for the structure itself which does not include grading, plumbing, heating, lighting, drainage and incidentals. The price per seat excluding only grading will be about $6.



Rapid Progress Made on the Oak Grove Power Project in Oregon

Rapid progress is being made on the Oak Grove project on the Clackamas River in Oregon where the Portland Railway, Light & Power Co. will develop 35,000 hp. in a single reaction turbine under a head of 850 ft. With a total of 1,700 men in the camps work has been carried on simultaneously on the several parts of the project.

The railroad has just been completed for its full length of 23½ miles, using a maximum of 6 per cent grades and 40-deg. curves. Five geared locomotives are in service. The region is heavily timbered and it has been worth while to log off all areas that had to be cleared. On the transmission line particularly this has been an important item.

Work is under way on the 65-ft. diversion dam; grading has been completed for about 70 per cent of the 32,900-ft. pipe line that will consist, for the most part, of 9-ft. steel pipe, and about 4,400 ft. of this pipe has been placed. Work is well under way on the five short tunnels and loose material has been sluiced from the penstock and power house sites. The plant is to be finished and in service by the middle of next year.

H. A. Rands is in charge of design and construction for the power company; the Hurley-Mason Co. of Portland are the principal contractors.

Random Lines

"The Frogs"

By Our Federal Aristophanes

We reprint below, without comment, an authentic bit of inter-departmental correspondence:

TREASURY DEPARTMENT
INTERNAL REVENUE SERVICE
Louisville, Ky.

June 9, 1923.

To the gentleman to whom
this letter will be referred.

Dear Sir:

Can you inform me how to get rid of a frog chorus that performs every night, and all night long—most of the time, too, all day long, around a pond in a vacant lot next to my home?

They are first-class sleep destroyers and a great nuisance generally to everyone within two hundred yards of them.

The property has been taken over by the State for taxes, which makes any interference thereon red-tapey, more or less annoying and more or less (principally more) a matter of time.

I have gone to quite some expense impregnating the pond to chase the frogs away, but they have absorbed everything so far and come up hollering for more.

Thanking you in advance, I am,

Yours sincerely,
R. O. DEPPEN.

June 14, 1923.

Mr. R. O. Deppen,
4700 S. 4th St.,
Louisville, Ky.

SUBJECT:

The bulldog on the bank and the bullfrog in the pool.

Dear Sir:

1. Your letter of June 9th, in which you ask how to get rid of a frog chorus, is one of the most pathetic that has ever come to this Bureau. Many persons enjoy such choruses and would be glad to be in your shoes, or bed, just for the sake of hearing the nocturnal concerts about which you complain. It is a pity that Nature's music should not be appreciated.

2. Unfortunately, there are persons of an excitable and choleric temperament who instead of being lulled to sleep by the song of the innocent batrachians are greatly enraged by it. Apparently you are in this class, and we venture to make a few suggestions for your relief.

3. Try autosuggestion. Imagine that you are listening to a jazz band performing for your benefit, playing a lullaby or nocturne.

4. Incite a crowd of small boys to capture the larger frogs and turn loose in the pond a number of water snakes to devour those that escape the boys. Perhaps a few lengths of garden hose, suitably painted and set around the banks at intervals, would serve as substitutes for real snakes. They might be called scare-frogs.

5. Your position in the Internal Revenue Service should make it easy for you to acquire plenty of the deadliest hooch. Have you tried impregnating the pond with that? If so, and the frogs came up for more, they are evidently steeped in the ancient traditions of the State and think that you are providing one of the essentials of life. The mint probably grows nearby.

6. There are various ways to deaden sounds, but you are probably not willing to sleep with closed windows in summer or to go to the expense of completely enclosing the pond in sound-proof walls. Besides, the State might shift the burden of paying the taxes to you, if you trespassed to that extent. Maxim silencers might be effective, but they would be burdensome to the frogs. Anyway, it would be easier to kill the frogs when caught than to attach the silencers.

7. These are but amateur suggestions for your relief. Frogs are not within our jurisdiction, but come under the Bureau of Biological Survey. Also, we do not work on drugs and poisons, and cannot recommend soporifics and sedatives for man or beast. Advice about these might come from the Public Health Service, Treasury Department, or from the Bureau of Chemistry, Department of Agriculture. We shall send your letter to the latter Department because it also includes the Biological Survey.

Respectfully,
GEORGE K. BURGESS, Director
U. S. Bureau of Standards.

D-O Process for Trenton Again Disapproved

New Jersey Health Board Rejects Sewage Plans and Directs City to File New Ones Within a Year

Reiterating and expanding portions of its resolution of May 1, in which it refused to approve plans for treating the sewage of Trenton, N. J., by the direct-oxidation or lime-electrolysis process as drawn for the city by Col. George A. Johnson, consulting engineer, the State Board of Health of New Jersey again rejected the plans on July 31. The city was directed to file new plans within a year, these plans to comply with standard and accepted methods of sewage treatment and to contain only such elements as are necessary to comply reasonably with the policy stated in the Delaware River sewage zoning agreement between the New Jersey and Pennsylvania Departments of Health. (For the zoning agreement and for the Trenton sewage-works resolution of May 1, see *Engineering News-Record*, Aug. 10, 1922, p. 243, and May 31, 1922, p. 972.)

In its resolution of May 1, rejecting the plans then before it, the board advised Trenton that in its opinion sedimentation alone would be sufficient treatment for the sewage of that city for ten years and probably longer, or that in lieu thereof fine screening and lime treatment, with use of sludge thickeners, would do. The resolution also gave Trenton a month to reconsider the plans and afforded it a chance to re-submit the rejected plans for consideration by the board as for an experimental process. The Trenton City Commission accepted neither alternative. Instead, it again submitted the old plans for unconditional approval, accompanied by a resolution stating that it considered the direct-oxidation process the best and most satisfactory method of sewage treatment available.

The resolutions adopted by the New Jersey Board of Health on July 31 follow:

Whereas, The Board of Commissioners of the City of Trenton have, at their meeting held on June 8, 1923, adopted a resolution requesting the State Department of Health of New Jersey to approve plans for a sewage disposal works for the purpose of treating the sewage of Trenton and have expressed it as the opinion of said commissioners that the system of direct oxidation provided for in plans submitted to this Department for approval on Dec. 15, 1922, and referred back to the said commissioners by this department on May 1, 1923, for reconsideration, is the best and most practicable method for the City, and

Whereas, The proposed sewage disposal plant for the City of Trenton is to be constructed because of proceedings initiated by this department in the chancery court compelling action by the commissioners of the City of Trenton, and

Whereas, The Department of Health of the State of New Jersey in conjunction with the Department of Health of the State of Pennsylvania, on June 20, 1922, adopted a policy declaring, insofar as the policy affects the City of Trenton, that "Sewage discharged into the tidal portion of the Delaware River, from and including Morrisville and Trenton and to and including Philadelphia and Camden, shall be treated by means of sedimentation and the effluent discharged through submerged outlets into deep water in the Delaware River; . . . provided, that when plans for sewage treatment works are approved, where sedimentation of sewage is the only treatment required under this policy, the approval shall be subject to the condition that means for the further purification of the tank effluent shall be installed when deemed necessary by the State Department of Health.

Whereas, This Department is of the opinion, and so stated in a resolution passed on May 1, 1923, that the direct oxidation method of sewage treatment is still in an experimental stage and has not as yet been demonstrated as a practical and continuous method for the treatment of sewage, and is informed that the system has as yet not been endorsed or accepted by the engineering profession skilled in the treatment and disposal of sewage,

Therefore, Be It Resolved, That the Department of Health of the State of New Jersey does hereby reject the plans for the direct oxidation method as submitted by the City of Trenton and directs said city to file with this department, within one year, plans for a sewage disposal works in accordance with accepted and approved standards and methods for the treatment of sewage and containing only such elements as are necessary to comply reasonably with the terms of the policy adopted by the State Department of Health of Pennsylvania and the State Department of Health of New Jersey on June 30, 1922, above referred to, said new plans to be readily adaptable to providing additional means of purification later on if and when in the opinion of the Department that shall become necessary, provided, however, that the extension of time shall meet the approval of the chancellor.

To Build Vehicular Tunnels at New York City

Gov. Smith of New York has announced that he will recommend to the Port of New York Authority that it proceed at once to issue the necessary bonds to finance the construction of two vehicular tunnels under the Hudson River at New York City. Gov. Smith expects to confer with the Port Authority as to the location of these tunnels. They will be in addition to the one now under construction at Canal St. and will probably be located farther uptown; one will probably be in the neighborhood of 14th St.

To Use Old Canal Plane as Hydraulic Laboratory

The New Jersey Department of Conservation and Development is working upon a plan for the establishment of an hydraulic laboratory at the site of the old inclined plane of the Morris and Essex Canal near Boonton. The contemplated laboratory would be made part of the Rutgers College School of Engineering to be used in conducting tests on all kinds of hydraulic equipment. The site of the old canal plane is an ideal one, as such experiments can be carried out without interfering with the existing water power rights at that point. At the same time it will be possible to preserve the old plane.

Albany Appropriates $600,000 for Filter Plant Improvements

An appropriation of $600,000 has been made by the city authorities of Albany, N. Y., to overhaul the water purification plant and build a 10,000,000-gal. coagulating basin in accordance with recommendations of Allen Hazen, consulting engineer, New York City, in a report to F. A. Raven, commissioner of public works. The slow sand filters built over twenty years ago with Mr. Hazen as engineer are reported by Mr. Hazen as being still in good shape but new sand handling equipment and new orifices and gages are advised, the latter because of an increased rate of filtration. The scrubbers installed some years after the slow sand filters were built are to be repaired and improved; the old sedimentation baffled; some piping and Venturi meters added; the pumping plant changed; and dry-feed apparatus for alum provided at an estimated cost of $29,000. There is an item of $52,000 for wash-water pumps and tanks and $40,000 for a new laboratory building and equipment. Extension of metering is advised as a readily possible means of still further reducing the per capita consumption so the original slow sand filters, operating at an increased rate due to the preliminary treatment—coagulation, sedimentation and rough filtration—may suffice for years to come. Possible new sources of supply, with particular references to gravity supplies, are reviewed but no specific action to this end is advised.

Civil Service Examinations

UNITED STATES

For the U. S. Civil Service examinations listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Hydrographic and topographic draftsman — Vacancies in the Coast and Geodetic Survey, at an entrance salary of $1,400 a year plus the increase of $20 a month allowed by Congress, and vacancies in positions requiring similar qualifications.

Hydrographer—Vacancy in the Reclamation Service at El Paso, Tex., and Powell, Wyo., at salaries ranging from $1,680 to $1,920 a year, plus the increase of $20 a month allowed by Congress, and vacancies in positions requiring similar qualifications.

Applications for both must be filed with the Civil Service Commission, Washington, D. C., by or before Sept. 11, 1923.

Tunnel Contractor's Claim for Extras Denied by Higher Court

Reversing a decision rendered by the federal district court a year ago, the U. S. Circuit Court at Boston last week denied the claim of Patrick McGovern for extra compensation because of encountering a ledge of rock in digging the Dorchester tunnel. The case has been in the courts for five years. It was dismissed by the Massachusetts Supreme Court in 1918, and later was carried into the federal courts. A master appointed by the district court found in favor of McGovern, awarding him $135,000 compensation, and this award was confirmed by the court. On the city's appeal to the circuit court this decision has now been reversed.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; Annual Conference, Chicago, Sept. 27-28, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 15-17.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga.; Nov. 12 to 16.

Personal Notes

F. H. Cothran, formerly resident manager of the Quebec Development Co. and the Alma & Jonquiere R.R., is now vice-president of these companies at St. Joseph d'Alma, Province of Quebec. The Quebec Development Co. is building a 480,000-hp. hydro-electric development on the Saguenay River.

V. A. Kaufman has been appointed assistant chief engineer on the Moffat Tunnel Work. He is the man who had charge of the original survey for the commissioners and supervised the drawing up of the plans and specifications. Mr. Kaufman is a civil engineer graduate of Ohio Normal University. He has had charge of various railway rock and tunnel projects in the West, and was for some time construction engineer for the Rio Grande, Sierra Madre & Pacific R.R. in Chihuahua, Mexico.

Robert Hoffman, city engineer of Cleveland, was tendered a banquet at Wade Park Manor recently by the members of his organization in honor of the completion of thirty years' service as the head of his department. The principal speaker of the evening was former Secretary of War Newton D. Baker.

A. W. Zesiger, formerly bridge engineer for Cuyahoga County, has recently been appointed by State Highway Director L. A. Boulay as chief engineer of bridges. Mr. Zesiger assumed his new duties in Columbus Aug. 1.

Carl J. Sittinger, for the past four years associated with John A. Stevens, consulting engineer, of Lowell, Mass., is now engineer in the Electrical Division of Stone & Webster, Inc., of Boston, Mass.

John B. Bray, commissioner of public works, Raleigh, N. C., has been appointed city manager of Elizabeth City, N. C. C. C. Page has been elected commissioner of public works succeeding Mr. Bray.

Grosvenor W. Stickney has been appointed city engineer of Wheaton, Ill., to succeed L. W. Ruddock, resigned. Mr. Stickney has been for some time assistant engineer with A. L. Webster, municipal and drainage engineer, of Wheaton.

Frank C. Squire, Portland, Ore., has been appointed engineer of the Western Group, President's Conference Committee, Federal Valuation of the Railroads in the United States, effective Aug. 1. Mr. Squire is at present valuation engineer of the Oregon-Washington R.R. & Navigation Co. at Portland.

Prof. Harold A. Thomas, for eight years associate professor of civil engineering and for the past five years professor of hydraulics at Rose Polytechnic Institute, Terre Haute, Ind., has been appointed professor of theoretical hydraulics and of hydraulic and sanitary engineering at Carnegie Institute of Technology, Pittsburgh, Pa. Prof. Thomas obtained his C. E. degree from Columbia University in 1908. In his professional work he has served as a member of the engineering corps of the New York State Water Supply Commission, member of the engineering corps of the Great Northern R.R., assistant engineer for the Miami Conservancy District on flood-control work, and as consulting and practising civil and hydraulic engineer at Terre Haute, Ind. He is a pioneer in concrete research work.

J. H. Gandolfo, who joined the engineering department of the Power Corp. of New York and the Northern New York Utilities, Inc., of Watertown, N. Y., in 1922 has been appointed chief designing engineer of these organizations. Mr. Gandolfo was formerly with the Hudson & Manhattan R.R. Co., J. G. White Engineering Corp., Westinghouse, Church, Kerr & Co., and the Division of Architecture and Construction, State of N. J., and has had charge of the design and construction of many important structures in the United States and its possessions.

Fred R. White, state highway engineer of Iowa, is now actively engaged in directing the affairs of the American Association of State Highway Officials. With the resignation of Charles J. Bennett, the State Highway Commissioner of Connecticut, Mr. White automatically succeeded in the presidency of the organization.

Obituary

John P. Leo, who was street cleaning commissioner of New York City from January to November, 1921, died July 23 of heart disease at Pawling, N. Y., where he was visiting. Previous to 1921 Mr. Leo had served on the New York snow removal committee which handled the exceptionally heavy snowfall of 1921, and as chairman of the Board of Standards and Appeal.

Edwin E. Baker, of Greeley, Colo., one of the state's oldest engineers, died recently at the age of 78 years. Mr. Baker built the Riverside reservoir near Sterling, Colo., the Tarry Lake reservoir near Fort Collins, the Fort Morgan canal, and the Platte and Beaver canals near Brush, Colo. He was a native of Fort Wayne, Ind., and a soldier in the Civil War.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Manufacturers Adopt Standard Size for Common Brick

Through the co-operation of the Division of Simplified Practice of the Department of Commerce the common brick industry has discarded a great variety of odd sizes of brick and established one standard size for the seven billion building brick produced every year in the United States. This size is approximately 8 x 3¾ x 2¼ in. The only exception now to be allowed is in the case of smooth-faced brick for special exterior use, in which a slight variation in one dimension only is permissible.

The common brick industry established the standard size some years ago, but experienced trouble because its standard was not insisted upon for public work and by many architects. With the Government now definitely supporting the industry in its efforts to standardize its product it is expected that before long all specifications will call for standard sized brick, to the great benefit not only of the brick industry but to all users of its product.

New Plant for Meter Company in Five-Story Building

On a 2½-acre plot of ground in the Brushton district of Pittsburgh, a five-story building is nearing completion which will contain the new offices and works of the Pittsburgh Meter Co., manufacturer of water and gas meters. Founded in the '80's, the company was first known as the Safety Appliance Co., later as the Fuel Gas & Electric Co.; since 1895 it has operated under its present name. The early types of gas meter manufactured by the company were the invention of George Westinghouse. The building which will house the new plant is 80x300 ft. In plan, five stories high and will provide a floor space of approximately 150,000 sq. ft. The building is served by a private siding from the Pennsylvania R.R.

Heavy Duty Truck Sales Increase

All sales records for the first six months of any year in the history of the General Motors Truck Co., Pontiac, Mich., were broken during 1923, according to a tabulation just completed. During the first six months of the present year, this company sold 171 per cent more trucks than during the same period of 1922; the figures show that the so-called heavy-duty models have grown in popularity during the last year.

During the first half of this year the company sold 284 per cent more heavy-duty trucks than during the corresponding period of a year ago. While national figures show that the 1-ton truck is by far the most popular model made by truck manufacturers, this company asserts that the heavy duty units are fast overhauling the 1-ton models.

Tests of Interlocks Point Way to Safer Elevators

About three-fourths of all fatal elevator accidents are found to occur at the hoistway door, either because of the door being opened when the elevator is not there or because of the elevator starting when the door is open. These accidents, according to the U. S. Bureau of Standards, can be prevented by a reliable interlock, as when such a device is used the elevator must be stopped at the floor before the door can be opened, and the door must be closed before the car can be started again.

During the past year the Bureau has been conducting tests to determine the reliability of the various types now on the market. The devices have been given endurance tests under normal conditions, they have been tested in a corrosive atmosphere, in a dust-laden atmosphere, without lubrication, and under conditions of misalignment likely to occur in practice. The tests were conducted at the request of the City of Baltimore, and will permit city governments to base their approval of such devices on actual performance tests instead of on visual inspection alone. The results have also been made available to the manufacturers of the devices tested, and in most cases they have improved their designs in accordance with the suggestions offered.

Chart Shows Trucks Needed With Mechanical and Hand Loading

By W. H. Bosworth
Field Sales Engineer, The Geo. Haiss Manufacturing Co., Inc., New York

The accompanying diagram shows the number of trucks required to haul a given daily yardage of material —sand, gravel, crushed stone, cinders or earth—for distances of ½ to 10 miles, with hand loading and mechanical loading of trucks. Approximate average conditions are assumed: 9-hour day; 5-yd. trucks; loaded speed, 8 miles an hour; empty speed, 12 miles an hour; allowance for dumping, 1 min.; time of hand loading for sand, 17 min.; time of hand loading for stone, 25 min.; time of loading with truck loader, 4 min.

To illustrate the use of the diagram assume the case of a contractor who must deliver 300 cu.yd. of crushed stone daily with a haul (one-way) of 3 miles. How many 5-yd. motor trucks will he need if the loading is (1) by hand: (2) by mechanical loader?

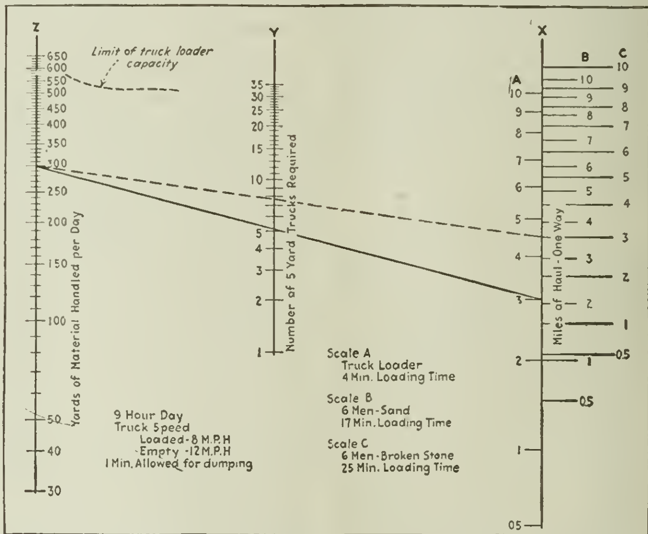


Diagram for Determining Number of Trucks Needed with Mechanical and Hand Loading

A line drawn between the yardage to be moved per day on "Z," and the length of haul on "X," to the proper scale, A, B, or C cuts "Y" at the number of 5-yd. trucks required. Similarly, a line from the haul on "X" through the trucks available on "Y" will meet "Z" at the yardage which can be moved with that combination of equipment.

For hand loading: On left-hand scale, (Z) select point at 300 (yd. of material to be handled daily) and on right-hand scale (X-C, for broken stone) select point at 3 (miles of haul, one-way). Join the two points with straight line and at intersection of this line with middle scale (Y) read "8" trucks.

For mechanical loading: Repeat process, except use right-hand scale (X-A) instead of scale (X-C). The trucks needed in this case are shown to be "5", or a saving of 3 trucks with mechanical loader.

The rates of hand loading are for 6 men per truck and are about twice the daily average. The men will load

half the time and rest the other half. The rate of mechanical loading assumed will be equalled or excelled by any high-powered truck loader, mounted on caterpillars and with self-feeding device and crowding speed, in any loose material. Scale A, for the truck loaders, is also applicable to any other mechanical means of loading of the same approximate capacity, such as power-shovels, crane and clamshell bucket, etc.

The diagram is only true for the conditions assumed, but they are reasonable. It shows forcibly one reason why machinery is used so largely for loading which has not been stressed so much as the obvious one of saving in cost of actual loading, and that is the greater efficiency of the trucks. When 500 yd. of stone are to be moved each day, mechanical loading saves 5 trucks, each of which costs more to operate than the loading machine. As a matter of fact the money saved in this way is usually greater than the saving in cost of actual loading.

The answer for other conditions than those assumed can of course be approximated from the diagram. The number of trucks required will vary approximately inversely as their capacity. If the speed at which the trucks travel is not as assumed, the number required will vary approximately directly as the total round-trip time, including loading. Different loading rates can be interpolated approximately on the line X.

Report on Bethlehem Plan of Employee Representation

President Eugene G. Grace, of the Bethlehem Steel Co., made public July 27 the first report on the results of the plan of employee representation which has been in effect at the plants of the company since 1917. Of the 2,365 cases which actually reached the employees' representatives in committee and in some instances reached joint committees as well, 1,682, or 71 per cent, were settled in favor of the employees. In the Bethlehem plan elected employee representatives operating by themselves, with negotiating powers through committees of their own choosing, and also in appeals through joint committees with appointed management representatives, pass upon every matter arising out of the employment relationship which has not been satisfactorily settled in the first instance with the ordinary plant authorities for individuals or for groups.

Three hundred and thirty cases raised by employees, or 14 per cent of the total, were settled in the negative, most of them in the first stage by the employee representatives' own committee, without the complainer availing himself of the appeal provisions of the plan. Over 201 cases, or 8.5 per cent, were withdrawn by the employees concerned after the facts were brought out. Over 103, or 4 per cent, were compromised, and only 49 were pending settlement in four large plants using the plan.

Since the inauguration of the plan in 1917, 2,365 cases have been adjusted; 612 of these cases, or more than one-fourth were directly concerned with employment and working conditions; 570 other cases which came up for adjudication dealt with wages, piecework, bonus and tonnage scheduled.

Simplified Asphalt Grades Win Endorsement

Substantial progress has been made in securing endorsement by both asphalt producers and consumers of the simplified scale of 10 grades (as determined by penetration limits) adopted at the joint conference with the Division of Simplified Practice of the Department of Commerce held in Washington, D. C., May 28.

"Engineering News-Record" has received from the Department of Commerce the following report on the status of the movement for fewer grades:

"To date (July 30, 1923), we have received acceptances to the asphalt simplification from the Asphalt Association, which speaks for its entire membership, the American Society for Testing Materials, and 15 out of 48 state highway engineers. This indicates that the project is going smoothly and we are in hopes of getting the remainder of acceptances from the engineers within the next two weeks."

Committee Names Three Sizes for Tilting Mixers

The Joint Committee on Construction Equipment, at a meeting held in Chicago this week, recommended for adoption as standards three sizes—3½, 5 and 7 cu.ft.—of concrete mixers of the tilting type.

The committee, at its previous meeting, June 27-29, considered only the non-tilting type of mixer, recommending four sizes of building mixer—7, 14, 21 and 28 cu.ft.—and three sizes of paving mixer—7, 12 and 21 cu.ft., as reported in *Engineering News-Record* of July 5, p. 36 and July 19, p. 120.

Business Notes

WESTERN WHEELED SCRAPER CO., Aurora, Ill., announces that W. G. Sharretts has been transferred from the Atlanta territory to take charge of the New York Office. He will have charge of the company's domestic sales in the Eastern territory with contractors as well as industrial and railroad companies, selling arrangements heretofore existing in New York having been cancelled.

GINSBERG-PENN CO., INC., New York, sales representatives for construction machinery, has been appointed, effective Aug. 1, to take on exclusive distribution of the line of locomotive auto and Truckranes manufactured by the Byers Machine Co., Ravenna, Ohio. Frank I. Ginsberg, president of the distributing company, was formerly with the R. E. Brooks Co. and the Insley Manufacturing Co., Hamilton, O. Penn served with the T. L. Smith Co.

VULCAN IRON WORKS, Wilkes-Barre, Pa., announces the appointment of Thomas MacLachlan as manager of its New York office, succeeding M. E. Davis. The company manufactures locomotives, electric hoists, steel castings, cement mills, coolers and dryers.

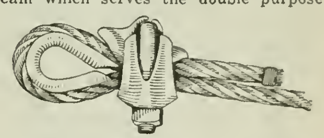
CLERMONT CLAY PRODUCTS CO., Philadelphia, has been organized to take over the plant and property of the International Clay Products Co., manufacturing underground conduits at Clermont, Pa.

A. S. MOODY, assistant Northwest manager of the General Electric Co., Schenectady, N. Y., has been appointed local manager of the Los Angeles office of the same company, to succeed R. L. Cash, who has been transferred to Schenectady. Mr. Moody has been identified with the General Electric Company on the Pacific Coast section for the past 16 years.

Equipment and Materials

Safety Clamp for Wire Rope

For fastening wire rope a clamp with a U-bolt and self-tightening cam which it is claimed cannot slip or crush the cable, is being manufactured by the Mal-Gra Casting Co., Cambridge City, Ind., under the trade name of the Keator safety clamp. The clamp, as shown in the accompanying illustration, is applied square with the cable and tightened with a wrench. A feature of the device is the use of a grooved cam which serves the double purpose



of protecting the cable from the concentrated pressure of the U-bolt and of providing an eccentric movement which causes it to increase its grip as the cable turns it under pressure. Only one clamp of the Keator type is said to be required for each cable. The self-tightening feature it is pointed out automatically compensates for the shrinkage of the cable under load, and merely grips the tighter as the load increases.

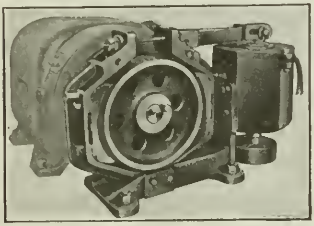
New 1¼-Yd. Heavy-Duty Shovel

To its line of revolving steam shovels, the Osgood Co., Marion, O., has added a new 1¼ yd. heavy-duty model of the full revolving type, mounted on crawler treads. The shovel, designed for heavy work, has over-sized castings and large bearing surfaces at points of great stress. The boom and dipper handles are built up of white oak timber shrouded with plate steel and the whole securely bolted to form solid units. Double gearing on the dipper shaft insures equal application of power to the dipper handle racks, eliminating side strain and twisting. The continuous tread mounting has an all-gear drive. In general design, the machine is patterned after the Osgood ¾-yd. shovel.

Quick-Acting Solenoid Brake for Crane Service

A quick-acting, powerful solenoid brake has been designed especially for crane service by the Whiting Corp., Harvey, Ill. The brake arms are so pivoted that the shoes release equally at all points, preventing dragging. The shoes are cast iron filled with a durable and heat-resisting asbestos composition. To take out the shoes it is only necessary to remove four cap screws and pry the shoe out. Under ordinary conditions, the manufacturer states, adjustment is required only once a month.

The brake is made in both direct-current and alternating-current models. On



the former, the plunger is of soft iron of large diameter, giving a fast operating solenoid even at light loads. The d.c. coils are designed to operate the brake at about 40 per cent full load current and remain open at 10 per cent or less full load current. The voltage lost in the coil in most averages less than 4 per cent, and in no case more than 7 per cent. On the alternating-current type, the plunger is of laminated iron of proper thickness for the service intended.

For test purposes a 12-in. brake was mounted on a 25-hp., 550-r.p.m., direct-current motor. The motor was stopped 50,000 times at a rate of 325 stops per hour without resulting in excessive wear of the brake shoes.

Publications from the Construction Industry

Rolling Steel Doors—J. G. WILSON CORP., New York, in a 72-p. illustrated catalog explains the design and operation of its rolling steel doors and illustrates the variety of their use in industrial and commercial buildings. The standard doors are made of slats of open-hearth or copper-bearing steel which are raised or lowered by winding on a shaft operated either by hand or electric motor. Among typical installations shown in about 30 pp. of photo graphs are warehouses, car barns, railway shops, power stations, freight sta tions, docks factories and airplan hangars.

Waterproofing — GARDINER & LEWIS, INC., New York, has published a 32-p. pamphlet, illustrated, dealing with the principles underlying the manufacture, use and specifications for bituminous materials employed for waterproofing. A number of specific waterproofing problems are presented, with drawings, in which the use of the company's Karnak membrane water-proofing is em ployed in buildings, swimming pools, reservoirs and dams, and steel and concrete bridges.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

N. Y. Builders Increase Support for Apprenticeship Work

An appropriation of $25,000 has been made by the New York Building Trades Employers' Association to the New York Building Congress for the work of the Apprenticeship Commission during the ensuing year. This represents a material increase over last year's appropriation of $8,000 by the same body for this purpose.

It is anticipated that the local labor organizations also will again contribute to the work of the commission as they did last year.

This enterprise is a joint undertaking of the building trades employers, building trades labor and the city educational authorities to provide a systematic training for apprentices in the several building trades. Its work was described and discussed at greater length in *Engineering News-Record* of Jan. 11, 1923, p. 62 and April 19, 1923, p. 695.

Lumber Movement Gains

The nation's lumber business for the week ending July 21 showed an appreciable gain over the preceding week, according to the weekly review of the National Lumber Manufacturers Association. With only 408 of the larger commercial mills of the country represented, as compared with a revised total for 423 for the preceding week, new business, shipments and production showed gains. As compared with last year the week also showed advances in all three factors. The 137 Southern pine mills gave their unfilled orders as 250,985,085 ft. as compared with 252,785,610 ft. the preceding week and 128 West Coast fir mills gave their unfilled orders as 306,985,928 ft., as against 349,761,933 ft. the week before, the net decline in unfilled orders for both groups taken together being 44,576,530 ft.

For all the reporting mills shipments were 87 per cent and orders 78 per cent of actual production. For the Southern pine mills these percentages are respectively 90 and 87 and for the West Coast mills 100 and 90. Most of the mills have an established normal production figure for the week, in relation to which actual production was 107, shipments 95 and orders 86 per cent.

The following table gives the lumber movement for the week ending July 21, the corresponding week of 1922 and the preceding week of 1923 for purposes of comparison:

	Week Ending July 21	Corresponding Week 1922	Preceding Week 1923 (Revised)
Mills	408	368	423
Production, ft.	273,971,556	224,534,859	263,569,278
Shipments, ft.	238,532,807	214,745,867	231,313,698
Orders, ft.	214,822,645	206,982,446	208,265,237

The following table compares the reported lumber movement for the first 29 weeks of 1923 and for the same period in 1922:

	Production, Ft.	Shipments, Ft.	Orders, Ft.
1923....	7,102,633,635	7,331,430,859	7,220,550,231
1922....	5,901,915,595	5,997,527,955	6,357,825,589
1923 Increase	1,200,718,040	1,333,902,904	862,724,642

Million Mark Again Passed in Freight Car Loadings

Loading of revenue freight for the week which ended on July 14, according to the Car Service Division of the American Railway Association, totaled 1,019,667 cars. This total fell short 2,103 cars of equalling that for the week of June 30 this year, when 1,021,770 cars were loaded, the greatest number for any one week in the history of the railroads, but this was the second time within three weeks that the previous record, which was made during the week of Oct. 14, 1920 at which time 1,018,539 cars were loaded, has been eclipsed.

Including the week of July 14, the million-car loading mark has been exceeded in six out of eight consecutive weeks so far this year, the average loading for the six weeks being 1,013,118 cars. In 1920, the million-mark was reached only on five occasions and then only in the fall of the year. The average for those five weeks was 1,009,688 cars. The million mark was reached in only two weeks in 1922, but never attained in 1921 or in any week prior to 1920.

From Jan. 1 this year to July 14, inclusive, 25,887,240 cars were loaded with revenue freight. This was an increase of 4,309,272 cars or 20 per cent over the corresponding period last year, and an increase of 5,785,900 cars or 28.8 per cent over the corresponding period in 1921. It also was an increase of 2,676,475 cars or 11.5 per cent over the corresponding period in 1920. In making comparisons with last year, however, consideration must be given to the fact that coal shipments were curtailed by the miners' strike which began on April 1, while on July 1 a strike of railway shopmen also went into effect, both continuing until early fall.

Malleable Castings

The Department of Commerce announces statistics on the production of malleable castings manufactured for sale during June, 1923, as shown by reports received by the Bureau of the Census. The figures for May are revised to include reports received since the preliminary bulletin for that month was issued. The returns include only those castings manufactured for sale as such and do not include those used in the plant or finished and sold as other products.

The returns for June include 96 establishments and show that during the month these plants were operated 67.3 per cent of their total capacity. The revised figures for May include the production of 90 establishments which were operated 71 per cent of their total capacity during the month.

Month	Plants Reporting (Number)	Total Production (Tons)	Total Shipments (Tons)	Orders Booked (Tons)	Monthly Capacity of Plants (Tons)
June.......	96	61,949	61,441	38,536	92,004
May......	90	64,726	62,806	52,898	91,174

July Contracts Over Thirty-Six Per Cent Heavier Than for Corresponding Period in 1922

Falling Off of Thirteen Per Cent Compared With June Awards—Gains in Bridges, Excavations, Streets and Roads

The total value of contracts awarded on large engineering construction projects during July, totaled $163,459,000 as against $188,786,000 for the preceding month. This represents a drop in actual money value of over 13 per cent in one month. Compared with July of last year, however, a gain is noted of somewhat over 36 per cent.

The number of awards totaled 755 during July, with an average value of $216,502 as compared with 816 in June, averaging $231,355.

Minimum costs observed in Construction News on each class of construction are as follows: Water-works, $15,000; other public works, $25,000; industrial construction, $40,000; and commercial buildings, $150,000.

Of the $163,459,000, a total of $8,436,000 represented Canadian awards, which fell off 20 per cent during July.

All classes of construction fell off during July except bridges, excavations and streets and roads. July bridge contracts nearly doubled those of June in total money value, although no single project reached above $780,000. Excavation, drainage and irrigation lettings gained heavily. Increases in these classifications were induced by several large jobs such as the four track subway at Rochester, N. Y., valued at $1,654,765 and a portion of two tunnels, approaches to river section of Hudson River Tunnel, $3,467,414. Streets and roads awards gained over 10 per cent during the month.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 61 to 73, are the following:

Temple, Louisville, Ky., for Kosairs Association, $1,600,000.

Foundation, Minneapolis, Minn., for H. S. Goldie, agent, bids on superstructure at later date, total cost $1,300,000.

Railway, Manitoba, Canada, from Beaconia to Ft. Alexander, for Manitoba Pulp and Paper Co., Ltd., $3,000,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 61 to 73, are the following:

Medical Association building, Seattle, Wash., to Great Northern Construction Co., $1,800,000.

Subway, Philadelphia, Pa., to Keystone Construction Co., $1,198,555.

Engineering News-Record Construction Cost Index Number

August, 1923	221.50
July, 1923	222.10
August, 1922	173.40
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number declined 0.6 points since last month due to drop in lumber. Prices of other basic materials remained unchanged during month. The average rate for common labor is still 54c. Thus, general construction cost is 28 per cent higher than one year ago and 19 per cent under the peak; it is 121 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
July, 1923 *(4 issues of E. N.-R.)*	128
June, 1923 *(4 issues of E. N.-R.)*	148
July, 1922 *(4 issues of E. N.-R.)*	118
1913	100
Yearly	
1922 (entire year)	130
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 128 for the month of July, and 130 for the whole of 1922, as against 100 for 1913. This means that the actual volume of construction in 1922 (not the mere money-value of the contracts let that year) is 30 per cent above the volume of construction for 1913. Our monthly volume number, 128 for July, 1923, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING JULY, 1923

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total United States	Canada	Total
Waterworks	....	$612,000	$195,000	$1,925,000	$867,000	$59,000	$3,658,000	$145,000	$3,803,000
Sewers	....	884,000	194,000	706,000	·939,000	196,000	2,919,000	264,000	3,183,000
Bridges	$780,000	526,000	800,000	702,000	803,000	330,000	3,941,000	500,000	4,441,000
Excavation, drainage and irrigation	....	5,146,000	828,000	36,000	570,000	22,000	6,602,000	300,000	6,902,000
Streets and roads	1,435,000	8,649,000	6,268,000	11,691,000	8,148,000	4,495,000	40,686,000	1,711,000	42,397,000
Industrial works	1,308,000	3,215,000	1,936,000	5,105,000	3,090,000	609,000	15,263,000	140,000	15,403,000
Buildings	5,177,000	9,708,000	7,683,000	20,943,000	8,314,000	10,909,000	62,734,000	1,791,000	64,525,000
Federal Government	197,000	638,000	1,251,000	420,000	1,166,000	179,000	3,851,000	......	3,851,000
Miscellaneous	....	5,255,000	4,910,000	516,000	1,769,000	2,919,000	15,369,000	3,585,000	18,954,000
July, 1923	$8,897,000	$34,633,000	$24,065,000	$42,044,000	$25,666,000	$19,718,000	$155,023,000	$8,436,000	$163,459,000
June, 1923	10,193,000	43,357,000	15,373,000	58,783,000	29,945,000	20,936,000	178,587,000	10,199,000	188,786,000
May, 1923	16,059,000	50,418,000	23,813,000	45,360,000	25,589,000	30,793,000	192,032,000	26,680,000	218,712,000
Total 3 months	$35,149,000	$128,408,000	$63,251,000	$146,187,000	$81,200,000	$71,447,000	$525,642,000	$45,315,000	$570,957,000

Labor Rates and Conditions Throughout the Country

Industrial operations, generally are proceeding at a rate somewhat over 80 per cent of capacity. The slowing down process now in effect in certain industries is purely seasonal, while in others the reserve materials stocks have apparently reached a point adequate to current trade requirements.

According to latest reports of the United States Department of Labor, employment shows decreases in the following basic industries: paper and printing; vehicles for land transportation; stone, clay and glass products; textiles; iron, steel and other metals.

Increases, however, were noted in the following: leather; lumber; beverages; food; railroad repair shops; tobacco and chemicals.

Wages paid common laborers, pick and shovel men in construction operations, remain at the July rate of 54c. as against 53c. per hr. during June, according to *Engineering News-Record* figures. Local building conditions are as follows:

Atlanta—Building permits indicate that peak has been reached; slowing down expected.

Baltimore—Scarcity of bricklayers, carpenters, hod carriers and common laborers. Conditions otherwise normal.

Boston—Scarcity of bricklayers, carpenters, and pile drivers; plenty of other crafts. Bricklayers attracted to New York by higher wages. Minimum

CURRENT BUILDING TRADES WAGE RATES PER HOUR
(Higher rates indicated by +, decreases by —)

Cities	Brick-layers	Car-penters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.90	$0.70	$0.50	.....	$0.75	$0.30@.35
Baltimore	1.50	1.00	.80@1.00	.87½	$0.65	.80@1.00	.30@.50
Birmingham	1.00	1.00	.50@1.00	.30@.40	.....	1.25	.30@.40
Boston	1.25	1.05	+1.25	.82½	1.05	1.12½	.55@.70
Cincinnati	1.25	1.05	1.05	.82½	1.05	1.05	.45
Chicago	1.25	1.15	1.00@1.25	.88¾	1.10	1.25	.82½
Cleveland	1.40	1.25	1.25	.87½	1.00	1.10	.87½
Dallas	1.50	1.00	1.00	.40	.87½	1.00	.30@.50
Denver	1.37½@1.50	1.12½	1.12½@1.18¾	.75@.81¼	1.00	1.15⅝	.35@.55
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.37½	1.00	1.00@1.25	.90	1.00	1.15	.35@.60
Los Angeles	1.25	.87½@1.00	.87½@1.00	.62½	.....	1.00	.50
Minneapolis	1.12½	.87½	.87½	.71½	.....	.87½	.55
Montreal	1.00	.65	.50	—.35	.50	.65	—.30
New Orleans	1.00	.90	.90	.65	.80	1.00	.35@.40
New York	1.50	1.25	1.50	1.00	1.00	1.12½	+.65@.75
Pittsburgh	1.40	1.20	1.12½	1.00	.....	1.25	.60
St. Louis	+1.50@1.75	1.25	1.25@1.37½	1.25	1.25	+1.25@1.50	+.50@1.00
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	1.12½	1.00	1.00	.93¾	1.00	1.12½	.50@.62½
Philadelphia	1.37½	1.12½	1.00	.75@1.00	1.10	1.10	.50@.65

rate to hoisting engineers advanced 25c.

Dallas—Excessive demand for bricklayers. Slight unemployment in common labor.

Detroit—Conditions normal in all trades.

Kansas City—Scarcity of bricklayers and carpenters; plenty of other crafts.

Montreal—Scarcity of bricklayers; carpenters not plentiful. Ample supply of other trades. Common labor wage rate at maximum of 30c., against 35c. per hr., last month.

New Orleans—Carpenters on strike since July 17, demanding "closed shop" at present rate or $1 per hr. with "open shop" conditions. No other crafts have struck in sympathy, as anticipated. Exodus of negro labor to North seriously affecting agricultural interests.

New York—All trades working. Construction has fallen off to a degree consistent with the supply of labor. Cement workers called off strike, accepting 93¾c. as against 81¼c. per hr. Difficulty experienced in obtaining bricklayers to work on school construction at established rate of $12 per day, when other building operations offer as high as $16. Tendency toward cost stabilization has prompted builders to lift ban on new construction projects.

St. Louis—Shortage of bricklayers and hod carriers. Carpenters union has voted to demand $1.50 per hr., an advance of 25c. The union has no contract with the builders. Jurisdictional dispute exists between carpenters and metal workers as to installation of metal trim. Bricklayers, structural iron workers and common laborers receiving higher wages than month ago.

San Francisco—All building crafts busy. Active construction program in sight.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Birmingham base on No. 2 foundry, $25 as against $27 per gross ton, one month ago. Lower prices tempting heavier volume of inquiries. New buying continuing on better scale but in small tonnages. Foundry and bessemer expected to develop firmer tendencies.

Railway Supplies—Track accessories in good demand; prices firm at July levels. Slight downward tendency in rerolled rails at Pittsburgh.

Pipe—No changes in prices of wrought steel and iron pipe, cast-iron pipe and clay drain tile. Buying of merchant steel pipe improved. Sewer pipe advanced slightly in Dallas and declined in Atlanta, during month

Road and Paving Materials—Crude oil output at new high mark. Road-oils' prices unchanged. Bulk asphalt declined slightly in Boston and Cincinnati. Granite paving blocks, 5-in., dropped $5 per M. in Boston. Wood-block paving declined slightly in Boston and New York.

Sand, Gravel and Crushed Stone — Gravel, ¾-in., dropped 50c. in New York, 10c. in St. Louis and advanced 13c. per cu.yd. in Dallas, during month. Sand declined 6c. in Dallas and 10c. per ton in Cincinnati. Crushed stone remained firm in nineteen cities reporting to *E. N.-R.*, with the exception of a slight advance in St. Louis.

Lime—Boston and Atlanta report declines both in hydrated and lump. Common lump, however, advanced sharply in San Francisco. New York prices remain unchanged despite shortage of finishing lime.

Cement—Mill prices firm. Price advanced 10c., f.o.b. Boston and Kansas City and 11c. per bbl. in Duluth, Minneapolis and St. Paul. San Francisco, however, reports drop of 8c. per bbl. in month.

Structural Steel—Buying on the increase, particularly in plates. Oil-storage tank, car materials and track accessories requirements taking bulk of business. Price of plates and shapes firm at $2.50 per 100 lb., Pittsburgh, for shipments at convenience of mill; as high as $2.60, however, obtained for small lots, or where immediate deliveries are required. Structural inquiries better; confined to small tonnages.

Brick and Hollow Tile — Common brick advanced from $20 to $21@$22 per M., wholesale, alongside dock, New York, since July 5. Slight rise also reported in Birmingham. Brick dropped 50c. in Boston; $1 in Detroit and $2 per M. in Atlanta. Hollow tile declined in St. Louis and Atlanta, and advanced slightly in Boston, during month.

Lumber—Price tendency continues downward throughout the country owing to decrease in demand. New York reports drop of $1 and Chicago, $2 per M. ft. in yellow pine timbers, during month. Declines also reported in New Orleans, Atlanta, Dallas and Birmingham. Slight advances, however, developed in Boston, Baltimore, Denver, Minneapolis, Kansas City and Detroit.

Explosives—Dynamite, 40 and 60 per cent gelatin, declined in Dallas and Minneapolis, and advanced in St. Louis, during month.

Scrap—Iron and steel scrap lower than month ago in New York and St. Louis. Firm at present levels.

Linseed Oil—Raw oil dropped 8c. per gal. in New York since July 5. Chicago prices unchanged in month. Tending downward in Atlanta, Dallas, Minneapolis and Denver.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Aug. 2	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	*$29.05*	$25.50
Northern Basic	*29.27*	26.52
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	*29.27*	26.52
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	*34.25*	31.66
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	*25.00*	20.50
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25 @ 2.75 sil.)	*28.76*	28.32
Virginia No. 2 (silicon 2.25 @ 2.75)	*32.17*	29.74
Basic	*27.76*	26.00
Gray Forge	*27.26*	26.00
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	*29.11*	24.50
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	*30.51*	27.17
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	*27.77*	25.50
Basic	*26.77*	25.50
Bessemer	*28.77*	25.50

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$15.00	$11.50	*$15* @ 16
Stove plate	*11.00*	12.00	*14* @ 15
No. 1 machinery cast	*17.00*	16.50	*18.50* @ 20.00
Machine shop turnings	*9.00*	4.00	*11* @ 12
Cast borings	*10.00*	5.50	*12* @ 13
Railroad malleable cast	13.00	12.50	20.00
Re-rolling rails	13.00	13.00	*18.50*
Re-laying rails	. .	30.00	*28.00 @ 35.50*
Heavy melting steel	*11.50*	. .	......

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Aug. 2	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$40.00	. . . .	$43.00	$43.00
Standard openhearth rails	43.00	40.00	$43.00	43.00	43.00
Light rails, 8 to 10 lb	45.00	35.00	2.00*	43.00	43 @ 45
Light rails, 12 to 14 lb	45.00	35.00	2.00*	43.00	43 @ 45
Light rails, 25 to 45 lb	45.00	35.00	2.00*	43.00	43 @ 45
Rerolled Rails	*18.75 @ 19.25*	28.00	.....	....	....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.50	$1.65
Chicago, Hardwood and Red Oak	1.25	1.40
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco...... Green Douglas Fir	.84	1.14
San Francisco, Empty Cell Creosoted, Douglas Fir	1.70	2.25
St. Louis, White Oak	1.30	1.55
St. Louis (creosoted) (zinc treated)	1.70	2.05
St. Louis, Red Oak, plain	1.20	1.45
St. Louis, Sap pine-cypress	1.05	1.30

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Aug. 2	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, $\frac{9}{16}$-in. and larger	$3.15	$2.25 @ 2.35	$3.00	$4.00	$5.00	$3.75
Track bolts	4.00 @ 4.25	3.00 @ 3.50	4.00	5.00	6.20	4.70
Standard section angle bars	2.75	2.40	2.75	4.00	4.25	3.10

PIPE

WROUGHT PIPE—The following mill discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	62	50½	¾ to 1½	30	13

LAP WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
2	55	43½	2	23	7
2½ to 6	59	47½	2½ to 4	26	11
7 and 8	56	43½	4½ to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 1½	60	49½	¾ to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT PIPE—From warehouses at the places named the following discounts hold for steel pipe:

Black	New York	Chicago	St. Louis
1 to 3 in. butt welded	48%	50%	49%
2½ to 6 in. lap welded	44%	47%	46%

Galvanized	New York	Chicago	St. Louis
1 to 3 in. butt welded	34%	37%	36%
2½ to 6 in. lap welded	30%	34%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 15%. Cast iron, standard sizes, 17½% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York Aug. 2	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	$53.00	$67.30	$58.30	$64.20	$61.60	$66.00
6 in. and over	49.00	62.30	53.30	60.20	57.60	62.00

Gas pipe and Class "A," $5 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Aug. 2	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$40.00	$50.00	$62.50	.....	$73.00
4	55.00	50.00	50.00	75.00	$76.50	83.00
5	80.00	80.00	.	100.00	97.75	108.00
6	105.00	100.00	85.00	175.00	127.50	133.00
8	170.00	150.00	195.00	187.50	212.50	199.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.	$0.114	......	. .	$0.15	$0.12	.....
4	.	.114	$0.11	$0.1175	.15	.15	$0.15
5	.	.171	.1375	. . .	.23	.18	.18
6	$0.24	.171	.165	.1645	.23	.21	.21
8	.38	.266	.26	.26	.35	.30	.325
10	.57	.399	.338	.364	.53	.42	.476
12	.72	.513	.442	.468	.68	.54	.612
15	1.13†	.684	.65	.78†	.90	.90	.884
18	1.65†	.95	.85	1.092†	1.25	1.32	1.156
20	1.98†	1.14	1.125	.....	1.50	......	...
22	2.64†	1.52	1.375	1.456†	2.00	......	1.554
24	2.97†	1.71	1.625	1.872†	2.25	2.16	2.04
27	4.81†	2.99	....	2.95†	4.69†	3.00	3.34
30	5.33†	3.312	....	3.65†	5.94†	3.60	4.06
33	6.93†	4.41	....	4.45†	6.88†	......	4.99
36	7.91†	5.0225	....	4.80†	7.50†	......	5.42

	3	5	8	12	24	36
Boston	$0.127	$0.195	$0.308	$0.595	$1.975†	$5.90†
Minneapolis	....	.....	.40	.72	2.55	5.66†
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.13	......	.36	.72†	2.60†	.....
Los Angeles	.13	.165	.275	*.475*	1.65	.....
New Orleans	.112*	.168*	.28	.476	1.182	.....
Cincinnati	.12	.18	.28	.54	1.80	4.10†
Atlanta	*1.05**	*.16**	*.27*	*.155*	*1.75*	.....
Montreal, *delivered*	.68‡	.45†	.70	1.35	4.50†	...
Detroit	.117	.1755	.273	.5265	2.34†	6.15†
Baltimore	.126	.189	.294	.567	1.89	5.4375
Kansas City, Mo	.15*	.21	.33	.40	1.60	.....
Philadelphia	...	...	...	....	..	.....

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

	Aug. 2	One Year Ago
New York, 45% asphalt....(at terminal)	$0.0525	$0.05
New York, 65% asphalt......(at terminal)	.0525	.045
New York, binder...........(at terminal)	.06	.0575
New York, flux.............(at terminal)	.0575	.055
New York, liquid asphalt....(at terminal)	.06	.06
St. Louis, 50 @ 60% asphalt	.0565	.05
St. Louis, 40 @ 50% asphalt	.0535	..
Chicago, 40–50% asphalt	.0525	.0525
Chicago, 60–70% asphalt	.055	.055
Dallas, 45% asphalt	.049	.10
Dallas, 55% asphalt	.0455	.13
Dallas, binder	.051	.15
San Francisco, binder, per ton	9.50*	13.00*

* F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Mexican*)	$19 00	$15.00
Boston (*Mexican*)	*20 50*	*16 50*
Chicago (*Stanolind*)	22 25	16 00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	17.00*	11.00*
Dallas, (*Texas*)	27 10	21.10
Seattle, "D" *grade (California)*	24 75	20.50†
Denver (*California*)	24 00	....
Minneapolis *f.o.b. Twin Cities* (*Stanolind*)	25 45	19 10
St. Louis (*Mexican*)	29 50	24 50
Baltimore (*Standard Oil*)	21.00	15.00
Montreal (*Imperial*)	28 00	21.00
Atlanta (*Mexican*)	26.00	23 50
Detroit (*Mexican*)	22 47	18.40
Cincinnati (*Kentucky Rock*)	**23.40**	*19.40*
Maurer, N. J (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	21.50	18.50
Philadelphia (*Mexican*)	....	....
Kansas City (*Texas*)	27.30	22 30
Los Angeles "D" *grade (California)*	17 00‡	11 00‡

*Freight to San Francisco, 80c. per ton.
†F.o.b. Richmond, Cal.
‡F.o.b. El Segundo refinery.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade 1)	5-in. granite, 30 blocks per sq.yd.	$134.50 per M.
Chicago	About 4x8x4 dressed	3 50 per sq.yd.
	About 4x8x4 common	3 10 per sq.yd.
San Francisco	Basalt block 4x7x8	70 00 per M.
Boston	5-in. granite 28 blocks per sq yd	*130 00* per M.
Atlanta	Granite	2 66 per sq.yd.
Detroit	5-in. Granite	106.00 per M.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	100.00 per M.
New Orleans	Granite, 4 x 8 x 4	3.25 per sq.yd.
Cincinnati	Granite	138.00 per M.
St. Louis	4x8x4 dressed	3 15 per sq.yd.
	4x8x4 common	2 95 per sq.yd.
Kansas City	Granite	3.55 per sq.yd.
Philadelphia	Granite	...... per M.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft wide	$0.22 per sq.ft.
	Manhattan, 4 ft. wide	.22 per sq.ft.
	Queens, 5 ft. wide	.24 per sq.ft.
	6x24-in. cross-walk	1.10 per lin.ft.
Chicago	18 in. wide	.. per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 80c.; 5 x 20 in., Queens, 85c. *St. Louis*: Class "A" straight, delivered, 5 x 16 in., $1.45 per lin.ft. *Chicago*: 5 x 8 in., $1.65; 6 x 8 in., $1.95 per lin.ft. delivered.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$*2.58*
New York (*delivered*)	3½	16	2.79
Boston	3½	18	*2.65*
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50
St. Louis	3½	16	2 55
St. Louis	4	16	2 90
Seattle	4	16	Off market
Minneapolis	3½	16	2.73
Atlanta	3½	16	2.00
New Orleans	3	16	2.45
New Orleans	3½	16	2.65
New Orleans	4	16	2.95
Dallas	4	18	3.90
Baltimore	3½	16	none used
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	3½	16	2.38
Kansas City	4	16	2.75
Philadelphia	4	16	..

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. Aug. 2	Gravel 1½ In. One Year Ago	Gravel ¾ In. Aug. 2	Gravel ¾ In. One Year Ago	Sand Aug. 2	Sand One Year Ago
New York	$*1 75*	$1.75	$*1.75*	$1.75	$1.25	$1.00
Denver	1.90	1.75	1.90	1.75	1.00	0.75
Chicago	2.00	1.80	2.00	1.80	2.00	1.80
St. Louis	*2.30*	1.25†	*2.35*	1.30†	2.10	1.10†
Seattle	1.25	1.25	1.25	1.25	1.25	1.25
Dallas	**2.38**	2.25	**2.38**	2.25	*1 89*	2.25
Minneapolis	1.85*	1.50	1.85*	1.50	1.25	1.00
Cincinnati	1.50†	1.87½	1.50†	1.87½	*1.20*†	1.43
San Francisco	2.15	2.25	2.15	2 25	1.50	1.50
Boston	1.50†	2.40	1.50†	2.40	1.20†	1.65
New Orleans	2.85	2.08½	2.85	2.08½	1.25	1.35
Los Angeles	**2.75**	1.50†	**2.75**	1.50†	**1.75†**	1.35†
Atlanta	1.90†	1.85†	1.90†	1 85†	1.24†	1.15†
Detroit	1.62	2.00	1.62	2.00	2.02½	2.00
Baltimore	1.86	1.40	2.06	1 60	0.80†	2.00†
Montreal	1.25†	1.25†	1.50†	1.50†	1.25†	1.25†
Birmingham (Crushed slag used instead of gravel)					1.30†	1.28†
Philadelphia	.	1.55	..	1.60	....	1.60
Kansas City	1.75	2.00	1.60	2.00	0.66†*	1.20

New York—Grit, $1.75 per cu. yd.; ready mixed, $*2.00*
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit.
† Per ton.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Aug. 2	1½ In. One Year Ago	¾ In. Aug. 2	¾ In. One Year Ago
New York	$1.65	$1.65	$1 75	$1.75
Chicago	2.00	1.60	2.00	1.60
St. Louis	**1 90**	1.65	**1.70**	1.65
Dallas	2 50	2.73	2 50	2.73
San Francisco	2 15	2.25	2 15	2 25
Boston	1.70*	3.00*	1.70*	3.00*
Minneapolis, *at plant*	2 00	2 00	2.25	2.25
Kansas City	1 50	2.10	1.50	2.10
Denver	3.50	3.50	3 50	3.50
Seattle	3 00	3 00	3 00	3.00
Atlanta	2 00*	1 90*	2 00*	1.90*
Cincinnati	1 65*	1 75	1 65*	1.75
Los Angeles *delivered*	**3.25**	1.75*	**3 25**	1.85*
Detroit	1.75	1.90*	1 75	1.90*
Baltimore	2.50	1.75*	2.55	1.65*
Montreal	1.80*	1.50*	1.90*	2.00*
Philadelphia		1.70*	..	1.55*
Pittsburgh	2 85	2 85	2.85	2.85
Cleveland	3.25*	3.00*	3.25*	3.00*

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1 30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa	0.85	0.90	2.50	
Birmingham, Ala	1.05	1.15	2.05	0.80
Buffalo, N. Y., and Erie, Pa	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.45	1.45	1 45	1.25
Eastern Pa. and Northern N J	1.20	1.20	2.50	1.20
Western Pennsylvania	1.25	1.25	2.00	1 25
Longdale and Glen Wilton, Va	1 25	1 25	2.50	1 00
Toledo, Ohio	1 50	1.50	1 50	1 50

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$18 20	$13.10	$3.75*	$3.00@3.25*
Chicago	20.00	20.00	1.50†	1.50†
St. Louis	23 20	20 00	....	....
Boston	*22.00*	*15.00*	*4.15**	*2.45**
Dallas	22 00	.....	...	2 35†
Cincinnati	16 80	14.30	....	
San Francisco	22.00	....	....	**2 10†**
Minneapolis	25.50	21.00 (white)	1.70†	1.50†
Denver	24.00	...	....	2.70†
Detroit	21.00	20.00	....	20.00‡
Seattle, *paper sacks*	24.00	.....	2.80†	.....
Los Angeles	.....	.....	....	2.60*
Baltimore	24.25	17.25	2.55	...
Montreal	21.00	21.00	...	10.00‡
Atlanta	*22.50*	*14.00*	*2.25*†	1.50†
New Orleans	.....	.....	2 40†	1 85†
Philadelphia	....	....	....	....
Kansas City	28 00	24 00	3.12*	2.96*
Birmingham	14 25	13 50	1 90†	1.65†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.80, Sheboygan $1.70. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Aug. 2	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.50	1.60
Cincinnati (Utica)	1.72	1.77
Boston (Rosendale)	2 70	0 80 per bag
St. Louis (Carney)	*2.35*	2.10
Birmingham (Magnolia) pozzolan cement	2.10	..

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Aug. 2	One Month Ago	One Year Ago
New York, del. by truck	$2.70@2.80	$2.70@2.80	$2.40@2.50
New York, alongside dock to dealers	2.30	2.30	2 10
Jersey City	2.48	2.48	2 28
Boston	**2 90**	2.80	2.50
Chicago	2.20	2.20	2 05
Pittsburgh	2.24	2.24	2.09
Cleveland	2.46	2.46	2.31
Detroit	2.48	2.48	2.33
Indianapolis	2.41	2.41	2.26
Toledo	2.48	2.48	2.33
Milwaukee	2.37	2.37	2.22
Duluth	**2.25**	2.14	2.14
Peoria	2.41	2.41	2 26
Cedar Rapids	2.48	2.48	2 33
Davenport	2.43	2.43	2.28
St. Louis	2.35	2.35	2 20
San Francisco	*2.63*	2.71	2.71
New Orleans	3.30	3.30	3.20
Minneapolis	**2.50**	2.39	2.39
Denver	2.84	2.84	2.85
Seattle	2.90	2.90	2.90
Dallas	2.25	2.25	2.25
Atlanta	2.85	2.85	2.50
Cincinnati	2.54	2.54	2.39
Los Angeles	*3.16*	3 20	3.30
Baltimore	2.65	2.65	2.50
Birmingham	2 70	2.70	2.10
Kansas City	**2 55**	2.45	2.40
Montreal	2.25	2.25	2.78
Philadelphia	..	...	2.31
St. Paul	**2.50**	2.39	2.39

NOTE—Bags 10c. each. 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind	$1.95	Hudson, N. Y	$2.20
Universal, Pa	2.00	Leeds, Ala	2.20
Steelton, Minn	**2.06**	Hannibal, Mo	2.10
Fordwick, Va	2.10	Lehigh Valley District	2.10
Mitchell, Ind	2.10	Wyandotte, Mich	2.30
Iola, Kan	2.10	Alpena, Mich	2 10
Mason City, Ia	**2.10**	Richard City, Tenn	2.20
La Salle, Ill	**2.10**	Kingsport, Tenn	2.20

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago Mill	Warehouse New York	St. Louis	Dallas	San Francisco
032	22	$0 95	$1.02	$1.24	$1 04	$1 12	$1 16
049	28	1 20	1 30	1 58	1 32	1 38	1 47
068	35	1 47	1 59	1 94	1 62	1 67	1 81
093	45	1 89	2 04	2 50	2.08	2 00	2 32
126	57	2 34	2 53	3 09	2.59	2 55	2 88
153	68	2 79	3 02	3 60	3.08	3.15	.....
180	78	3 20	3 47	5 22	3.54	3 47	.....
245	103	4 22	4 57	4 60	4.66	4 58	.....
287	119	4 88	5 28	6 44	5.39	5.26	6 09
336	138	5 66	6.13	7 39	6.25	6 11	.....
395	160	6.56	7 10	8 67	7.25	7.12	.....
			PAVING				
036P	17	$0 72	$0 78	$0.95	$0 79	$0.76	.....
053P	24	1 02	1 10	1 35	1.12	1 07	.....
072P	31	1 29	1 40	1 71	1.42	1 39	.....
097P	40	1 66	1 80	2 20	1.83	1 90	.....
049R	24	..	1 10	....	1.12	1 07	.....
067R	31	..	1.40	..	1 42	1 39	.....
089R	40	..	1.80	...	1.83	1 90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27Dia.	2.3	$22 00	$21 25	$20 72	$21 43	$25.50
26 "	2.5	22 00	22 50	22 39	20 78	27 58
25 "	3.0	22 00	25 25	24 93	..	30 71
24 "	3.4	24 00	27 25	27 10	24 88	33 16
22 "	4.33	27 00	31 75	32 27	....	35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
¾ and larger..	$2 40	$2 65	$3 54	*$3 20*	$3.35	$3 80	$3 65
⅝..........	2 45	2 75	3 59	*3.25*	3.40	3 85	3 70
½..........	2 50	2 85	3 64	*3 30*	3 45	3 90	3 75
⅜..........	2 65	2 90	3 69	*3.45*	3 60	4 05	3 90
¼..........	2 90	2 95	4 04	*3.70*	3 85	4 30	4.15

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¾ and larger	$2 30	$3.05	$3 50	⅜........	$2 55	$3 30	$3 75
⅝ in........	2 35	3.10	3 55	¼........	2 80	3.50	4 00
½..........	2.40	3.15	3 60	....	.....	.....	....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Aug. 2	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)..	$24.60@25 70	$23.50	$23.50	$46 50	$54 00
New York (at dock)...	21@22	20.00	20.00	......	......
Chicago	11 00	11.00	11 00	34 00	42 00
St. Louis, salmon......	16@18	16@18	14 00	38@40	40@44.50
Denver, salmon.......	12 00	12 00	12 00	......	......
Dallas...............	13 10	13 10	11 15	33.00	......
San Francisco	15 00	15 00	15 00	......	......
Los Angeles (del.).....	16 00	15 00	15 00	(not used)	
Boston (del.)	*22 00*	22.50	16 00	48.25	56 00
Minneapolis (del.).....	17@19	17@19	17@18	......	......
Kansas City..........	14 50	14 50	14 50	......	......
Seattle..............	13 00	13 00	14 00	50 00	.. ..
Cincinnati...........	17@20	17@20	15.00	45.00	50.00
Montreal	16.50	16 50	16 00	100.00‡	68 00
Detroit (del.)........	*19.00*	20.00	16 50	38.50	41.50
Baltimore (del.).......	21.00	21.00	20.00	40.00	45.00
Atlanta..............	*12 00*	14 00	11 00	40.00	45.00
New Orleans..........	18 75	18 75	12 50	......	......
Birmingham..........	13 50@16	13@16	12.00	......	......
Philadelphia	..	....	17.50@18 50	40 00	48.00
Pittsburgh (del.)	16.00	16.00	16.00	...	......
Cleveland...........	16 00	16.00	14 00	....	......

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Aug. 2 on Trucks*	One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12...	$0 1573	$0.1112	$0 0724	.....	$ 092	$0.108	....
6x12x12...	2097	.1667	.0996	......	.126	.156	....
8x12x12...	2621	.2084	1358	......	.170	244	$0.2691
10x12x12...	....	...	.1695	......	*.19*	......	.3505
12x12x12...	....	.....	.1937	......	*236*	......	.4206

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston....................	$0.16	$0.225	.. ..
Minneapolis (f.o.b. cars)........	0736	.12125	$0.214
Minneapolis (delivered).........	.0816	.13375	.234
Cincinnati..................	.0815	.153	....
Kansas City.................	.083	.1455	....
Denver....................	.065	.123	.188
Seattle (delivered)	.11	.25	.36
Los Angeles factory...........	.10	.175	....
New Orleans................	.12	.23	....
Detroit (delivered)...........	.1145	.2147	.27
Montreal..................	.115	.225	.30
Baltimore..................	.125	.27	......
Atlanta....................	*.102*	*.175*	......
Dallas.....................	.115	...	......
Birmingham................	.11	.18	......
Pittsburgh (delivered).........	.068	.128	.179½
Cleveland	.09	.172	......

San Francisco and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh Mill	Birmingham Mill	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.....	$2 50	$2 75	$3.64	*$4.20*	$3 45	$3.40	*$3 60*
Channels, 3 to 15 in....	2 50	2 75	3.64	*4.20*	3 45	3 40	*3.60*
Angles, 3 to 16 in., ¼ in. thick......... ..	2 50	2 75	3 64	*4 20*	3 45	3 40	*3.60*
Tees, 3 in. and larger...	2 50	2 75	3 64	*4 20*	3.50	3 40	*3.60*
Plates, ¼ in. thick and heavier......... ...	2.50	2 75	3.64	*4.30*	3 45	3.40	*3.60*

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York Aug. 2	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
¾ in. and larger	*$3.15*@3.25	$4 40	$3.60½	$3.75	$4 15	$5.00	*$4 90*
		CONE HEAD BOILER					
¾ in. and larger	*$3.25*@3.35	$4.50	$3 70	$3 85	$4.25	$5 10	*$5.00*
⅝ and 11/16........	*3.40*@3 50	4.66	3 86	4 00	4.40	5 25	*5 15*
½ and 9/16........	*3.65*@3.75	4.90	4 10	4 25	4 60	5.50	*5.40*

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.........	$3.00	$3 45	*$4 20*	$4 25	*$3.34*	$4 95
Cut..........	.	5.50	5.80	5.75	*3.64*	5 00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco Galv.	San Francisco Black	Seattle Black
½......	$9 85	$7.65	$8.00
⅝.....	7.80	6.30	7.75
¾.....	7.75	6.15	7.70

Pittsburgh base in lots of 200 kegs or more, $3.50@3.75.

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.50 per roll in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5 75 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., *$5.85* per square.

ROOFING MATERIALS—Prices f.o.b. New York, in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton..................	$67.50
Tar pitch (in 400-lb. bbl.), per 100 lb	1.62½
Asphalt roofing (in barrels), per ton, f.o.b. plant*..................	38.75
Asphalt felt (light), per ton, f.o.b. plant*.........................	75.00
Asphalt felt (heavy), per ton, f.o.b. plant*.........................	75.00

* Delivered in Metropolitan Dist., $3.00 additional.

WINDOW GLASS—Double strength, box list, united inches, 34, "AA" grade, at discount of 84 per cent from standard lists, f.o.b. New York; "A" grade less 86 per cent and "B" grade, 87 per cent.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10...............	$3.00	$4.45	$4 15	$5.10	$4.59
No. 12...............	3.10	4.50	4.20	5.15	4.64
No. 14...............	3.20	4.55	4.25	5.20	4 69
No. 16...............	3.40	4.65	4.35	5.25	4.79
Black					
*Nos. 18 and 20.......	3.70	5.00	5.05	5.95	4 95
*Nos. 22 and 24......	3.75	5.05	5 05	6 00	5.00
*No. 26.............	3.80	5 10	5 10	6 05	5 05
*No. 28.............	3.85	5.20	5.20	6.15	5 15
Galvanized					
No. 10...............	4.00	5.35	5.35	5 50	5.15
No. 12...............	4 10	5 45	5 45	5 60	5.25
No. 14...............	4 10	5 45	5 45	5.75	5.25
Nos. 17 to 21.........	4 40	5 75	5 75	5 90	5.55
Nos. 22 and 24........	4 55	5 90	5 90	6.05	5.70
*Nos. 25 and 26.......	4.70	6 05	6 05	6 20	5.85
*No. 28........	5.00	6.35	6 35	6 50	6.15

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York Aug. 2	New York One Year Ago	Chicago Aug 2	Chicago One Year Ago
Raw in barrels (5 bbl. lots).....	*$1.05*	$0.91	$1.28	$1.01

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry		In Oil	
	Aug. 2	1 Yr. Ago	Aug. 2	1 Yr. Ago
Red	14 00	12 50	15 50	14 00
White	14.00	12.50	14 00	12 50

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$40.00	$41.00	$42.00	$45.00
3x6 and 8	40.00	41.00	42.00	45.00
4x4-6 and 8	40.00	41.00	42.00	45.00
3x10 and 12	40.00	41.00	42.00	45.00
3x14	42.00	42.00	44.00	46.00
4x10 and 12	40.00	41.00	42.00	45.00
4x14	42.00	42.00	44.00	46.00
	24 Ft. and Under		25 to 32 Ft.	33 to 40 Ft.
6x10	$42.00		$44.00	$46.00
6x14	47.00		49.00	51.00
8x10	42.00		44.00	46.00
8x14	47.00		49.00	51.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22-24 Ft.
3x4 to 8x8	*$50.00*	*$51.00*	*$50.50*	*$52.50*
3x10 to 10x10	*54.00*	*55.00*	*53.50*	*55.50*
3x12 to 12x12	*58.00*	*59.00*	*56.50*	*58.50*
3x14 to 14x14	*65.00*	*68.00*	*61.50*	*63.50*
3x16 to 16x16	*70.00*	*71.00*	*66.50*	*68.50*
3x18 to 18x18	*84.00*	*85.00*	*78.50*	*79.50*
4x20 to 20x20	*94.00*	*95.00*	*89.50*	*91.50*

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under.

Other Cities

	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	**$68.00**	......	**$65.00**	$57.00	**$90.00**	......
Seattle	......	*$28.00*	......	......	...	*$28.00*
New Orleans	*28.00*	......	......	......	*31.00*	......
Baltimore	33.50	53.00	53.00	60.00	**50.00**	53 00
Cincinnati	40.00	75.00	75.00	90.00	44.00	80.00
Montreal	50.00	......	......	......	70.00	90.00
Los Angeles	......	*50.00*	......	.	......	*51.00*
Denver	40.75	**41.75**	**41.75**	**41.75**	......	*42.75*
Minneapolis	43.50	**42.50**	41.50	......	46.00	**44.75**
Atlanta	*36.00*	......	......	......	*40.00*	......
Dallas	*47.50*	......	......	......	*52.25*	...
Kansas City	44 25	**47.00**	**47.00**	......	57.25	**49.00**
Birmingham	*30@35*	.....	......	......	*40@45*	..
Philadelphia	......	...	......	......	......	
Detroit	48.75	**54.00**	......	......	61.75	**54.00**
St. Louis	44.00	..	......	......	56.00	..

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	**$50.00**	$90.00	$50.00	**$62.00**	.....
Seattle	......	*24.00*	.....		*$26.00*
New Orleans	*72.00*	......	.....	*31.00*	...
Baltimore	60.00	44.00	44.00	34.00	50.00
Cincinnati	76.00	81.00	76.00	35.00	90.00
Montreal	......	50.00	37.00	45.00	45.00
Los Angeles	......	*45.00*	.....	......	...
Denver	......	*33.25*	*33.25*	......	34.25
Minneapolis	43.50	41.75	39.50	40.25	38.25
Atlanta	*20.00*	......	.....	*30.00*	....
Dallas	*47.50*	......	.....	*50.83*	...
Kansas City	69.00	**44.00**	.....	**45 00**	**46.00**
Birmingham	*26@30*	......	.....	*38@40*	..
Philadelphia	....	......	.....	...	....
Detroit	**53.00**	39.00	.....	**47.00**	*41.25*
St. Louis	*44.00*	......	.....	**37 00**	.....

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M.ft. to contractors.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers price to contractors on large projects.
St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M.ft. additional.
Seattle—Price to contractors, delivered.
Dallas—Wholesale to contractors, $10 per M.ft. additional.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

MISCELLANEOUS

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Aug. 2	One Month Ago	One Year Ago
$2 65	$2 65	$2.00

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	20%
Patent flattened strand, special steel wire rope	20%
Patent flattened strand, iron rope	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington Discount: 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arizona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft., ⅝-in., 6; ¾-in., 4⅓; 1-in., 3⅓; 1⅛-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.16¾	New Orleans	$0.18¾
New York	.18½	Los Angeles	.18
Chicago	.18	Seattle	.18
Minneapolis	.20½	St. Louis	.19½
San Francisco	.18	Montreal	.30
Atlanta	*.21*	Detroit	.19
Denver	.22	Baltimore	.18
Cincinnati	.21	Kansas City	**.21**½
Dallas	**21**	Birmingham	.20½
Philadelphia	.....		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Boston	.23	.25
Kansas City	.225	.25
Seattle	.165	.19
Chicago	.22	.25
Minneapolis	*.1917*	*.21.3*
St. Louis	**2225**	**.2475**
Denver	.2025	.2275
Dallas	*.225*	*.305*
Los Angeles	.17	.20
Atlanta	.23	.2575
Baltimore	.22	.23
Cincinnati	.225	.25
Montreal	.195	.235
Birmingham, *delivered*	.16	.17
New Orleans	.195	.220
San Francisco	.1625	.1925
Philadelphia	......	......

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f. o. b. New York:

Sulphate of aluminum, in bags, per 100 lb.	$1.40@1.50
Sulphate of copper, in bbl., per 100 lb.	5.40@5.50
Soda ash, 58%, in bags, per 100 lb.	1.45@1.51
Chlorine, liquid, cylinders, 100 lb., per lb.	.09
Hypochlorite of lime (bleaching powder) in drums, per 100 lb.	2.20@2.30

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.29
Birmingham	.69	Kansas City	.735
Boston	.365	New Orleans	.515
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.34†
Cincinnati	.29	Philadelphia	.32
Cleveland	.215	St. Louis	.43
Denver	1.27*	St. Paul	.60

† Minimum carload, 40,000 lb.
* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.

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A Man Departs

HE CAME to power when the world was out of joint; his was the heavy task of setting it right. Small wonder that he was not able in the brief two years allotted him to build up the broken body. The healing of the economic and political wounds made by a great war is a long process and doctors and specifics can do little to hasten it. His was the temperament which put its trust in calm and order, which distrusts the unusual and loves accord. There are those who would have had more of the iron hand in his velvet glove, a more spectacular and emphatic program for relief, but who can say which of the two courses will lead to the most speedy cure? One thing remains; a man has gone, a lovable personality, a personification of the American ideal of rise from obscurity to the great place of the nation. To all of us, from those scattered settlers in our far northern outposts who last saw him in his prime, to the busy workers in our crowded cities who were shocked by the headlines last Friday morning, there will remain the inspiration of his kindly spirit. And this is Warren Harding's greatest legacy to the people he was chosen to lead.

A Prophecy?

IT WAS at the reconstruction congress of governors and mayors called by President Wilson in March of 1919. There was a rather crowded buffet luncheon served that day in the large state dining room of the White House, where only standing room was available except for a few chairs ranged against the walls. In one of these, the great, high-backed, eagle mounted mahogany quite evidently reserved for the President's use at the head of his own table, sat a man clad in the severest of black relieved only by the white of linen—a curiously pallid face intensified by his smooth, plastered taffy colored hair. An unnatural seriousness seemed to overburden him. So strange he looked that one of the editors of this journal who was there was moved to ask who he was. "Why," was the answer, "that's Coolidge of Massachusetts."

New Structural Possibilities

TO THE ENGINEER familiar with steel construction the use of material of sheet-metal thickness in large engineering structures necessarily appears so far outside the range of practical possibility as to be wholly out of relation to his engineering thinking. The rust danger makes it imperative to use thick sections, and in consequence the entire habit of structural practice and structural thinking is predicated on thick material. The engineer is likely to carry his conclusions farther, however, to the extent of believing structural framing of thin material to be impracticable from the standpoint of strength and all but impossible from the fabricating standpoint. In the airship just completed at Lakehurst we have convincing proof that such conclusions are wrong, and correspondingly the work is of remarkable instructional and stimulative value. The successful solution of all fabricating difficulties shows clearly that shop requirements do not fix a lower limit of thickness. And on the question of strength, several hundred tests of members of the airship, showing very high strengths in column, beam, and combined service, have established the fact that this sheet-metal structural work can be developed to substantially as high a strength efficiency as we expect in ordinary structural steel members. The Navy Department is entitled to the thanks of the structural engineering profession for making available an account of its construction experiences, and it is to be hoped that the test results also will be placed before the profession soon. The building of the ZR1, as described in some of its technical aspects in this issue, is certain to exert a strong, progressive influence on the development of thought in the structural field.

The Port of San Francisco

WITH the recent adjournment of the California legislature, the fight to prevent taking control of the San Francisco waterfront away from the state and giving it to the city has again been won. The case for the state is so clear that it will bear study. Two navigable streams empty into San Francisco Bay, and together drain a valley 500 miles long with 10,000,000 acres of fertile land of which about 5,000,000 is now under irrigation. These rivers, therefore, serve a useful transportation purpose in delivering produce to a central market or shipping point. Under these conditions a port becomes something in which many shippers have a vital interest and in whose management and control they are entitled to have some influence. Under state management the facilities provided on San Francisco's waterfront for the distribution and export of produce have encouraged the development of farms and factories in the great central valley. Without such facilities the products of those farms and factories could not be profitably marketed. Should control of the port be transferred from the state to a small part of the area from which the traffic of the port is drawn, the remainder of the area would have to take chances on getting necessary concessions.

State Harbor Control

ON ONE point San Francisco has ground for dissatisfaction with the present arrangement. The east bay cities are not under the jurisdiction of the State Board of Harbor Commissioners, and they are therefore in a position to compete as they please for the business of the port. San Francisco, being unable to dictate waterfront policies, rates, etc., as do the cities across the bay, feels itself to be the victim of discrimination. Although a large percentage of the

business of the port as a whole is still handled on the San Francisco side of the bay, east bay cities have grown rapidly and it is highly important that some way be found to prevent rivalry between bay cities that is not in the best interests of the port as a whole. Rather than to vest full port control in the city of San Francisco the state jurisdiction should be extended to all the bay cities with some proportional representation and some measure of local veto which would prevent unfair domination by state interests not connected at all with the port. This has been done by interstate control at New York, though as yet the results have been disappointingly small, it has existed for years at Boston, it doubtless will eventually be brought about at Philadelphia. There is no similarity between the usual demand for home rule of cities and the demand which San Francisco and New York make for release from state authority in their ports. Property interests, through their sinister representatives, the real estate men, seem to assume that possession of some waterfront land gives autocratic rights to a harbor. That is wrong in principle; the port is merely a gateway for the state and the country and its administration can not be hampered by the selfish claims of those who happen to live at the gate.

Promotion and Ethics

NOW that the Trenton plans for sewage treatment by the direct-oxidation process have again and finally been rejected by the New Jersey State Board of Health, attention may be turned from the process itself to some ethical aspects of the promotion methods employed in an attempt to hasten action by the board. These are of direct concern not merely to other state health departments but also and more deeply to engineers, since the promoters, besides charging the entire New Jersey board with holding up the plans, laid the onus on one of the two engineer-members of the board and were backed in this by Col. George A. Johnson, consulting sewage-works engineer for Trenton.

The charges submitted to Governor Silzer by Mr. Hirst last February, Mr. Potts' denial, and a summary of what was brought out at the hearing have been detailed in previous issues of this journal. As modified and explained at the hearing, the charges come down to this: Because the Trenton plans had been before the New Jersey Board of Health for two months without final action, and because Mr. Hirst had heard indirectly that Mr. Potts had expressed himself as against approving the plans, and since Mr. Hirst could explain all this to his own satisfaction in no other way than that Mr. Potts was out for "revenge" because he had been denied an interest in the direct-oxidation process, Mr. Hirst decided "to throw the full light of publicity" on Mr. Potts and so brought the charges in question. Colonel Johnson initialed each paragraph of the charges except those alleging motive, but he did not appear at the hearing to substantiate his joining in the charges. Nor did Mr. Hirst offer any testimony whatever to establish his allegation that the other ten members of the board had been induced to join Mr. Potts in holding up the plans, nor that it is at all unusual for a state health department to defer action on sewage-works plans for two months.

This is promotion run mad. It is all the worse because it was seconded by a consulting engineer in a way that seems to have been shrewdly designed more to evade possible punishment under the law of libel than with that high regard for professional ethics that should accompany technical ability. Trying to discredit engineers and to bully and defy state health departments who are skeptical or seem unduly slow in approving plans is hardly the way to establish the direct-oxidation method of sewage treatment, which, like hundreds of others that have been promoted in the last half century, will have to take its place on merit or fall by the wayside.

Traffic on Bridge Approaches

MOTOR traffic has set up entirely new capacity standards for streets and bridges. It is obvious that the greater loads from the heavy motor trucks entail new considerations of load bearing capacity from those held in the days of horse-drawn vehicles, but it is not always remembered that the much greater number of vehicles and their higher speed, both due to the introduction of the motor, have brought with them new problems of space and volume capacity. There is much yet to be done in traffic analysis with relation to roadway width, particularly in the spacing and speed of vehicles for the maximum capacity of a given thoroughfare.

Bridge approaches offer an excellent illustration of this new development. In planning the new vehicular bridges for Portland, Ore., for instance, special attention is being given approaches in the belief that by providing a traffic capacity on approaches greater than that heretofore considered necessary, the result will be a considerable increase in the rate at which the structure as a whole can handle traffic. This point of view is summarized in a comment on Portland's existing bridges (built before motor traffic had become heavy) by the engineers in charge of the new structures that "There is not a single bridge in Portland today that is being used to as much as one-half of its capacity on account of the fact that the approaches in all cases are inadequate to get the traffic on or off the structures."

In planning the new structures effort is being directed toward developing the full capacity of the bridge by approaches of suitable design. The theory on which this is being done is that at the last cross-street the bridge traffic is slowed up, and in fact during the rush hours is frequently brought to a full stop, by the cross-traffic. The bridge traffic therefore is assumed to be entering the bridge approach from a standing start or at a relatively low speed and, according to the ability of the cars to accelerate, will require some considerable distance to attain the speed that gives the maximum capacity on the bridge. If several hundred feet is required to attain that speed, then the approach must be wider than the bridge for that distance in order that the capacity of the approach, on which the average speed of the cars is less, may equal the capacity of the bridge itself, over which the maximum capacity speed is maintained. On the new Burnside bridge five lanes of traffic each way on the approaches are to be converged to three lines on the bridge proper by marking the converging limits of the traffic lanes on the roadway.

In making their bridge capacity studies the Portland engineers disagree with the conclusions reached by Herbert S. Swan and published in *Engineering News-Record*, Feb. 22, 1923, to the effect that a speed of 10 miles per hour, because of the greater spacing required

at higher speeds, gives the maximum capacity, i.e., the maximum number of cars past a given point in a given time. The Portland engineers believe that a higher speed (something like 20 miles per hour) and a closer spacing are safe. The theory in support of this is that it is impossible for any car to come to a full stop instantly and that assuming the greater rate of deceleration in the car ahead (which is the more dangerous situation) the safe spacing would be determined by the relative rate of deceleration of the two cars plus a distance to allow time for the driver of the car behind to get warning that the car ahead is slowing down.

The whole problem is so involved with the human equation and with such widely varying conditions that no mathematical formula can give an exact solution. Moreover, any theoretical solution must be checked with actual conditions in traffic because it is not so much what spacing and speed is best as it is what spacing and speed can be secured, all things considered. Even when theory and practice are co-ordinated it may be that more efficient brakes — such as the four-wheel brakes that are rapidly coming into vogue—or some other factor may require complete revision of the conclusions. It is safe to say, however, that where busy intersections cross bridge approaches, a roadway width greater than that of the bridge proper is justified, and finally that there is need for more study and observation on this whole question of maximum capacity of roadways for motor traffic.

To The New President

IN ACCORDANCE with precedent President Coolidge has announced his intention to carry out in full the policies of his predecessor. There is no doubt of the honesty of this intention but history has shown that each of our Presidents who succeeded in like fashion has before long been forced by the strength of his own convictions and by the force of his own personality into policies of his own, which quite possibly may be in opposition to those which he inherited. Engineers and contractors who have watched as professional and business men and not as partisans the course of the Harding administration, could they obtain the ear of Mr. Coolidge, might well point out some definite viewpoints as to past and future performances which might be of value to the new President.

In the first place there would be praise for the fiscal policy of the Harding administration. In these days of foreign and domestic complications too little credit has been given for the planning at Washington which has led to that combination of increasing income and decreasing outgo which is the primary requirement for either business or government. The excellent administration of the Treasury, which has so successfully taken care of the early stages of the retirement of the war bonds, the successful adjustment of the British debt, the initiation and execution of the beginnings of the federal budget, the veto of the soldiers' bonus with the terrific added burden of expense which was thereby prevented, and the reduction in costly armament (itself possibly the minor part of that crowning diplomatic triumph, the Washington conference, the Far-Eastern agreement and the four-power treaty)—all go to make up a consistently economical fiscal plan for which the administration deserves more praise than has usually been given. Add to this the sane attitude toward business, best exemplified in the methods of the engineer member of the cabinet, and we have a purposeful policy carried out, insofar as it has gone, to the benefit of the country. Few engineers will be found who would advise the President to depart from the course laid out in these matters.

There are, however, two acts, or series of acts, of the Harding administration which in the mind of the engineering profession have been manifestly improper. To what degree the late President approved or condoned them we do not know. We do know, though, that a new chief executive, however much he may feel bound to his late chief, will do well to consider their inherent justice as well as their effect on his political fortunes. We refer to the violent campaign carried on by Attorney General Daugherty against the engineers and contractors of the army construction program and to the reorganization—and possibly disorganization—of the Reclamation Service begun by Secretary of the Interior Work by the dismissal of Director Arthur P. Davis.

Both of these performances smell too strong of party politics. The whole history of the Construction Division suits and indictments, from the strictly partisan Congressional investigation to the personnel of the staff which is using that investigation as its bible, brand that persecution with political motives. It was plainly an effort to magnify the new administration by discrediting the Wilson administration. Reputable engineers and contractors were to be made martyrs in the process. A new and independent study of these cases by the President should be made. He is the one who will now suffer if they are pursued to their apparently inevitably unsuccessful conclusion.

The Reclamation Service case is too fresh in the minds of engineers to need description. Suffice it to say that the evidence is accumulating that Secretary Work was governed more by the necessity for providing a place for one who is politically powerful in certain sections of the West where votes are needed than in an honest effort to put reclamation on a sound basis. Governor Davis, the new commissioner of reclamation, has a business past which is anything but a recommendation if the avowed "business administration" is the main thing being sought in the Reclamation Bureau, but he has been twice elected governor of Idaho and is wise in political methods. The trip to Alaska and the tragedy at San Francisco will delay for a while the combined efforts of the engineers of the country to defend the engineering control of irrigation but nevertheless the evidence in the case is being accumulated and when Congress comes to meet in November, the Secretary will find that he has opened up a controversy which is far wider in its implications than perhaps even he realized. Here again the new President is free to take his own course and to refuse to be burdened by the unwisdom of his predecessors.

Engineers have no desire to form a professional soviet which thinks and acts only for the good of the profession. They are, however, by virtue of their vocation closely concerned with public activities and vitally interested in public policies. We believe, furthermore, that engineering is essentially an unselfish profession, perhaps too unselfish for its own good, but certainly one that is looking toward benefiting the general run of the people all the time. For that reason the views of engineers on such public questions as these are, we submit, worthy of consideration.

Structural Engineering in Dirigible Airship Work:

Building the Navy Airship ZR1

Completion of Ship Marks Solution of Complex Problems of Structural Design, Related to Those Worked Out in Development of Bridge and Building Work

FIG. 1—ZR1 APPROACHING COMPLETION

Strength of Riveted Duralumin Members Determined by Tests and Problems of Fabrication and Assembly Worked Out by Trial in the Shop—Elaborate Test Work

IN UNDERTAKING to build its first rigid airship, the ZR1, the U. S. Navy Department confronted a complex mass of new problems. The completion of the ship, now ready for its trial flights, marks the successful solution of these problems. They are essentially problems of structural design and fabrication, and are closely related to those which have been worked out by gradual practical development in the related field of steel structural work for building and bridge construction.

The ZR1 is a huge structural framework of latticed struts braced by wire ties. Though precisely similar to any structural steel frame in its principles of arrangement, it is made radically different from such a frame by three characteristics: (1) The metal is duralumin, a light alloy of aluminum and copper; (2) the material is in sheet metal thicknesses; (3) the members, with few exceptions, are of triangular cross-section, so that the joints become special problems involving great complication.

The pecularities of the duralumin, the problems of fabricating and assembling the sheet metal members, and the difficulties presented by the joints and of connections constituted the outstanding elements of the fabrication problem.

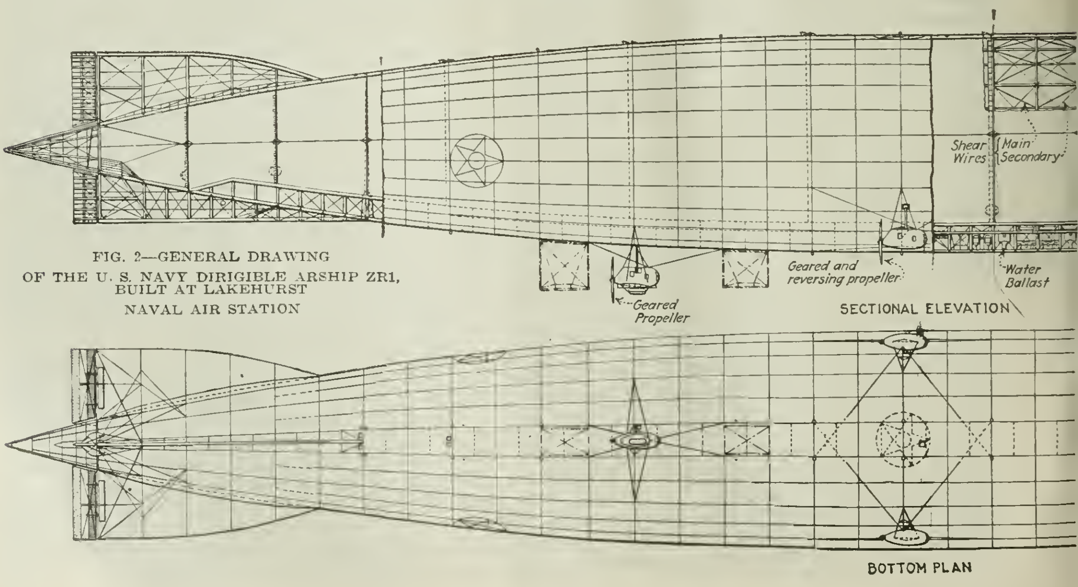
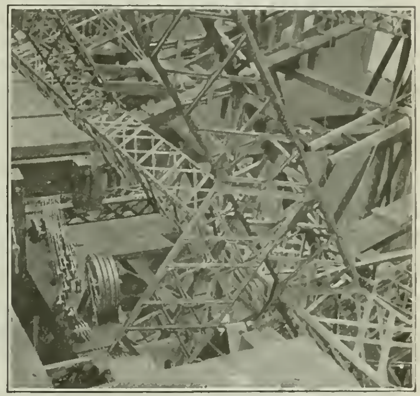


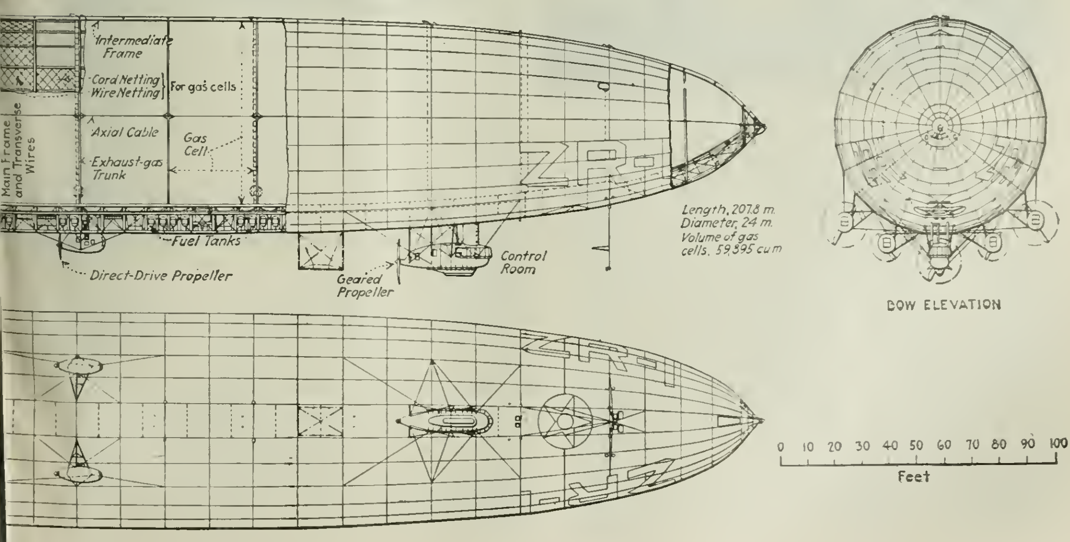
FIG. 2—GENERAL DRAWING OF THE U. S. NAVY DIRIGIBLE ARSHIP ZR1, BUILT AT LAKEHURST NAVAL AIR STATION

Design presented equal complications and difficulties, in view of the commanding importance of weight economy and on the other hand the absence of precise data for estimation of attacking forces and analysis of the resisting strength of the frame. This part of the development, however, may be summarized for present purposes by the statement that the design is modeled closely after the most successful foreign practice but that many members and parts were increased in strength. Careful analyses of the stresses in the frame for the estimated loads, wind pressures and accelerations were made by two methods of approximate solution of the complex indeterminate framework, which two methods represent opposite divergences from the true condition and thus yield opposite limiting values of the frame stresses. An independent reinvestigation of the design was made last year by an engineering board appointed by the department, composed of men outside the Navy Department. The detailed findings of this board have not been made public, but they are known to include a complete endorsement of the design as safe and adequate.

Structure and Material—For a general understanding of the construction problem it is necessary to outline a few essential facts concerning the structure of the ship and the material used. The frame of the ship, a cigar-shaped body of circular cross-section, 680 ft. long and 79 ft. (24 m.) in diameter in the mid-section, is made up of frame rings spaced 32.8 ft. apart, connected by thirteen longitudinals and made rigid by diagonal wire bracing in the transverse planes of the frames and in the rectangular panels formed by frame members and longitudinals. Halfway between the main frames are intermediate frames, of lighter section and without transverse wire bracing; similarly, halfway between the main longitudinals are intermediate longitudinals, this



FIGS. 3 AND 4—DURALUMIN FRAMEWORK AND AN INTERIOR JOINT OF THE FRAME



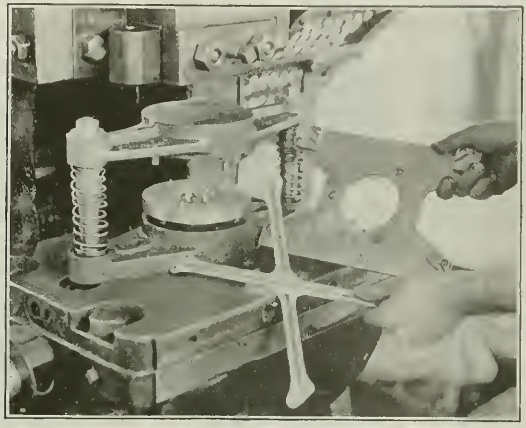
secondary system being braced by a system of secondary wire diagonals in the outer surface. The entire hull frame weighs only about 15 tons; as there are about 3,000 struts in the frame, this is less than 10 lb. weight per average strut. Duralumin, the material used, has a specific gravity of 2.8 (slightly more than one-third that of steel), an ultimate strength of about 55,000 lb. per square inch and a minimum yield point of about 35,000. The frame members are essentially struts or columns, and stiffness against buckling required that they be of large transverse dimensions and hence of very small metal thickness. For weight economy they were made of triangular cross-section.

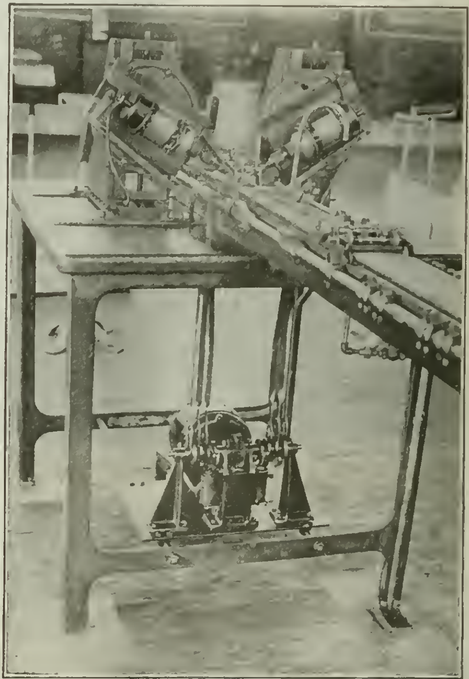
Metallurgical difficulties in the production, rolling and handling of duralumin have been largely overcome. The metal may be annealed to a soft state by heating for one-half to one hour at 350 deg. C., and either quenching or slow cooling; or it may be brought to a tempered condition by heating to 490 deg. C. and cooling. Immediately after the tempering treatment it is soft, and remains so for one or two hours, slowly assuming the hard condition. The hard condition is wanted in the finished structural members, but work must be done in the soft condition. The processes of manufacture must therefore be arranged to utilize the short-time soft state immediately following the tempering treatment, unless tempering of the finished article is practicable.

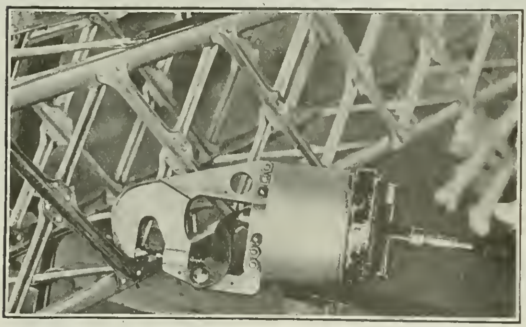
Aside from the difficulties introduced by the nature of the material, there were perplexing difficulties of fabrication, chiefly due to the very light thicknesses of the shapes used. These may be readily appreciated by comparing with ordinary structural steel. As in any structural framework, it was vital that the individual members should be straight and that the structure should be assembled firmly and true to form, with bracing of uniform tension.

Fabrication of the latticed struts was the first and principal problem.

Fabrication of Struts—Duralumin rolled channels of special section for the main members of the struts, and stamped and punched lattice bars were furnished from the mill of the Aluminum Co. of America. The channels were in random lengths, to be cut to length at the factory as required. The lattice bars, cut and formed by die stamping from an annealed rolled strip and punched for the end and center connection rivets, were received ready for assembly.







SPECIAL TOOLS FOR DRILLING AND RIVETING STRUTS
Fig. 5 (Top left)—Fixture for riveting lattice cross. Fig. 6 (Right)—Automatic spacing table for drilling strut channels. Fig. 7 (Bottom left)—Compressed-air riveter; grip adjusted by changing dies.

Fabrication of the parts of the airship was allocated to the League Island Navy Yard, Philadelphia, and erection of the airship to the newly built naval air station at Lakehurst, N. J., where an airship shed 264 x 803 ft. was built three years ago for constructing and housing dirigible balloons (see *Engineering News-Record*, May 6, 1920, p. 892). The work was put in charge of Commander R. D. Weyerbacher, U. S. N., who organized the fabrication at League Island and later took up the erection work at Lakehurst. In both parts of the work it was necessary to develop methods, tools and machines from the ground up, and work out in

succession the problems met in the work. In spite of the assistance of English and German airship experts, the work remained essentially a pioneer undertaking.

Assembling Lattice Bars—For quicker and more accurate assembly of the struts the lattice bars were first riveted together in pairs to form crosses. The necessary high precision was obtained by use of a two-piece fixture shown in Fig. 5. A rectangular plate with corner dowels receives the two lattice bars and positions them; when it is laid over a die plate having three dowels registering with holes in the rectangular plate, the four central rivet holes are brought directly over rivet dies on the die plate, and all four rivets are headed up in one stroke of the press in which the die plate is mounted. The punching of the lattice bars is initially checked up by their fit on the dowels of the frame plate; absence of distortion in the course of the riveting is checked by noting the absence of binding when the riveted cross is removed from and replaced on the plate.

Drilling the Channels—The channels which form the longitudinal members of the struts are first cut to length by hand hack saws, allowing 2-in. over-run at each end. The rivet holes are then drilled in an automatic spacing machine (Fig. 6).

The triangular struts, which form the entire framework except for a few rectangular struts in minor positions, are of two shapes, equilateral and isosceles, the latter having a long side equal to twice the short side. Two forms of channel were provided, differing in the angle between the flanges. Both sections are 1.18 in. wide on the back and 0.459 in. wide on the flange, with the outer edge of the flange slightly turned in to stiffen it; they are 0.59 in. deep. Their thickness ranges from 0.031 to 0.079 in. The angle between flanges is 60 deg. for the channels used in the equilateral sections and the base channels of the isosceles section, and about 45 deg. for the channel used at the peak of the isosceles struts.

In foreign practice, the struts have been built up complete in box-like forms, in which the channels and lattice bars were held firmly in position and then drilled and riveted in place. The builders of the ZR1 decided upon pre-fabrication as being more rapid and accurate, believing that precision in locating the rivet holes would assure straightness and truth of the struts. Laying out and individual drilling of the holes were out of the question from this standpoint, and the development of an automatic mechanical spacing machine was undertaken, with entire success. This is the machine shown in Fig. 6.

One end of the channel to be drilled is attached to a light carriage pulled along the table of this machine by a weight. Dogs along the sides of the table bring

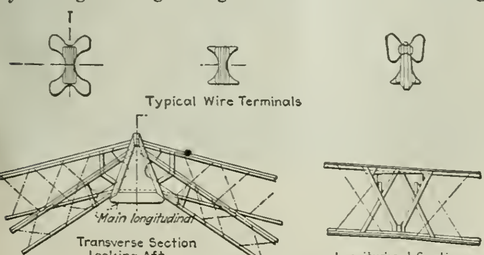


FIG. 8—A TYPICAL FRAME JOINT

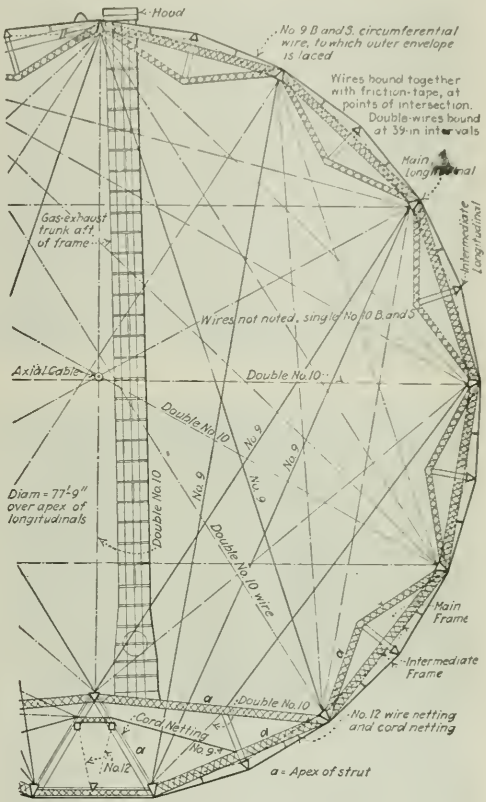


FIG. 9—FRAMEWORK OF ZR1 IN TRANSVERSE SECTION

the carriage to a stop at the proper position for a rivet hole. As the table strikes the dog, it trips a clutch which actuates a cam shaft (on a stand on the floor beside the machine) by means of which four control motions are initiated in succession. The first presses a hold-down pad on the channel at the point of drilling, the second closes the drill circuit, the third feeds and returns the drill, and the fourth throws out the dog and sets the following one.

A high degree of precision is required in the work. An accumulated error of 0.006 in. on the 18-ft. length of a strut gives the finished strut a wind of $\frac{3}{4}$ in. in a 5-m. length. It was therefore considered necessary to limit the overall error in rivet holes in one channel to 0.002 in. To assure this degree of precision the stops on the machine were set up by the use of fixed end-gages corresponding to the various rivet spacings required.

With the channels drilled thus accurately and the lattice crosses assembled precisely by help of the fixture plate previously described, it is possible to assemble a strut in the open and obtain entirely satisfactory results. Quicker work can be done, however, by assembling it in a form. Such forms, as shown in Fig. 10, have therefore been used for most of the work. Before the parts of the strut are placed in the form, the peak channel is clamped, back down, on a base strip and the lattices of both sides are bolted to it, with bolts in half the total number of holes; the bolts are set up tight by screw-

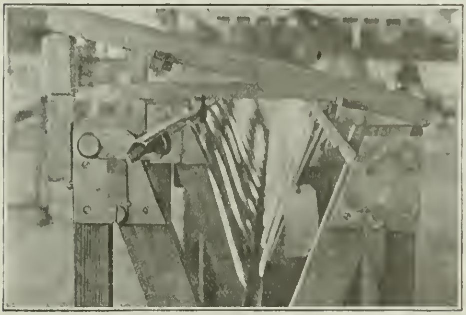
driver. Similarly the two base channels are bolted to the bottom lattice, on a flat support. The two parts then go into the form, where the strut is assembled peak down and clamped. The empty holes are riveted and then the bolts are successively replaced by rivets.

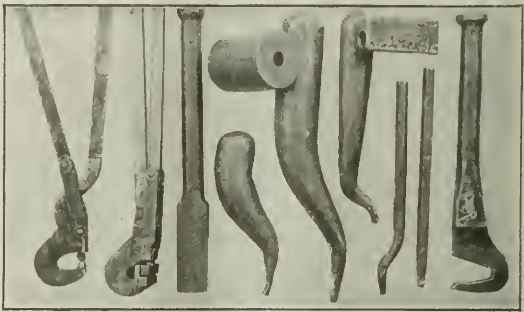
Rivets are driven cold. The air-operated toggle riveting press (Fig. 7) is also one of the tools designed for the job. It has a 3-in. air cylinder, and with 85 lb. air exerts a pressure of about 3,000 lb. It is necessary to adjust the grip of this press (gap at full stroke) to the grip of the rivet to be driven, as greater closure would be likely to deform or cut the metal of the channel; this adjustment is made by changing the dies, various dies of suitable length being provided. The strut shown in Fig. 7 happens to be of square section, through the main framing of the dirigible consists of triangular struts.

or ends of members, and the details worked out with them thereafter were used as templets for laying out the total number of connection pieces required. Where only one connection of a given kind was to be made, it was usually worked out on the members themselves.

If the complexity of the joints involved in the airship structure is considered, it may be realized that the detailing of the joints was a very tedious and extensive item of the whole work. A number of joints may be seen among the accompanying views, and two mockups are shown. In the original drilling of the channels on the spacing table, the connections were in all cases left blank, and they were drilled later in the mockup or from the templet produced thereby.

A special method of working out the joints was applied to the circumferential frames, which constitute the major part of the ship framing. A large floor jig





FIGS. 10 AND 11—ASSEMBLING STRUT SECTIONS IN FORMS AND A GROUP OF HAND RIVETING TOOLS

Doubled latticing (successive lattice crosses half spaced) is provided at the ends and load points of those struts which have to carry transverse load, as occurs in a number of members in the keel section, and also in general where strength of joint is important. For the necessary inside attachment of alternate lattice members the in-turned edge of the channel flange must be straightened. This "lipping out" is done by a small press, or in individual cases by a hand tool shaped like a broad flat-nosed pliers (shown in Fig. 11). Lipping out tends to curve a channel concave toward its inner edge, but the operator can neutralize this tendency by bending the channel out during the operation.

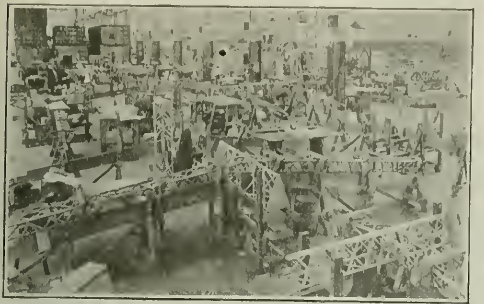
Riveting—Three sizes of rivets are used in the structure, 0.0965 in. for the center connections of the lattice bars, 0.115 in. for the girder-lattice connections, and 0.154 in. for the joints. They are tempered before driving and must be driven within an hour following this treatment. In fabrication as well as erection the system was followed of collecting all undriven rivets at one-hour intervals and distributing freshly treated rivets.

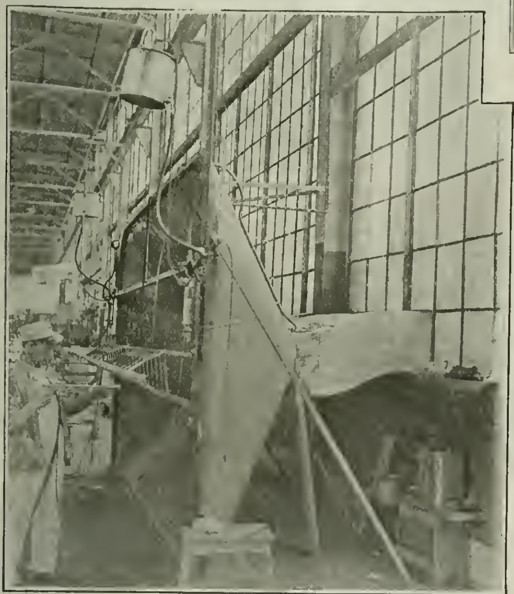
Joint Detailing—Details of typical connections were worked out on the drawing board in the course of the original design, but much of the detailing was left to the shop, to be worked out in actual set-up. No attempt was made to develop templets or shape the connection parts from the drawings, but all these data were worked out by shop set-ups or, as they were called, "mockups." Where a large number of duplicate joints was involved, all or part of the mockup was built with waste members

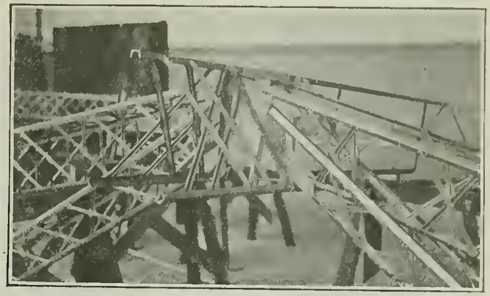
was built for fitting up these frames at League Island, as shown in Fig. 14. Thirteen radial members, passing through the peak point of the frame, carry movable support plates, on which are mounted vertical angle plates in the line of the two adjoining circumferential members. The plates are set at the proper distance out for a given frame, and then the frame members are laid in position against the angle plate, marked for bevel, cut, and the joint details worked out. On this jig, finally, the connection plates were riveted to one of the two connected frame members and bolted to the other, the frame being subsequently disassembled and the individual sections shipped to Lakehurst for re-erection on a similar jig and final riveting and wiring.

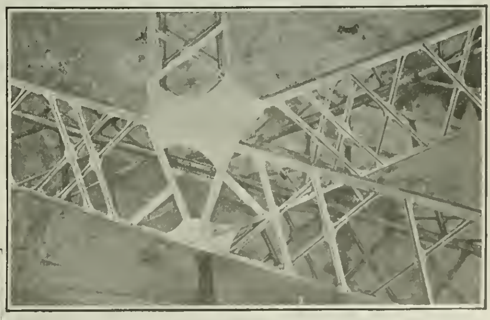
Several sub-assembly operations preceded and served this main assembly of the frame. Separate jigs were provided for these operations. On one the king post at mid-length of each main frame member was cut to bevel; on another the ends of the trussing struts of the king post frame were mitered, and on the third the trussed member was fully assembled. Connection plates and parts worked out from templets were also bent, cut and drilled in sub-assembly shops.

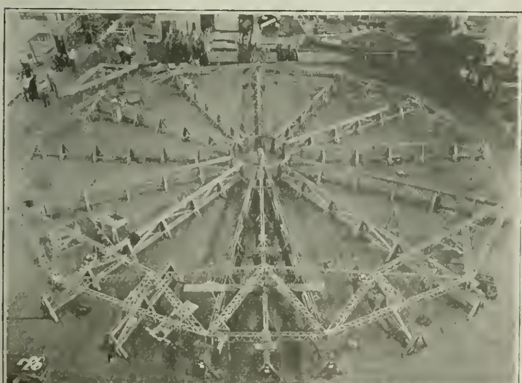
The main frame jig at League Island was adjustable for all frames, main and intermediate (the latter are 25-sided polygons in place of 13-sided as are the main frames, and their members are not trussed). After the early stages, however, to speed the work the intermediate frames were beveled and detailed by templet and were assembled on a loft floor, leaving the jig free for work on the main frames.

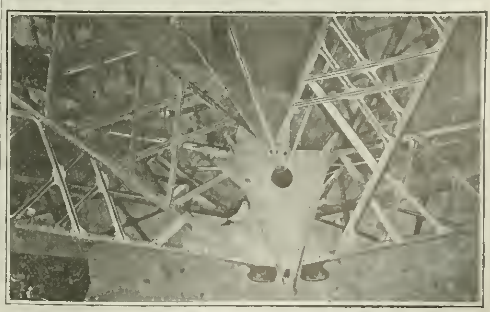












CONSTRUCTION OPERATIONS ON NAVY AIRSHIP ZR1

Fig. 12 (Top left)—"Mockup" assembly of joints for detailing.
Fig. 13—Varnishing struts with air spray.
Fig. 14—Main frame assembled at Naval Aircraft Factory.
Fig. 15 (Top right)—Intermediate frame in assembly at Lakehurst.

Fig. 16—A joint in mockup assembly.
Fig. 17—Frame joint, with double lattice near connection.
Fig. 18—Attachment of transverse wiring to joint of main frame.

FIG. 19—SERVED AND SOLDERED BRACE-WIRE LOOP

All completed members were varnished by compressed air spray (Fig. 13), using clear varnish with a small amount of blue pigment. Most of the material was shipped from League Island to Lakehurst by motor truck.

Final Assembly—A floor jig like that used at League Island but somewhat simpler in construction was built at Lakehurst for final assembly of the ring frames. Here they were riveted and the diametral and chord wiring which holds the ring to shape was inserted and drawn up to proper tension. With some care in handling, the completed frame could be picked up without serious distortion and handled by hoist lines suspended from the roof, over to the erection trestles, along one side of the big hangar, where it was set and blocked up, being lined up transversely and longitudinally by transit to true position.

FIG. 20—CENTRAL SECTION ERECTED AND BRACED

Erection—The system of erection differed from that used in England, where it has been customary to set and brace permanently a pair of frames, then skip a panel and erect and brace the next pair of frames, later filling in the empty panels. For the Lakehurst work it was decided that continuous working would be better, starting from a rigid mid-section to be first set and braced. Accordingly the middle six frames were set, the longitudinals put in place, beginning at the bottom, first in the middle panel and then in the panels to either side, etc., and finally the wire bracing between frames and longitudinals was put in in similar sequence. In this process the farthest advanced portion, at the middle, was at all times more rigid than the portions to either side, and disturbance or distortion was minimized by carrying on the work symmetrically toward either end of the group of frames. It was thus possible without great difficulty to maintain the framework true and thus finally produce a mid-section fully braced and true to form, with uniform tensions in the bracing wires. In this initial operation only the main frames and longitudinals were placed, and the secondary system with its secondary bracing followed as a second operation.

Once the rigid central section was complete, work could progress toward either end independently without any tendency to distortion.

Inserting the Brace Wiring — The wire bracing throughout the ship consists of hard drawn steel wire from No. 9 to No. 11 wire gage, with No. 12 and No. 13 used in some minor services. Turnbuckles are not used, but instead the wire is drawn up and end loops formed and safe-ended, with the use of a tensioning device which permits the application of precisely the tension wanted. The tensioning device consists of a small winding frame comprising a cable drum or spindle attached to a gear, and a crank handle attached to a pinion meshing with the gear; a pawl on the housing of the device engages a ratchet wheel on the pinion shaft. A vise-like clamp is connected by a link to the winding gear housing, and a similar one is attached to the outer end of a length of tiller rope which is wound on the drum of the winding gear. When a wire diagonal is to be put in, one end of the wire is passed through one of the eyes which it is to connect, a loop is bent, served with wire wrapping and soldered; then the other end of the wire is passed through its eye, and one of the clamps of the pulling device is attached to this free end, while the other clamp is attached to the standing part of the wire near the opposite eye. By means of the ratchet gear the connecting rope is wound up on the drum and the free end of the wire thereby pulled up to any desired tension. The tension in the standing part of the wire is measured with a Larson wire-tension gage while the pulling goes on, and when it reaches 300-lb. tension, the desired amount in the diagonals of this airship, the free end of the wire is clamped to the standing part, served and soldered. The serving is done with No. 30 annealed steel wire, put on in about 100 turns with a small space left every fifth turn. Without releasing the clamp, the serving is then filled with a flux of stearic acid and resin, and soldered and wiped. The result is shown in Fig. 19.

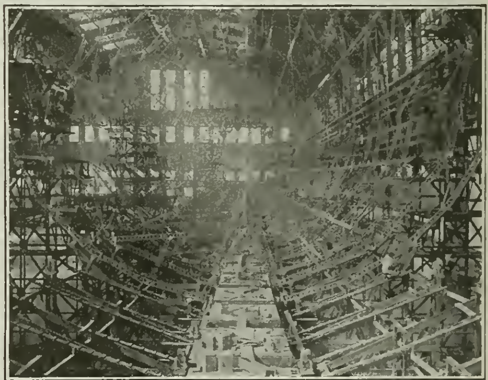


FIG. 21—ERECTION PROGRESSING TOWARD TAIL

Fitting Longitudinals—The field connections of longitudinals to the ring frame were drilled in the field; the end details were worked out fully in the League Island factory, and cut and formed, but the rivet holes were drilled in the member from the connecting holes in

frames and gusset plates when the longitudinal was actually built into the ship on the blocks.

Protection Netting and Skin—Each longitudinal element of the ship between main frames (10 m. long) is

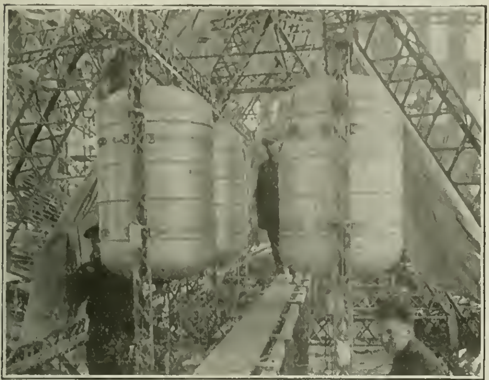


FIG. 22—GASOLINE TANKS HUNG ALONG KEEL PASSAGEWAY

occupied by a separate gas bag. The bag has a manually operated escape valve at the top and an automatic release valve at the bottom, vented upward through a tube passing between the bags. To resist the bulging tendency of the bags in the openings between the frame members, the entire inner surface of the frame is covered with a tightly stretched network of crossed diagonal wires (No. 13) spaced about 18 in., which are fastened to the inner channels of the longitudinals and ring frames. Inside of these is a smaller netting of knotted ramie cord, about 9 in. mesh.

A skin of impregnated fabric covers the outside of the ship. It is put on in wide longitudinal strips, which are laced to the frame members around their edges. The spaces between the sections of fabric are covered with strips cemented on, and the entire skin is brush-coated with cellulose acetate.

Tests to Be Made—Wind and air resistance forces are applied to the airship structure through this skin. Buoyancy forces are applied by the retaining wire meshwork surrounding the gas bag, and bear chiefly on the frame members about mid-height of the structure. Loads other than the hull weight itself are due to the cars (power and control), fuel tanks hung along the sides of the keel passageway, and water ballast bags of one ton each in the same location. These vertical forces are applied partly at six panel points of the ring frames in the lower quarter, and partly along the length of intermediate longitudinals in the upper part of the keel section. The propulsive forces are exerted at the frame panel points to which the center and side power cars are fastened. Certain concentrated forces due to the action of the fins and rudder surfaces act on the tail section.

With the forces of attack on the structure thus concentrated at different points of the ship, knowledge of the way in which stresses distribute through the structure is of great importance. The difficulties of analysis in view of the very high degree of statical indeterminacy of the structure are, however, such that theoretical knowledge of the stress distribution is quite imperfect. On this account it is planned to make elaborate tests when the ship is completed. By comparison of the results of the stress measurement in these tests with calculation results, a high degree of approximation in correcting the theory is attainable.

Certain of the tests have already been made. One of them is illustrated in Fig. 24, showing one of the gas bags inflated, putting tension on the transverse wiring of the main frames at either end and correspondingly putting the frame itself in compression. Several thousand stress and distortion measurements were made in this test, or rather in a subsequent test of which this was the preliminary. For accurate measurement of distortions a wooden bridge, 85 ft. in span and 110 ft. high, was built over the test panel (Fig. 23) before the final gas-bag test was made. The results of the test agreed closely with calculations of ring stresses, as

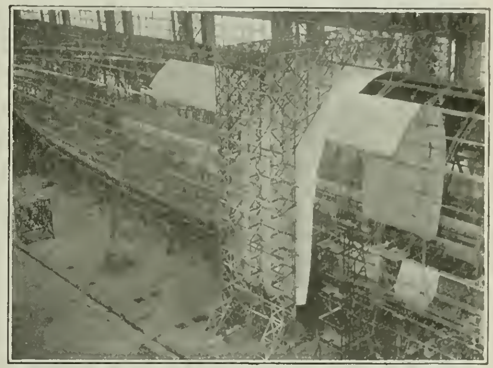


FIG. 23—BRIDGE OVER CENTRAL PART OF SHIP FOR GAS-BAG TEST; SPAN 85 FT., HEIGHT 110 FT.

might be expected if the structure was of reasonably uniform constitution.

In the tests after completion of the ship more significant results are likely to be obtained. These tests will be made under full buoyancy, with loads applied at definite positions along the keel and then shifted to other positions, giving a known change in bending moment. Comparison of the stresses measured for the two positions will give precise values of the stresses due to the increase or decrease in bending moment.

Local tests are being made on different parts of the structure. The tail stresses due to pressures on the fins are being investigated by measurement under known loads placed on the fins. It is probable also that tests in flight will be carried out. The McCollum-Peters carbon-resistance strain-gages of the Bureau of Standards (*Engineering News-Record*, July 5, 1923, p. 27) are used for the stress measurements. These gages permit making stress measurements at points inaccessible during the measurements and enable the readings from a large number of points to be taken at one central point.

Mechanical Problems—The various problems encountered in the equipment of the ship cannot be gone into here. One of them may be noted, however, to illustrate the original experimentation required in their solution.

The aluminum gasoline distributing piping in the ship is connected by fittings of sand-cast "linite," an

aluminum alloy. These fittings proved to be very porous; practically the entire lot leaked gasoline under a pressure test. The problem was to make them tight. Extensive experiments were carried out. Finally, success was attained by impregnating the castings with silicate of soda (water glass) under pressure. In the method finally used a lot of the castings are first subjected to a vacuum (25½ in. mercury was obtained), after which the water glass solution is admitted. The tank full of castings immersed in the solution is then subjected to a pressure of 300 lb. per square inch, which is left on for an hour. When taken out of the solution the castings are dried in the sun or at a gentle heat. The treatment makes them tight against gasoline in

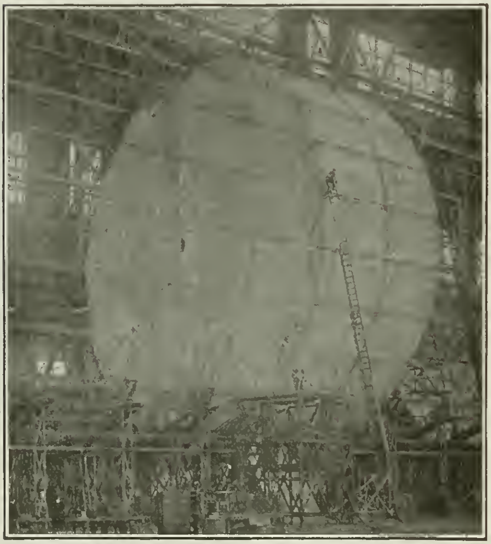


FIG. 24—GAS-BAG TEST OF TRANSVERSE WIRING AND FRAME RINGS

tests at 110 lb. pressure, which is several times as great as the highest service pressure.

It may be added that expansion is provided for in the longitudinal piping as well as in the wire and wire-rope lines of the control system, which operates valves of gas bags, ballast tanks, and the like, engine telegraphs, rudders and other necessary controls throughout the ship from the control car under the forward portion of the keel. The expansion provision in the pipes consists of goosenecks, while the wire and cable lines have mechanical take-up, also operated from the control car.

The general design of the Fleet Airship ZR1 was started under the direction of Commander J. C. Hunsaker, Construction Corps, U. S. Navy. The design of airships was under the cognizance of the Bureau of Construction and Repair. As chief of the bureau of construction and repair, Rear Admiral D. W. Taylor always displayed great interest in airships and due to his energy the work never lagged. Upon formation of the Bureau of Aeronautics, under Rear Admiral W. A. Moffett, the design of the ZR1 was completed under the direction of Commander Hunsaker. The detailed design, fabrication of parts of the structure and power plant installation were performed at the Naval Aircraft Factory, Navy Yard, Philadelphia, Pa., under the direction of Commander G. C. Westervelt, Construction Corps, U. S. Navy, its manager. The development of plant facilities, methods and processes of erection and tests of the ZR1 were performed under the direction of Commander R. D. Weyerbacher, Construction Corps, U. S. Navy, manager, Naval Air Station, Lakehurst, N. J.

Truck Sizes and Traffic Capacity of Highways

Extract from an address by Major F. S. Besson, Assistant Engineer Commissioner, District of Columbia, before the Washington Society of Automotive Engineers.

IN ORDER that the maximum capacity of highways may be developed, the widths of vehicles, with their loads, must be limited to 7½ ft. Likewise, in order to obtain this maximum capacity it would appear to be unwise to eliminate the 7½-ton truck, for its load would then be carried by more than one truck and more space would be occupied on the roadway.

A 7½-ton truck weighs, on the average, 11,000 lb. with no load, and 27,000 lb. loaded. Its average length over all is 21 ft. If its load is carried on 1½-ton trucks, five are necessary, the total weight of which unloaded would be 25,000 lb. compared to 11,000 lb. for the 7½-ton truck; and the length over all on the road would be 138 ft. compared to 21 ft. for the 7½-ton truck. Furthermore, we are not certain as yet, granted that the two types of trucks are equally well designed, that carrying the load on 20 wheels would not do more damage to the pavement than carrying it on 4 wheels. Certainly congestion on the streets would be greatly increased. Gross weight alone is not the all-important factor. Speed, unsprung weight, wheel loads, character of tires, tractive stress on the pavement, all these enter into the matter.

Pavements can be built at reasonable cost strong enough to carry 7½-ton trucks. Practically every pavement failure in Washington has been examined and in no case could blame be placed upon the heavy truck. Engineers need some unit upon which to base design and, having adopted the 7½-ton truck as this unit, the public should be informed that this limit is to continue indefinitely.

Within the permissible gross weights for vehicles, certain regulation is, however, required. A basic rule should be that trucks may not carry more than the weight for which they are manufactured, and in accordance with which weights the owners have paid fees in obtaining operating permits. The motor vehicle industry condemns overloading, and manufacturers generally are arriving at the point where they furnish caution plates stamped with chassis and body weights and load capacities. In accordance with the data furnished by the manufacturers, the license bureau should make certain that the permissible gross weights are painted on the sides of all cargo vehicles, and fees should conform to these gross weights.

It is believed fair to base registration fees for the time being on maximum gross weight alone, at 50c. per hundred pounds. Passengers should be rated at 150 lb. each. Thus, the usual 5-passenger car, weighing loaded about 3,200 lb., loaded would pay a fee of $16; a Ford roadster about $10; a heavy limousine probably $30; a 7½-ton truck, gross weight about 28,000 lb., $140.

These fees equal about the average paid throughout the United States, when gasoline, personal, and all other taxes combined are considered. The main principle of the suggested rate is that vehicles are taxed upon a graduated scale. It may not be absolutely accurate as judged from the pavement standpoint, but it is as nearly so as can be made under the present state of our knowledge. An important point is to enforce loading regulations.

New Gravity Freight Yard at Denison, Tex.; M.-K.-T. Ry.

Extensive Layout on Cutoff Line Has Daily Capacity for 80 Trains and Classifying 2,000 Cars—Two Hump Tracks Have Different Grades—Separate Departure Yards

OF MANY projects on the extensive improvement program which has been carried out during the receivership of the Missouri-Kansas-Texas Lines, the largest single undertaking is the new freight terminal at Denison, Tex., which it is expected to have complete and ready for service in August, 1923. Heavy concentration of traffic occurs at this place and the layout includes units for southbound and northbound movements. Each unit has a receiving yard and a combined classification and departure yard, these two yards being connected by a hump track. A special feature of the design is that provision is made for future development of a separate departure yard in each unit, to be located beyond the classification yard. The general situation is shown in Fig. 1.

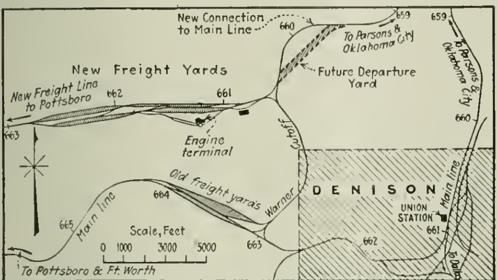


FIG. 1—NEW AND OLD FREIGHT TERMINALS AT DENISON, TEX.; M.-K.-T. RY.

For some years past the old yard, built in 1894 and enlarged in 1909, has been inadequate for the traffic and the amount of classification required. In planning the improvement, consideration was given first to the expansion of the old facilities, but this would have required heavy grading and unfavorable alignment involving inconvenient and expensive operating conditions.

A new location was selected therefore about a mile from the old yard and requiring a new approach line. This site is much more favorable as to grades and curvature and is well adapted to a hump yard layout, since it has open rolling ground which descends with moderate slopes in both directions from a central ridge and is intersected by ravines which provide excellent lateral drainage. The axis of the yard is a tangent for more than a mile in each direction from the hump and the natural fall of the ground is favorable to the hump profile. In the six miles of new work, including a three-mile single track connecting to the main line at the south end, the length of freight main track is shortened by 1.3 miles, with a reduction of 235 deg. of central angle in total curvature and 72 ft. in rise and fall. This new work being entirely separate from the old facilities, its construction involves no interference with traffic and no disturbance of existing tracks. The new six-mile freight line leaves the Warner cutoff west of M.P. 660 (see Fig. 1) and joins the main line near M.P. 669, just each of Pottsboro.

Traffic Conditions—In the M.-K.-T. Ry. System, Denison is an important assembling and classification point. Studies showed that present traffic conditions require a yard of sufficient capacity to handle about forty inbound and forty outbound trains per 24 hours, and to switch and classify approximately 1,500 to 2,000 cars in the same period. Furthermore, the volume of traffic is increasing steadily and provision for growth was a prime requisite in the design of the new terminal.

Yard Layout—From the plan, Fig. 2, it will be seen that the northbound and southbound units are parallel with each other and that the two parts of each unit are in tandem, connected by the hump track. In the northbound unit the capacity of the receiving tracks is 69 to 92 cars and that of the classification tracks is 51 to 145 cars. In the southbound unit the receiving tracks hold from 86 to 121 cars and the classification tracks from 71 to 87 cars. The body tracks are spaced 13 ft. c. to c., and 16 to 18 ft. c. to c. from running tracks. Yard ladders have No. 8 frogs with a lead angle of 8 deg. 34 min. and a spacing of 84 ft. between points of switches. Turnouts from lead tracks also have No. 8 frogs. Rails of different weights are used at present, all laid on creosoted ties, with gravel and sand ballast for yard tracks and stone ballast on the connection to the main line. Drainage is provided by culverts crossing the yards, some of these being reinforced-concrete boxes 8 x 6 ft. with inlets 20 x 24 in. between the tracks.

Two caboose tracks holding 22 cabooses in all and a 12-car bad-order or cripple track are located alongside the upper or rear end of each classification yard, so as to be served by a minimum amount of switching. These tracks are 16 ft. c. to c. Between the two units and readily accessible from them are a car repair yard and a transfer platform for handling L.C.L. freight. South of the yard is the engine terminal, approached by running tracks from both directions. Yard tracks now under construction aggregate sixty miles and are divided as shown in Table I.

TABLE I—TRACK CAPACITY OF DENISON FREIGHT TERMINAL

Yard	Number of Tracks	Standing Car Capacity Maximum	Minimum	Total
Southbound receiving	6	121	88	600
Southbound classification	16	87	3[illegible]	1,200
Northbound receiving	10	92	69	700
Northbound classification	24	145	34	1,800
Car repair	4	17	14	65
L.C.L. transfer	4	18	18	75
Total	..	...	..	4,400

Interlocking plants protect the junctions of the new connecting line with the main line at Red River (Denison) and Pottsboro. An automatic switch set for southbound movements but opening under northbound trains (and returning to normal position) connects the northbound and southbound sections of the yard with the single track connection at the north end, near M.P. 660 (Fig. 1).

There are no highway crossings at grade within the yard limits. Two highways, one near the north end of the yard and one at the hump, are carried over the tracks on steel spans. One highway at the south end of the yard passes under the yard approach and switching lead through a concrete subway. Another over-crossing of timber trestle construction carries the main highway

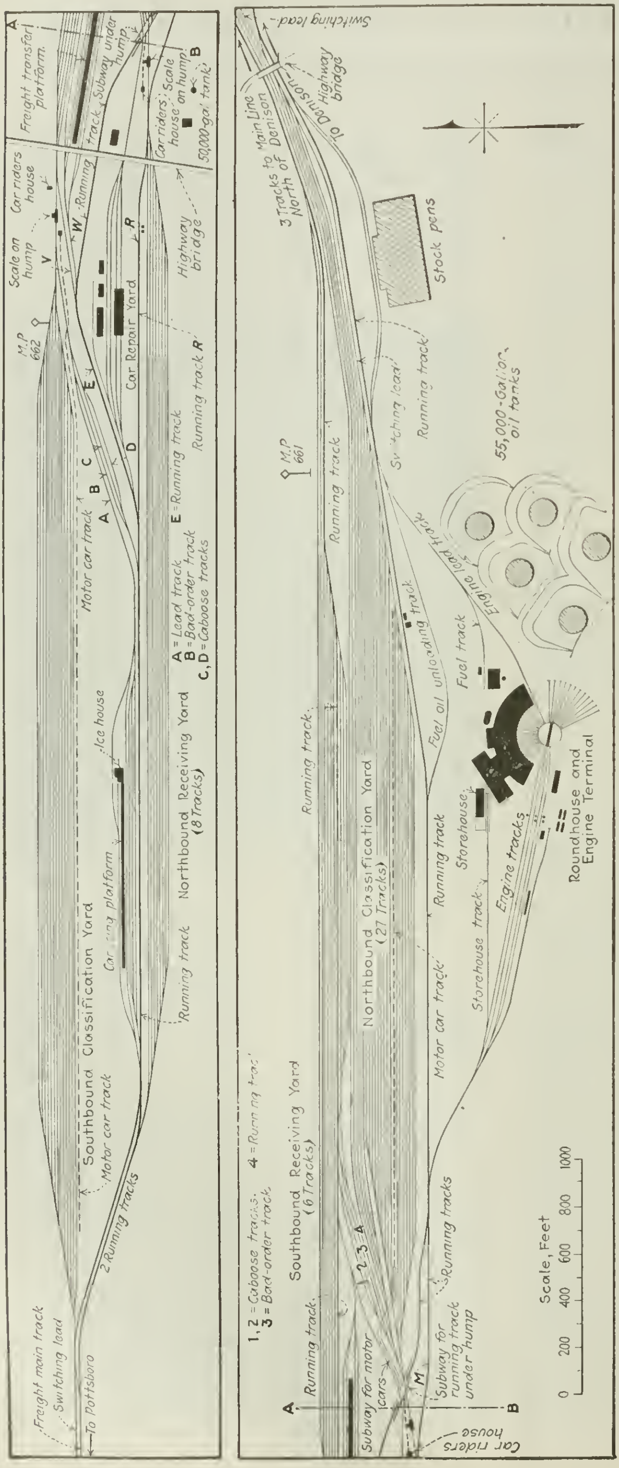


FIG. 2—LAYOUT OF FREIGHT YARDS AT DENISON, TEX.

over the single-track freight main line which connects the south end of the yard with the Fort Worth division of the main line, five miles west of Denison.

Switching Humps—The two humps are nearly opposite each other and about 600 ft. apart, each with a 56-ft. 75-ton track scale conforming to the specifications of the U. S. Bureau of Standards. Their profiles are as shown in Fig. 3 and in Table II, the slightly steeper grade of the northbound hump being due to the larger proportion of empty cars in that direction. In each yard a track is provided for the operation of motor cars to return the car riders to the hump. In the southbound yard this track is located at the side of the body tracks but in the northbound yard it is located in the center, crossing under the classification lead through a concrete subway.

A considerable proportion of the traffic terminates or originates in Denison or on branch lines centering there. As this traffic comes from or is destined for points both north and south on the main line there is a certain amount of reverse movement of such cars. To meet this condition provision is made for convenient cross movements of cars over either hump, without separate switching, into tracks so located that cars can be classified in reverse direction over the other hump. It is expected that when traffic is light both humps will be operated by a single engine.

To control the movements of the hump engines, electrical signals, operated from the humps, are placed on the steel spans which carry the highway over the hump tracks. The switches of the classification tracks are thrown by hand.

Miscellaneous Yard Facilities — Transfer for L.C.L. freight in order to consolidate shipments is provided for by a timber platform 24 x 600 ft. having an office and locker room. This platform, Fig. 4, serves two tracks 12 ft. c. to c. on each side. Creosoted pile butts on concrete footings carry joists 10 ft. apart on which are stringers for the 2⅝-in. floor planking. Along each side of the platform a trucking runway is formed by a pair of 10-in. steel plates ⅛ in. thick, the floor being grooved so that these plates are flush with the surface. Two-post bents 20 ft. apart carry stringers for the joists of the butterfly roof. By inclosing three bays of these bents, an office 10 x 60 ft. is formed and the lighting and ventilation of this inclosure is assisted by a triangular skylight with hinged sash, as shown.

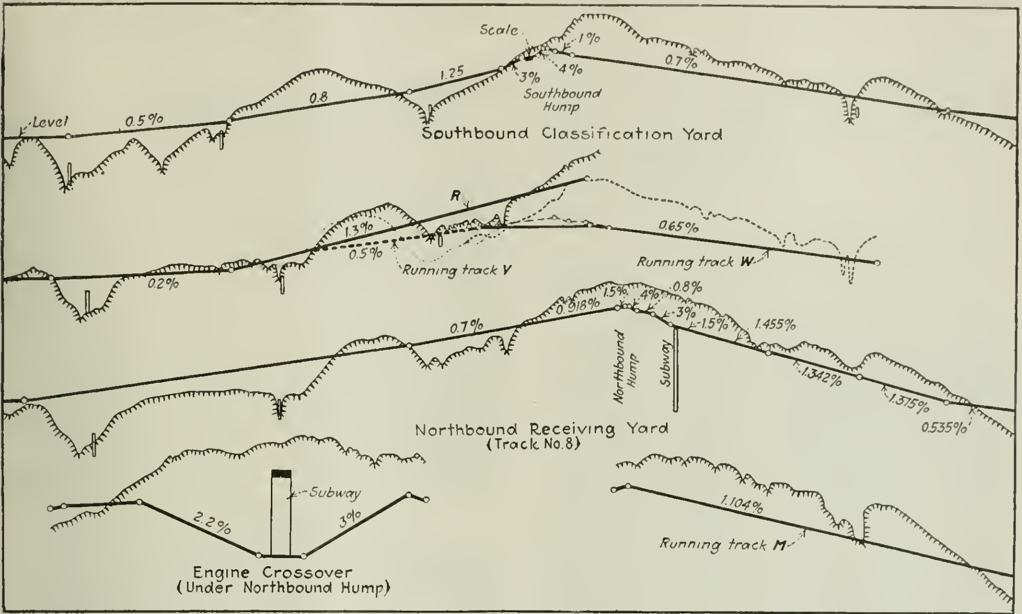


FIG. 3—PROFILES OF SWITCHING HUMPS

An icing station along the north side of the northbound receiving yard comprises a 100-ton ice storage house of frame construction, an ice crusher, conveyors and a double-deck platform 16 x 800 ft. for delivering block or crushed ice to the bunkers of refrigerator cars. This plant serves two tracks 29 ft. c. to c. Stock pens are provided for unloading and feeding stock in transit.

Car repair facilities are provided at four tracks spaced 16, 20 and 24 ft. c. to c., two of which are covered by a shed 200 x 40 ft. There are also a lumber shed, small shop, office and storeroom, served by a material track at the rear. Compressed air is piped from the power house to the repair tracks and also to the departure tracks for testing the train brakes. A two-story brick yard office is located midway between the humps, giving a good view of the entire yard and convenient access to the humps and the transfer platform.

TABLE II—PROFILES OF SWITCHING HUMPS IN YARD AT DENISON, TEX.; M.-K.-T. RY.

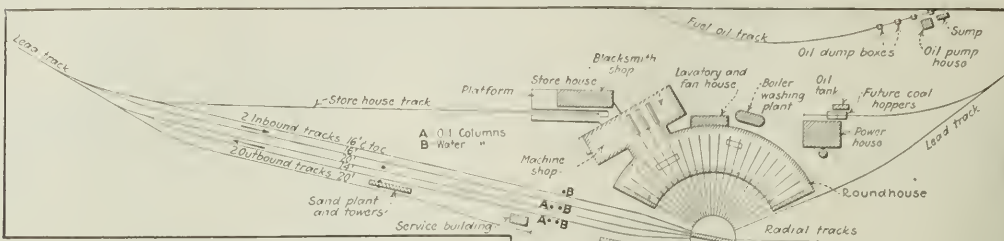
	Northbound Hump	Southbound Hump
Aacent from receiving yard	0 7 and 0 98 per cent	0 70 per cent
Bunching grade at summit	1.5 per cent for 50 ft.	1 0 per cent for 100 ft.
Bunching grade at summit		1 5 per cent for 50 ft.
First accelerating grade....	4 per cent for 75 ft.	4 per cen for 50 ft.
Over acale	0.8 per cent for 100 ft.	0 8 per cent for 100 ft.
Second accelerating grade to ladder ...	3 per cent for 100 ft.	3 per cent for 100 ft.
On classification ladder ..	1 5 per cent for 250 ft.	1.25 per cent for 500 ft.
On classification ladder...	0.435 per cent for 300 ft.	
On classification tracks...	1.342 for 500 ft.	0.8 per cent for 1,000 ft.
On classification tracks...	1.375 for 500 ft.	0 5 per cent for 900 ft.
On classification tracks...	0 536 for 500 ft.	Level
On classification tracks...	0.38 for 1,000 ft.	....
On classification tracks...	Level	....

Engine Terminal—The locomotive facilities, arranged at the south side of the yard, include a 100-ft. deck turntable of center-bearing type operated by an electric tractor, and a 22-stall brick and frame roundhouse 105 ft. deep with shop annex 72 x 225 ft. There is no through track, the roundhouse being served only by the turntable. This turntable also serves twelve radial tracks opposite the roundhouse. All the radial tracks are at an angle of 5 deg. 48 min. 23 sec. The layout of the engine terminal is shown in Fig. 5.

Concrete engine pits 79 ft. long provide for inspection and repair in the roundhouse, Fig. 6. A drop pit for handling driving wheels and axles serves the three tracks which extend into the shop, and two of the other tracks are served by a smaller drop pit for truck wheels. Four post cranes are located adjacent to the larger drop pit. The roundhouse floor is of concrete. Wooden swinging doors form the inner front of the building, and the outer or rear wall has a large proportion of glazed area. In the middle of the roof of the roundhouse is a high and wide cupola or monitor, with ventilating sash.

The shop, of brick and steel construction, is divided into two parts by 50-ft. working pits in three of the roundhouse tracks which are extended into the shop. At one end of the shop are the machine tools and the other end is used for blacksmith and tube work. A 10-ton electric overhead crane travels the entire length of the shop and handles materials between the locomotives and the machines.

This shop building is connected also by a covered passage with the concrete and brick store and oil house, 60 x 120 ft. The floor of the store house and the adjoining platform are at the same elevation as the shop floor and the track serving them is depressed so that the car floor is level with the platforms. This arrangement of all facilities under one roof and at one floor level provides passage between roundhouse, shop and store house with a minimum of man-travel. Windows in the shop buildings and roundhouse have steel sash glazed with factory wire glass. The roundhouse cupola has wood sash. The roundhouse and shop are



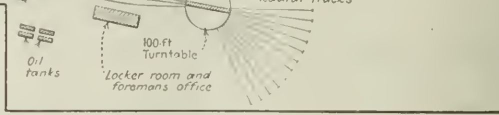


FIG. 5—NEW ENGINE TERMINAL; M.-K.-T. RY.

heated by hot air, distributed to pits and columns by fan through underground concrete and tile ducts.

A power house, 60 x 83 ft., of brick and steel fireproof construction, houses two 328-hp. water-tube boilers, two steam-driven compressors each with a capacity of 1,000 cu.ft. per second, together with fire pumps and other accessories. Electric power for operating machinery and for lighting the yard is purchased from the local power company and the power house will not contain any prime movers for the present, steam being provided only for operation of the compressors, the heating plant and the boiler washing plant. The boilers use oil fuel, but the power house is designed to accommodate future coal and ash handling facilities. A lavatory and locker room and a fan room for the heating system adjoin the back of the roundhouse, and the boiler-washing plant is housed in a separate structure.

Fuel and Water Supply—Oil fuel is used by all locomotives operating out of this terminal and is supplied to the tender tanks by two oil columns near the roundhouse. Fuel oil is dumped from tank cars at eight oil boxes (see *Engineering News-Record*, 1921, Aug. 4, p. 183, and Oct. 13, p. 618) and is stored in five 55,000-barrel steel tanks which are surrounded by low earth banks for fire protection. From storage, the oil is pumped to four 10,000-gal. elevated horizontal delivery tanks, which serve the oil columns. There is a sandhouse and drier and the plans provide for a future coaling station and ash handling facilities when these shall be required.

Water is purchased from the city and delivered through a 10-in. main to a steel tank 115 ft. in diameter

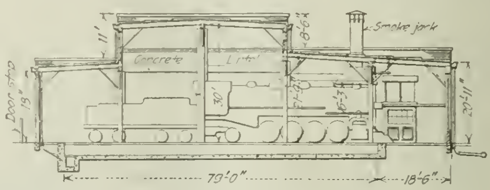


FIG. 6—SECTION OF ROUNDHOUSE

and 30 ft. high, of 2,300,000 gal. capacity, erected on a hill about 900 ft. south of the roundhouse and with its bottom about 75 ft. above rail level. This tank supplies emergency storage and direct pressure for delivery of water to the engines. An elevated steel tank of 40,000-gal. capacity, opposite the humps, provides a service supply in the buildings and also supplies two water columns located along running tracks adjacent to the humps.

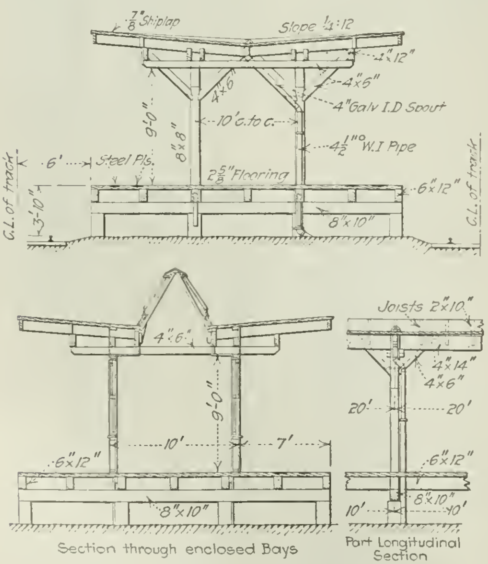


FIG. 4—FREIGHT TRANSFER PLATFORM
Note trucking runways of steel plates

Engineers and Contractors—Grading for the yard and locomotive terminal involved about 800,000 cu.yd. Culverts and bridges comprise 7,850 cu.yd. of concrete. The grading and concrete work was performed by the C. R. Cummins Co., Cleveland, Ohio; and Bowie, Lydon & Co., Chicago, were general contractors for the building work. Three oil tanks and the water storage tank were constructed by the Chicago Bridge & Iron Works, Chicago, and two oil tanks by the United Iron Works, Kansas City, Mo.; fuel oil facilities and boiler washing plant, by the National Boiler Washing Co., Chicago; water and air pipe lines and stock pens, by T. H. Johnson, Sedalia, Mo. Tracks are being laid and ballasted, including the furnishing of sand ballast for yard tracks, by Zay Gardner, McAlester, Okla. The cost of the whole project will be about $3,200,000.

This improvement was planned and is being carried out under the supervision of F. Ringer, chief engineer, Missouri-Kansas-Texas Ry., assisted by J. M. Metcalf, principal assistant engineer; with A. L. Sparks, architect, in charge of preparation of building plans, and A. Harvey, construction engineer, in charge of the work on the ground.

Hammer Rigged to Follow Pile Down Under Water

Lumber Saved and Submarine Sawing Minimized on Foundations for Brooklyn Edison Power Plant Construction

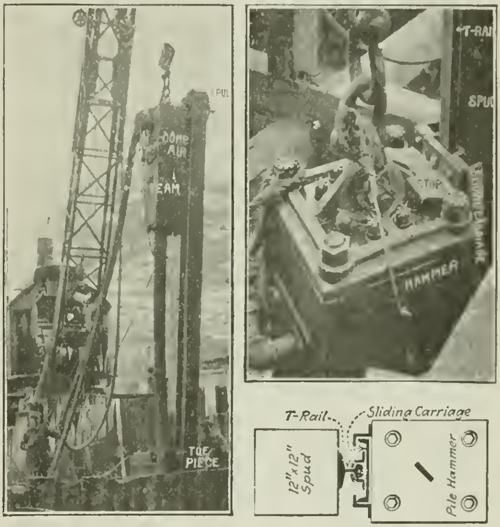
BY THE USE of a rig which makes possible the driving of wood piles with a standard steam hammer submerged in water 30 to 40 ft. deep foundations have been prepared for the large new power plant along the East River, at the foot of Hudson Ave., for the Brooklyn Edison Co., New York City. The outstanding feature of the scheme of submarine driving is the mounting of the hammer on a long timber spud equipped with a T-rail track and a sliding carriage which allows the hammer to move down under water with the pile head to grade. Thus the use of a follower frequently employed in submarine driving of this sort is dispensed with, the full force of the blow of the hammer is delivered direct to the top of the pile, the costly operation of sawing off piles to grade under water is largely eliminated and short lengths of pile can be used effectively with little or no waste of lumber.

The Brooklyn work involved the driving of piles in 11 cofferdams containing heavy timber cross-bracing which divides the cofferdams into groups of rectangular pockets. The bottom is composed of sand and gravel. The foundation requirements called for piles having a penetration of from 15 to 25 ft., spaced on about 2-ft. centers. With the submarine rig described below 3,000 piles have been driven in three of the cofferdams. In the other cofferdams long piles were driven and cut off with a saw as described in *Engineering News-Record* of March 22, p. 548.

Sliding Carriage for Hammer—To avoid the necessity of unwatering the cofferdams, which would have brought great pressure on the interlocking steel sheet piling of which they are formed, the plan of submarine pile driving was decided upon. For this work, a submarine rig was developed consisting of a McKiernan-Terry steam hammer weighing 6,600 lb. mounted on a sliding carriage which, in turn, engages a vertical T-rail track attached to a 12x12-in. timber spud about 55 ft. long. The sliding carriage consists of a steel channel to which Z-bars are riveted to engage the head of the T-rail and the sides of which are, in turn, engaged by a second pair of Z-bars riveted to the back of the hammer. There is a stop riveted to the top of channel carriage to prevent the hammer from being pulled out of its guides, a similar stop at the upper end of the spud to limit the upward movement of the carriage, and a toe-piece at the bottom of the carriage, consisting of a pair of steel straps drilled with holes large enough to receive large spikes. The function of this toe-piece, through which one spike is driven from each side into the wood pile, is to hold the lower end of the pile in position, prior to the operation of the driving, and to guide it in its descent.

Wooden piles with 12 to 14-in. butts are delivered on barges alongside a scow within reach of a locomotive crane from the boom of which the piledriving equipment is suspended by a two-part wire cable. The operations preliminary to actual driving consist in sawing the wood piles to the proper length (15-25 ft.) by hand and shoeing them with metal points. A chain hitch is then passed around the pile and it is snaked to position under the hammer which is raised as high as the stops on the channel carriage and the spud will permit. The top of the pile is then fitted under the bell-bottom anvil block of the hammer, the foot of the pile is swung into the U-shaped opening formed by the sides of the toe-piece, and two spikes, one from each side, are driven part way into the pile through the holes in the toe-piece to hold the pile point in line. The spud is then accurately spotted by the derrick boom, brought to a vertical position and held there by guy lines. The hammer on its sliding carriage is lowered until the pile point strikes bottom; in this position the hammer is completely submerged, although the spud is long enough so that its top is well above water level.

The first few blows of the hammer force the pile



HAMMER CARRIED ON SPUD BY SLIDING CARRIAGE
Cross-section shows carriage and track details.

down through the toe-piece, turning up the spikes and disengaging their grip. The hammer then follows the pile down through the water along its sliding carriage until the top of the pile reaches grade. The exhaust steam is led to the surface through a rubber hose. The hammer and spud are raised and the operation is repeated.

The Hammer—The hammer is of the double-acting type, operated, in this case, by steam at a pressure of about 100 lb. per square inch. The hammer has overall dimensions of 20x20x87 in., a cylinder bore of 8½ in. and a stroke of 16 in. It weighs, with its base, 6,600 lb. and delivers 140 strokes per minute. The energy per stroke is 7,700 ft.-lb. This is a standard model of hammer, but for submarine work it is equipped with a hose connection to supply compressed air to the bottom cylinder to compensate for the water pressure when the hammer is submerged. This prevents water from entering the cylinder and interfering with the reciprocating movement of the ram.

With this rig the number of piles driven in water 30 to 40 ft. deep average about 30 in an 8-hour day. The driving crew consists of 8 men, distributed as follows: 4 on the guides; 2 sawing piles to proper length and attaching shoes; 1 on the hoist; and 1 to regulate the

compressed air. Divers sent down to inspect the work reported that the piles were driven to grade without brooming and were accurately spaced. Only occasionally was it necessary to do any sawing off under wate.. One of the chief advantages of this method of submarine driving is that, even in deep water, long piles are not needed to extend above the surface; the length of piles with this rig need be only a foot or so more than the actual depth of penetration.

Advantages of Method—Summing up the advantages of the method, these points are made: Shorter piles, with saving of lumber; elimination of a follower; full force of blow delivered direct to pile head; piles driven straight; piles accurately spaced by means of spud; no need of unwatering cofferdams for driving; no delays on account of high water; divers not required except for inspection and occasional sawing off.

The work described is being done for the Brooklyn Edison Co. by the Frederick Snare Corp., New York City.

Conclusions From Core-Drill Tests of Concrete Roads

New Jersey Records Furnish Unexpected Information on Influence of Reinforcement and Nature of Cracks

By R. B. Gage
Chemical Engineer, State Highway Commission, Trenton, N. J.

Core drills make it possible easily to determine the strength, character and thickness of any concrete pavement or foundation. The samples taken represent the concrete better and supply more data than cylinders or cubes cast during construction. The location of reinforcing metal, the character of expansion or construction joints and the nature of cracks can easily be determined. This equipment has also made it much easier to detect errors in construction and determine the causes than was possible before its use. The general conditions, governing the construction of pavements, as interpreted from the cores cut to date, may be classed as follows:

1. The thickness of a concrete pavement or foundation will not vary from the thickness specified more than ½ in., if the contractor performs his work in the manner required. When the thickness of the pavement departs more than this amount from that specified, it is very good evidence of careless workmanship.

2. There does not appear to be any definite relation between the strength secured on samples prepared during construction and the strength test shown by the cores cut from the same pavement after construction. The variation is so marked that it has been deemed advisable to discontinue taking sample cubes or cylinders during construction and depend altogether upon the cores taken after construction to determine the character and thickness of the concrete.

3. The position occupied by reinforcing fabric or bars is definitely shown. Reinforcing metal that was supposed to be installed from 2 to 3 in. from the base of the pavement has frequently been found resting on the subgrade

4. The character of the concrete beneath a reinforcing fabric frequently differs from that on top of the fabric in that it does not have the same density.

5. The porosity of the concrete appears to increase as the slump decreases. The quantity of porous concrete appears to be much greater in pavements containing reinforcing metal than in those not so reinforced for the reinforcing metal has a tendency to bridge over the concrete and form openings.

6. The quantity of porous concrete increases with the size of the aggregate, other conditions being the same.

7. Stone aggregate is more prone to bridge and form openings around reinforcing metal than gravel.

8. Cores cut on tranverse expansion joints have shown that the bitumen in a premoulded joint filler often is completely squeezed out, leaving only the felt or paper edges; also that there is practically no adhesion whatever between the concrete walls of the joint and the surface of the joint filler.

9. Another important fact, demonstrated to date by the core drill is that cracks are more prone to form in concrete having a low crushing strength than in concrete that has a high crushing strength. The general character of the cores also indicates that the higher the crushing strength, the better the concrete is able to resist the ravages of travel and climatic changes.

10. In order that the different errors in construction may be reduced to a minimum by correcting them as soon as possible after they are made, it is recommended that all concrete foundations and surface pavements be sampled during construction as soon as the concrete has attained sufficient strength to permit the cores to be cut and the crushing strength of these cores determined when they are 28 days old. Such a method of sampling will be much more satisfactory than to wait until the construction of a pavement or foundations has been completed or partly completed. If this procedure is followed, a contractor will soon know, after his job is completed, whether his work is to be accepted at par or at a reduction in price.

11. It has generally been assumed that most of the transverse cracks in concrete pavements start from the bottom of the slab and work to the surface. Some of the cores cut indicate that just the reverse is true. Cores cut on well defined surface transverse cracks, which extend completely across the pavement, showed that the cracks did not extend the full depth of the pavement. In some instances, these cracks have extended through two different lines of reinforcement; other cracks have extended through only single lines of reinforcement. The reinforcing metal appears to prevent longitudinal cracks from opening up; but it is very difficult to tell as yet from the cores cut whether a reinforcing metal decreases the number of cracks in the pavement or not. They do appear, however, to indicate that more benefit would be secured by placing the reinforcing metal adjacent to pavement surface than to base.

New Hudson River Power Plant

The Moreau Manufacturing Co. has just announced that it is about to undertake a new power development on the Hudson River just above the Sherman Island development, now nearing completion for the International Paper Co., above Glens Falls. This new development, which is to be partly used by the International Paper Co., is called the Cedar Dam Hydro-Electric Development. It will utilize 17 ft. of head with preliminary output of 7,500 hp. and a final one of 12,000 hp. The work is in charge of A. H. White, engineer, for the International Paper Co., and is to be done by the Parklap Construction Co., which is also completing the Sherman Island development.

Analysis of Attendance at Engineering Schools, 1921-22 and 1922-23

Abstract of a paper presented before the annual convention of the Society for the Promotion of Engineering Education, Ithaca, N. Y., June 20-23, by Walton St. John, specialist in rural and technical education, United States Bureau of Education, Department of the Interior, Washington, D. C.

THE Bureau of Education has collected educational statistics of engineering schools for several decades. These statistics have been published in recent years as a part of the biennial survey of education and consequently are from one to two years old before they reach the public. Engineering statistics of State-controlled universities and colleges have been published annually but these data necessarily are a year old or more before publication.

In order to overcome the delay in obtaining these statistics the Bureau of Education with the co-operation of the Society for the Promotion of Engineering Education has obtained the enrollments in engineering schools for the year 1921-22, and 1922-23. The enrollments have been obtained for the first semester of each year, and tabular summaries of these enrollments have appeared in the journal of the Society.

With these figures it has been possible to ascertain the enrollments of the graduating classes in the several branches of engineering and also to predict with some degree of assurance the enrollments of the graduating classes for the year following.

There are 133 engineering schools which report to the Bureau of Education, but the data of this study are based upon the reports of only 129 of these institutions.

The table given below shows that losses are recorded in the five leading branches of engineering, the per cent of

COMPARATIVE ENROLLMENTS IN ENGINEERING SCHOOLS FOR THE YEARS 1921-22 AND 1922-23

Based on enrollments during the first semester of the year

Curriculum or Course	Year	Freshman and Sophomore Years	Junior Year	Senior Year	Total
Total Enrollment.......	1922	35,738	11,834	9,157	56,729
	1923	31,472	10,823	9,995	52,290
		—4,266	—1,011	+838	—4,439
		—12%	—9%	+9%	—8%
Civil Engineering.......	1922	8,065	2,695	2,078	12,802
	1923	6,761	2,433	2,018	11,212
		—1,304	—226	—60	—1,590
		—16%	—9%	—3%	—12%
Mechanical Engineering.	1922	9,105	3,005	2,343	14,453
	1923	7,774	2,637	2,481	12,892
		—1,331	—368	+138	—1,561
		—15%	—12%	+6%	—11%
Electrical Engineering....	1922	8,363	2,961	1,951	13,275
	1923	7,613	2,658	2,360	12,631
		—750	—303	+409	—644
		—9%	—10%	+21%	—5%
Chemical Engineering...	1922	4,444	1,406	1,204	7,054
	1923	3,207	1,082	1,097	5,386
		—1,137	—324	—107	—1,668
		—26%	—23%	—9%	—24%
Mining, Engineering and Metallurgy..........	1922	1,824	481	590	2,895
	1923	1,545	514	602	2,661
		—279	+33	+12	—234
		—15%	+7%	+2%	—8%
All other branches......	1922	3,938	1,322	991	6,251
	1923	4,570	1,499	1,437	7,506
		+632	+177	+446	+1,255
		+16%	+13%	+45%	+20%

loss varying as follows: mining engineering and metallurgy, 8 per cent; mechanical engineering, 11 per cent; civil engineering, 12 per cent; electrical engineering, 5 per cent; chemical engineering, 24 per cent. The other branches of engineering taken together record a gain of 20 per cent.

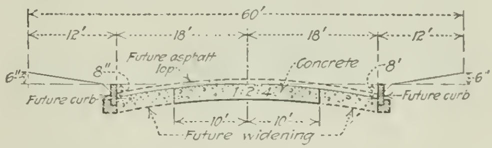
In a comparison that has been made between the enrollments in the junior and the senior classes for the year 1922-23, it was found that there was an average loss of 16 per cent in the senior classes. For 1922-23 the junior classes average 9 per cent less than for 1921-22. Therefore the total senior enrollments for 1923-24 will be about 9 per cent less than for 1921-22 and will approximate 9,100, the senior classes having enrolled 9,955 for 1922-23.

The relation of the number of students in schools of engineering to the enrollments in the secondary schools and also to the total number of students in universities, colleges and special training institutions (including in this group all schools requiring for admission graduation from a secondary school) is as follows for the year 1919-1920:

	Per cent
Percentage of engineering students, 51,908, in relation to total male enrollment in secondary schools, 1919-1920, 1,114,833	4.7
Percentage of engineering students, 1922-1923, 52,290, in relation to total male enrollment in secondary schools, 1919-1920, 1,114,833	4.8
Percentage of engineering students, 51,908, in relation to total male enrollment in universities and colleges, 1919-1920, 324,977	16.0
Percentage of engineering graduates, 9,157, in relation to male secondary school graduates, 1919-1920, 101,106	9.0

Partial Pavements for New Subdivisions

STREET improvement practice in subdivisions has been modified in some instances recently, in St. Louis, Mo., by substituting what is virtually rural concrete-road construction for standard city pavement extending the full width between curbs. The accompanying sketch indicates the construction and its future incorporation into a full-width pavement. The advan-



PARTIAL PAVEMENT, ST. LOUIS SUBDIVISIONS

tage of the plan is, first, economy—a paved roadway is secured without an excessive cost burden on the bordering unimproved building lots. Second, spaces are left on each side for installing underground conduits and house services without tearing up pavement. The third advantage is that the original pavement is fully capitalized as a major part of the base for a full-width pavement. As the subdivision builds up and standard city paving is warranted, the old concrete is widened on each side, curbs are built and a bituminous surface is spread over the old and new concrete between curbs.

In the original construction, of course, the concrete slab is built to grade as established by the Board of Public Service of St. Louis and from plans by and under inspection of the engineers of the Board. While the partial-pavement type of subdivision street improvement is not required—companies developing subdivisions sometimes preferring to pave and curb the full street width—it is advised, and, in a number of instances, has been adopted, it is believed, to considerable advantage to those buying and building in the new settlement. W. W. Horner, engineer, Board of Public Service, has been largely instrumental in creating the new practice.

Highway Progress and Problems in the Mid-South—III

South Carolina	North Carolina
Virginia	West Virginia
Kentucky	Tennessee
Missouri	

Seven Southern States Contemplate Road Expenditures Approaching a Billion Dollars — Automobile License Fees and Gasoline Taxes Will Provide the Money—Editorial Review Based on Studies in the Field

This is the third article of the series. The first article, on Group Problems and the two Carolinas, appeared in "Engineering News-Record of July 26, 1923, p, 128 and the second article, on the two Virginias, appeared in the issue of Aug. 2, p. 168.

Kentucky and Tennessee

IN THE similarity of their highway problems, Tennessee and Kentucky are more nearly twin states than are the two Virginias or even the two Carolinas. Both have about the same traffic, physical, and financial conditions. In Kentucky centralized state direction is most advanced but the effects of recent county domination are still felt. In Tennessee county co-operation in state road development remains a dominant factor. The population is about equally sparse and traffic is overwhelmingly local; not over 2 per cent of the vehicles recorded in traffic counts are foreign to the county in which the counts were made, considering the average for the state.

Finance and administration are the outstanding highway problems. Both states lack development of inter-county and across-state routes. Their present funds scattered about among the counties promise no immediate system development of continuous routes. There have to be larger expenditures and they have to be controlled by the state highway department to build up a connected system of roads if either state is soon to take rank among states which lead in highway development.

Kentucky

Recovering from Local Control

Despite legislation in 1920 which established strong centralized state direction of road improvement, Kentucky has a legacy, from past county direction, of debt and unrelated improvements which presents a difficult problem. Without a large increase in road funds its solution will, indeed, be long delayed. Comprehensive highway financing is the pressing need of the Blue Grass State.

In its general aspects the situation in Kentucky is typical of a situation rather general in southern states. Years of county control of roads have left the state with a system composed of unimproved roads and of improved roads having no relation to each other and also with a mess of responsibilities for up-keep and refunding which it is not financially equipped to manage. Change of administration from county to state has not endured long enough to have formulated and harmonized their necessary interrelations and there is a clash of state, regional and county interests which hinders adequate state highway financing. There is a lesson in noting how these conditions have arisen.

Kentucky in 1912 established a State Department of Public Roads with a commissioner as its chief officer. From 1912 to 1914, however, the duties assigned the commissioner were purely advisory to county officials, no funds having been appropriated for state participation in road building and no means being granted to compel adoption of the recommendations made to the county.

In 1914 a forward step was taken. The General Assembly declared the inter-county-seat system of some 8,000 or 10,000 miles to be proposed state highways and created a state road fund out of the license tax received from motor vehicles and a 5c. ad valorem tax on all property. This fund was distributed to the counties each year for road construction under the supervision of the commissioner, in proportion to their assessed valuation, no county receiving more than 2 per cent of the fund. Counties were, however, permitted to anticipate their annual apportionment from the state road by voting bond issues and expending the proceeds under the provisions of the act, reimbursement for the state's share of the cost to be received in future years in annual installments equal to their apportionment of the road fund. The fiscal court of the county was permitted to designate each year any of the inter-county-seat roads for improvement under state aid, and the surveys and plans of the proposed work were made, subject to the approval of both the court and the commissioner.

From 1914 to 1916 the maximum amount that the state road fund received each year did not exceed \$750,000 and as the counties put up an equal amount this was all the money available for the construction and reconstruction of 8,000 to 10,000 miles unless a county elected to vote bonds for expenditure under the act, which was done by many counties. Under this law the counties were required to maintain all roads built with state aid. But as there was no penalty for their failing to do so, and as they had but small revenue for such purposes, but little attention by the fiscal courts was paid to this provision. The state aid law continued in force and effect until July 1, 1920, with the exception of minor revisions made by the General Assemblies of 1916 and 1918 relating to the making of surveys and plans by the engineers of the road department instead of those employed by the fiscal courts, and changes in the apportionment whereby the state participated in accordance with the assessed valuation of a county and not on a basis of 50 per cent to each county. Authority was also given to the commissioner to co-operate with the United States in the handling of federal-aid appropriations to the state, pledging the road fund to that purpose with priority over distribution to the counties under state aid.

Though several hundred miles of mediocre roads, disconnected one from the other, were built in the period

between 1914 to 1920, it became apparent that, if the state system of highways connecting all county-seat towns was ever to be constructed, the mileage embraced in the inter-county-seat system must be materially reduced and its construction and maintenance be placed under the direction of the state highway department, with the responsibility fixed. During this time it has been conclusively shown that as long as the initiative in state road construction and maintenance was left in the hands of the average fiscal court, with the right to perform such work with the county forces regardless of plans and specifications, just so long would state funds be unwisely expended and a poor type of construction obtained.

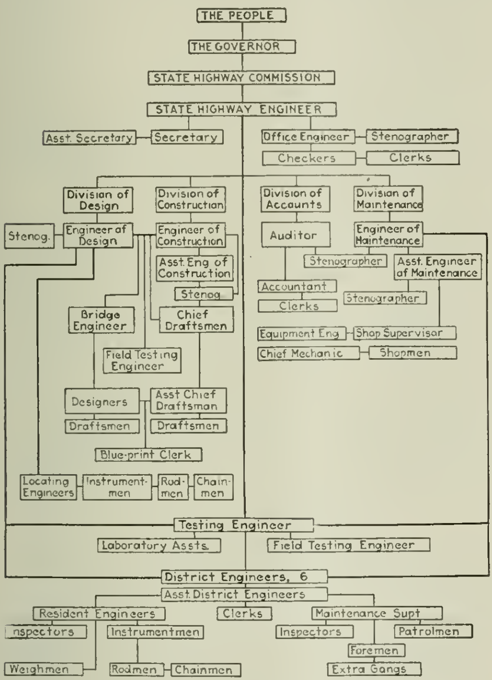


FIG. 6—KENTUCKY HIGHWAY COMMISSION ORGANIZATION CHART

The General Assembly of 1920, realizing the facts, abolished the state aid law, save for the completion of such contracts as were under way prior to July 1, and enacted in its place the present law, under which the Department of State Roads and Highways, as it is now known, is operating. They declared approximately four thousand miles of the inter-county-seat system to be proposed primary state highways and limited the expenditure of state and federal-aid funds to this system. The administration of the department was placed under the direction of a bi-partisan state highway commission which has developed the organization shown by the chart Fig. 6.

The legacy left the new organization by the preceding eight years of county direction was:

1. A large refunding debt: The operation of the state aid law, by which counties were permitted to vote bond issues, created a debt that will amount to $500,000 per annum for the next four or five years, which debt the department is obligated to pay each year out of its revenues.

2. A large maintenance charge: In the proposed primary system of state highways 862 miles were constructed under the provisions of the former state aid law, and the state highway commission is required to maintain such parts of this 862 miles as meet the requirements of a state highway or that have been brought up to those requirements by the counties.

Handicapped by the old state-aid obligations and by the requirement of the law of 1920 that construction must be simultaneous from 54 construction centers, these conditions exist:

1. The state is building and maintaining patches of road here and there without any considerable length of continuous road anywhere.

2. It is impossible with the available funds to construct within a reasonable time a connected system of inter-county and trans-state roads.

It is proposed to meet the financial requirements by a bond issue of $50,000,000 at the rate of $10,000,000 a year. Legislation providing for a referendum vote on this bond issue failed at the last session of the legislature apparently because (1) the size of the debt was frightening to the people who were accustomed to thinking in county units; (2) the fear was general that increased taxes would be imposed; (3) there was regional and county jealousy. In brief the people had not been educated to think of highways in the modern terms of quantity production and correlated state systems. This task of educating the public prior to the next legislative assembly is the work primarily before those who are promoting road improvement in Kentucky.

Tennessee

Learning Finance and Administration

Tennessee like Kentucky lacks money for highway system development. Roads are being built, many of them are of high type, but they are disconnected. The state has no continuous inter-county routes of significance, nor is it working effectively toward them or toward trans-state lines. Continuity of direction and policies in highway affairs has been interrupted by a changed state administration. Determined official thought is not evident and popular thought is unformed. Definite policies of finance and development are indicated only in the bond promotion plans of the Tennessee Good Roads Association.

County co-operation is the theory of state road development in Tennessee. An act of 1913 amended in 1919 enabled counties to raise bonds for highway purposes. The counties have been prompt to take advantage of this privilege. In 1922 the 70 counties of Tennessee had voted bonds for road building to the amount of $34,365,000. Of the total voted, $27,780,500 have been issued and the par value of the bonds sold is $27,345,000. The amount authorized but not issued totals $6,585,000. Of the bonds issued $4,487,000 were for federal and state-aid projects, while the counties themselves issued $22,933,500 for the construction of local roads. Primarily to meet federal-aid a one-mill property tax was assessed in 1919, all funds in excess of the amount of federal-aid to go to the counties for expenditure on state roads. In 1919 was passed the bill establishing a state highway department and creating a road fund by establishing license fees on automobiles,

provided that half of the money shall go to the counties for state roads.

Participation of counties in the administration of state roads exhibits the usual results—a fair mileage of isolated improvements often of high type, but little continuous route development. All funds for state roads including federal-aid allotments amount to between three and four million dollars a year. This fund promises very slow system development and the prospect is unsatisfactory to a large faction which, directed by the Tennessee Good Roads Association, is demanding more active development. In furtherance of their demand they are asking for a bond issue.

At the session of the Legislature for 1922-23, a bill was introduced which provided for a referendum on a bond issue of $75,000,000, to be sold at a rate not to exceed $10,000,000 a year, and on a method of financing these bonds. By the law all income from auotmobile license fees, from a 2c. gasoline tax and from a ½-mill property tax was to go to the state highway department "to be used exclusively for retiring the bonds with interest and to build and maintain the state system of highways." This bill failed to pass. The Legislature did, however, enact a law imposing a 2c. gasoline tax. The influences worked for the failure of the bond referendum act. One was the large figure set; a sum of the size named was staggering in the light of previous expenditures. The second influence and perhaps the stronger, was the disinclination of the counties to relinguish all part in the administration of state highways. Even the provision of the act for refunding county bond money spent on state roads did not overcome this county opposition.

The fight for a bond issue is being continued by a campaign of public education: (1) to make clear the necessity of large expenditure, and (2) to overcome the prejudice for county management of funds for state roads in the county. There is a demand for roads. Already state aid has been asked by counties on 2,500 miles estimated to cost over $62,500,000. With the financing plan made clear and the argument for state direction forcefully presented it is a fair presumption that enabling legislature will come.

A contributing complication to the situation is the change in the direction of the highway department. Tennessee like 13 other states, put its state highway affairs under new management during the past winter. The new management has scarcely aligned itself for its work.

[*In the final article of the series, the highway situation in Missouri will be discussed.*]

Essington Channel Deepens Itself

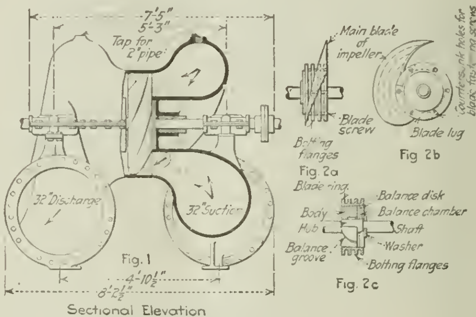
Manufacturers on the Essington Channel of the Delaware River are much aggrieved because of the failure of the Government to dredge the channel. During the war permission was given the Shipping Board to partially obstruct the channel in the course of its improvement of the Hog Island ship yard. The Shipping Board in turn agreed to keep Essington Channel dredged. In disposing of the ship yard, the purchaser was relieved of the dredging obligation. The manufacturers who use the channel contend that it is the obligation of the War Department to maintain the channel. The District engineer at Philadelphia has reported that the channel is scouring out of itself. He does not think the navigation requirements justify dredging.

New Type of Low Lift Pump Called Rotary Flow

Drainage and Irrigation Pump—Axial Flow Type—Steadily Increasing Delivery—Wide Variation of Speeds

By Eugene F. Deléry
Design Engineer, Sewerage and Water Board, New Orleans, La.

A NEW TYPE of pump, of value as a drainage and irrigation pump for lowhead work, was invented, patented, and built by the author in 1915 and has given very satisfactory results after several years of testing. It is of the axial flow, or screw, type and its outstanding features are: (1) The use of a suction volute to conduct the fluid to the impeller with a constant tangential component of velocity as well as a constant axial component of velocity and its discharge in like manner by means of a discharge volute, both volutes registering with the impeller in an axial rather than a radial direction. This makes possible the use of a higher speed



FIGS. 1 AND 2—DETAILS OF ROTARY FLOW PUMP
Six-blade impeller, blade mounting and balance device. One blade in position.

than is usual, without cavitation, and also makes it feasible to secure a correct entrance blade angle at all points and equal radius at the entrance to the impeller. This is not possible with the ordinary type of entrance elbow, due to the variation in velocity at the inner and outer radii of the elbow. (2) The impeller is hydraulically balanced by means of an integrating hydraulic balance consisting essentially of a set of secondary blades formed by grooves cut on the drum of the main impeller and by the blade ring carrying the main impeller blades. These secondary blades, which are reversed in pitch, as regards the main impeller blades, take a small percentage of the fluid pumped to the discharge passage, immediately beyond the impeller, at the discharge passage pressure and discharge it at a higher pressure to a normally closed pressure chamber within the impeller. This chamber is formed between the inner surface of the main blade ring and a free floating disc fitting closely within the blade ring and placed on the shaft in such manner that the fluid within the chamber reacts against the impeller body and the disc which in turn reacts against the suction face of the casing but is not attached to either the blade ring or the shaft in any manner. These secondary blades are so pitched that the pressure in the balance chamber is inversely proportional to that existing in the discharge passage as the areas of the disc is to the area of the discharge

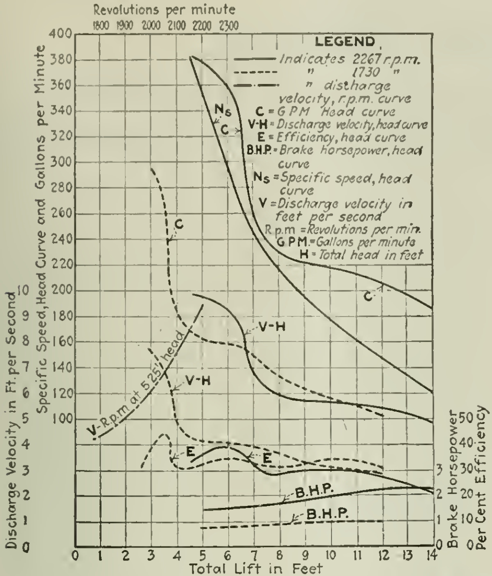


FIG. 3—TEST CURVES—4-IN. ROTARY FLOW PUMP

face of the impeller. As this ratio is a constant the device operates equally well at all lifts.

Provision is made whereby a small amount of fluid is allowed to pass through the balance disc by means of a small aperture to a recess next the suction stuffing box, thus furnishing high-pressure fluid as a seal at that point. Anyone who runs low-lift pumps will readily concede that this is a desirable result.

The blades are detachable, but are fastened in a manner which makes them easily removable for any purpose. This allows a large variation of pitch and speeds, making it possible to standardize one casing for a large range of capacities, heads, and speeds. The method of fastening consists essentially in first cutting a series of parallel circumferential grooves on the blade ring (or in its absence the hub). On each blade there are cast as many lugs as there are grooves on the blade ring. These lugs are set in advance of each other in such manner that lugs of adjacent blades superpose each

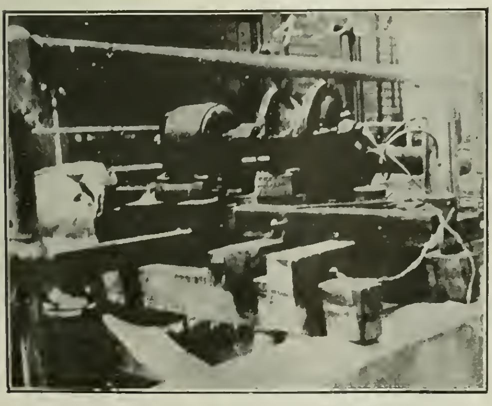


FIG. 4—MODEL PUMP USED IN MAKING TESTS

other. The fastening bolts, set parallel to the shaft, each fasten in double shear one lug each of as many blades as there are grooves. Ordinarily there will be only as many bolts as there are blades, and all blades are independently removable with ease. As diffusion (directing) vanes are not necessary they are omitted, thus making for better general efficiency and reducing the liability of choking to a minimum. Smoothness of operation and balance are thus assured, as all blades are cast from the same pattern.

A study of Figs. 1, 2a, 2b, 2c, will readily bring out the above. Fig. 3 is a chart showing the results of tests run on the 4-in. test pump shown in Fig. 4. The tests conducted according to standard rules for testing show, when size, lift, and capacity are considered, a broad variation of speeds, a steadily increasing delivery for increasing speed and constant lift; a high specific speed; a large increase of delivery at the very low lifts, with well sustained delivery over the whole range of lifts. On the very low lifts, up to the point of design, the efficiency is very high for a pump of its size under the operating conditions, and the efficiency is well sustained at all other lifts, giving a high average efficiency. The brake horsepower curves show a very constant power demand over the whole range of lifts, and as in order to get maximum plant efficiency it is desirable to have the prime mover always operate as near as possible to its best rating this is a very desirable feature. The efficiencies shown compare more than favorably with the efficiencies of the best types of other pumps of equal size operating at equal capacities and against equal heads, for which it has been possible for the author to secure records.

Tennessee Power Developments

Application for a preliminary power permit covering three large projects on the Clinch and Powell Rivers, part of the upper Tennessee River system, has been filed with the Federal Power Commission by the Tennessee Electric Power Co. Applications covering almost the identical sites covered by this application have already been filed by the Knoxville Power & Light Co., a subsidiary of the Electric Bond & Share Co., and by the Tennessee Hydro-Electric Co. One of the three proposed developments is on the Clinch River below its junction with the Powell. The plan calls for the erection of a plant with a 175-ft. head and a dam which will create a storage reservoir 72 miles long. A 40-ft. draft on this reservoir will make 1,000,000 acre-ft. of storage available for stream control purposes, an amount which will equalize the flow of the river and make it possible to develop 100,000 continuous horsepower at this site. The second development is at the upper end of the pool of the first development near the Cheat River station, with a head of 160 ft. and an output of 50,000 hp. The third development is to be on the Powell River near the town of Combs. It will have a head of 180 ft. and an output of 27,000 hp., making a total of 177,000 hp. for the three sites. The Tennessee Electric Power Co. has a present installation of 108,000 hp. in hydro-electric plants at Hales Bar on the Tennessee, another on the Ocoee, and another at Great Falls on Taney Fork. In addition it has three steam plants with a capacity of 59,000 hp. The company reports that its load is growing at such a rate that it will require 40,000 more horsepower within the next four years.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Rule for Computing Angle-Bar Weights

By Paul C. Trimmer
St. Paul, Minn.

It is often necessary to determine the weight per lineal foot of an angle bar when only the thickness and flange dimensions are known, and also the thickness of any given angle knowing only the weight per lineal foot and flange dimensions. Men to whom the billing, stocking and handling of steel from stock are intrusted are, many times, unacquainted with the steel handbook. It is to them that the following method may be of good use.

If one cubic foot of steel is assumed to weigh 489.6 lb., then a square foot (12 in. x 12 in.) 1 in. thick weighs 40.8 lb., and a strip 12 in. long, 1 in. wide and 1 in. thick weighs $\frac{40.8}{12}$ or 3.4 lb. A strip 12 in. long, 1 in. wide and $\frac{1}{32}$ in. thick is equal to $\frac{3.4}{32}$ lb. or 0.10625 lb. or 0.1 lb., say. It can be seen from the foregoing that a strip of metal 12 in. long and 1 in. wide has $\frac{1}{32}$ of an inch in thickness for every $\frac{1}{10}$ of a pound in weight.

Example: 12 in. of a certain 3x3 angle weighs 7.2 lb. per lineal foot. The sum of the flanges is 6 in. If 6 in. = 7.2 lb., and 1 in. of this particular thickness weighs $\frac{7.2}{6}$ or 1.2 lb., or $\frac{12}{10}$ lb.; and if $\frac{1}{10}$ lb. is $\frac{1}{32}$ in. thick, $\frac{12}{10}$ lb. is equal to $\frac{12}{32}$ or $\frac{3}{8}$ in., which is the thickness required.

Rules: $\frac{\text{Weight per foot} \times 10}{\text{Sum of Flanges}}$ = the number of thirty-seconds in thickness; also the number of thirty-seconds $\times$ sum of flanges = $\frac{\text{weight per foot}}{10}$

These simple rules may easily be memorized by anyone and computed mentally.

Successful Means of Removing Hard Spots From Filter Beds

By W. Compton Wills
Assistant Engineer of Distribution, Water Department, Wilmington, Delaware

Under-drainage difficulties in the operation of mechanical filters often give the water-works engineer considerable difficulty. The means by which these difficulties may be overcome are well demonstrated in the experience of the writer at the Wilmington plant. Soon after the plant was put in operation in 1917, "hard spots" appeared in the filter sand. The size of the spots increased until about one-third of the filtering area was affected. Various methods of removing the spots were tried, such as increasing the vertical rise of the wash water, ejecting water pressure by perforated pipe, and ejecting water pressure through hose into the hard areas. In some instances, even, the hard portions of the filtering area were dug out. All such means proved only temporary, so the conclusion was reached that the faulty wash was caused by some undiscovered condition existing in the under-drain or strainer system of the beds.

In the latter part of 1920 permission was granted to tear out and thoroughly examine the sand, gravel, and strainer system of a filter bed. After such an examination methods were devised to overcome the faulty wash. Early in 1921 this filter bed was turned back into service and up to the present time it has been free from hard spots and has remained level over its entire filtering surface.

The strainer system of these beds as shown by Fig. 1, consists of four 6-in. x 9-in. cast-iron manifolds, two placed end to end and running longitudinally and spaced one-half way between the side of the filter and the flumeway shown in the center of the bed. Leaded into these manifolds are $1\frac{3}{4}$-in. cast-iron laterals on 6-in. centers and drilled every 6 in. of length with two holes, $\frac{1}{4}$ in. in diameter, facing downward at an angle of 30 deg. from the vertical. The center line of each lateral is 3 in. from the filter floor.

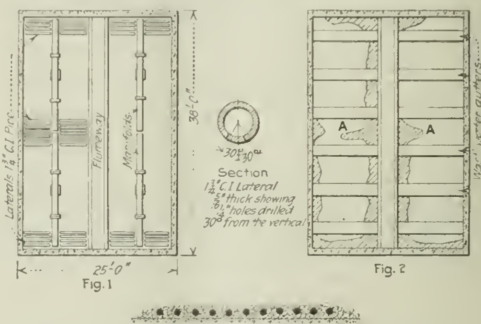


Fig. 1 Fig. 2

Section through Laterals
Fig. 3

UNDER-DRAINAGE SYSTEM OF FILTER PLANT

The hard spots appeared in the locations and approximate shapes shown by Fig. 2. The trouble seemed to be around the walls and a particularly bad place appeared over the ends of the manifolds (Section A-A, Fig. 2).

Upon removing the sand and gravel muddy deposits were found that had not been removed by the wash water. Upon inspecting the laterals, it was discovered that in several instances the large gravel (for which specifications called for a layer 9 in. thick of such size as would pass a $2\frac{1}{2}$-in. circular opening and be retained on a sieve with 1-in. circular openings) had become wedged against the laterals and cemented over the $\frac{1}{4}$-in. holes, and thus had stopped the flow of the wash water to this portion of the bed. The next step was to remove all the laterals and manifolds. In the ends of some of these laterals were found debris and laitance, so located as to stop from the inside the proper distribution of the wash water. The material had probably gotten into the system during construction, when because of war-

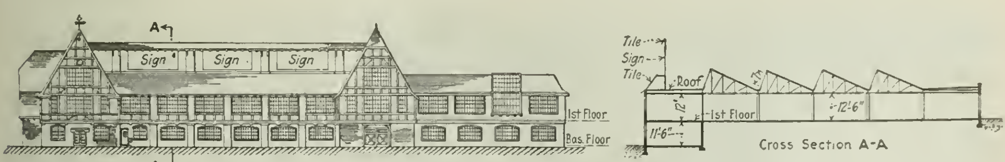
time conditions proper selection and supervision of labor was difficult.

The conclusion at this point was drawn from our findings that the small ¼-in. holes of the laterals were not free enough to deliver, and the voids of the coarse gravel not open enough to allow a sufficient quantity of wash water to be collected above the entire strainer system before it was forced on its vertical rise. In correcting this condition the laterals were dipped in a preparation which would not give taste to the water and were replaced into the manifold. About these laterals and manifolds were placed blue granite stone screen tailings. The tailings selected were mostly laminated stone varying in size from 2 in. x 4 in. x ¾ in. to 5 in. x 6 in. x 2 in., and having all shapes. Spaces beneath the laterals were left entirely open, the laminated stones forming side walls along the laterals. Enough tailings were placed over the laterals to cover the pipes and any large voids between the heavy stones. Next, the old courses of gravel were replaced, followed by the filtering sand.

This filter has been in continuous operation since the first part of 1921 and the sand remains perfectly level at the present time. This bed has a sand area of 735 sq.ft. The washing is done by high velocity wash-water, without air or mechanical agitation. A vertical rise of wash-water equal to 27 in. is being used on this filter bed and the difficulties previously experienced in washing have entirely disappeared.

Craftsman Type Architecture for Industrial Buildings

ENGINEERS who are concerned with the development of architectural details in industrial buildings will be interested in the new plant which is being built for the Latham Litho & Printing Co. at Long Island City. For a manufacturing plant this building presents a novel appearance. It is not the idea of the Latham company to disguise the fact that they are using the plant for manufacturing, but rather to express the individuality of their business. They believe that this craftsman type of architecture accomplishes their purposes, and although the two facades shown in the sketch give the building an impractical appearance for a manufacturing plant the cross-section in the accompanying sketch shows that its saw-toothed roof provides a very practical floor layout.



ELEVATION AND SECTION OF NEW TYPE INDUSTRIAL BUILDING

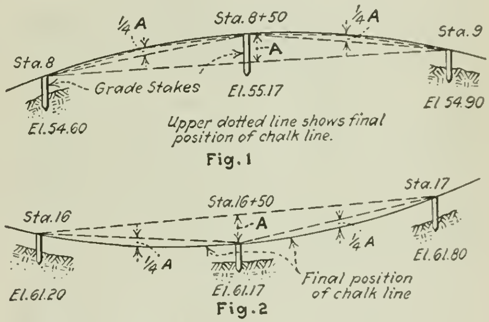
The building will have a floor space of about 60,000 sq.ft. which includes lounging and lunch rooms for the employees and a garage for trucks and employees' automobiles. It will be set back about 70 ft. from the building line and this area, together with the rest of the land surrounding the property, will be laid out in an attractive park. The first story will be built of tapestry brick, the upper story of half timber and stucco, and the roof will be green shingle tile. The windows will be of steel sash of the cottage casement type. The saw-toothed roof will be covered with a standard tar and gravel roofing. As the face of the building is along the elevated tracks of the Long Island R.R., the gable will be provided with three spaces for standard bill posters where the Latham company will display copies of the posters which they print in their plant.

Walter Kidde & Co., Inc., are the architects and engineers, as well as the builders of this plant, and have engaged McDonnell & Peare of New York to design the facades.

Setting Forms on Vertical Curves for Concrete Paving

By Ray E. Behrens
County Highway Engineer, Waukesha County, Waukesha, Wis.

REGARDLESS of the nicety of the finish on a concrete road it will not possess desirable riding qualities unless the form setting is good. Little trouble is experienced in getting a satisfactory job on tangents and on straight grades. But vertical and horizontal curves frequently present difficulties to the form setter, as is evidenced by many completed jobs in which practically all curves, horizontal as well as vertical, consist of a series of angle points joined by chords. This is especially true of vertical curves, where poor form setting is not so noticeable to the eye, but where it is however, decidedly deficient in riding qualities.



METHOD OF FORM SETTING ON VERTICAL CURVES

On tangents and on straight grades stakes should be set with a transit every hundred feet to line and to grade. Intermediate stakes can be set with sufficient accuracy by means of Swedish T-stakes. Where vertical curves are circular and not parabolic, the following method has been found extremely practical and simple of application. When correctly applied perfect vertical curves will result.

On vertical curves stakes should be set to grade every 50 ft. with an instrument. The form setter then determines by means of his T-stakes and an ordinary rule,

how much the 50-ft. stake is above or below the two adjacent 100-ft. stakes (regular stations), depending upon whether the curve is a "crest" or a "sag."

Fig. 1 represents a "crest." Here the form setter will "T" between Sta. 8 and 9 showing that the grade stake at Sta. 8 + 50 is 5 in. above a straight line from Sta. 8 to Sta. 9. Call this distance "A." He will then stretch a chalk line tightly to grade between Sta. 8 + 00, 8 + 50 and 9 + 00. At the 25-ft. points, i.e., at Sta. 8 + 25 and 8 + 75 he will set auxiliary grade stakes, the grade points of which will be ¼ of "A" or 1¼ in. above the chalk line. Raising the chalk line to the grade points at the 25-ft. stakes will reveal the outline of the vertical curve. However, his final step will be to raise his forms by ¼ of 1¼ in. or $\frac{5}{16}$ in. above the chalk line at each 12½-ft. point. If the engineer or the inspector on the job will furnish the form setter with the value of the distance "A" it will save him the operation of "T"ing between the station stakes. "A" can readily be computed from the plan elevations.

Fig. 2 represents a "sag" or a "trough." Here, again, stakes are set to grade by instrument at Sta. 16 + 00, 16 + 50 and 17 + 00. The form setter by the use of his T-stakes has determined that Sta. 16 + 50 is 4 in. ("A") below a straight line from Sta. 16 + 00 to Sta. 17 + 00. After stretching his chalk line tightly from Sta. 16 + 00 to 16 + 50 and from 16 + 50 to 17 + 00, he allows it to drop or sag by an amount equal to ¼ "A" or 1 in. at the 25-ft. point. The chalk line will then show a perfect vertical curve, and the forms can be set directly to the line.

The above method of measuring mid-ordinates can be used equally well on horiztonal curves.

When once thoroughly explained and *demonstrated* to a form setter, the latter will pride himself with possessing a "system" and better form setting will result.

Ford Engine Used to Operate Headgates

By William Arthur
U. S. Indian Service, St. Xavier, Mont.

At the Big Horn Headgate, at St. Xavier, Mont., there are five gates, each weighing two tons. When they were geared to a hand wheel to raise and lower them, it required 64 turns of the wheel to move a gate one inch. This was a slow process; in fact the 64 to 1 ratio proved too slow in cases of emergency. The average water pressure is 11 ft., low water 17 ft. and high water 16 ft.

A Ford engine has been used to move the gates, as shown in the accompanying illustrations. The engine was geared to the hand wheel, with eight control levers, one of which slides the fork clutch into the perpendicular hand wheel, another controls the brake for clutch or speed, a third is the reverse to lower the gates, a fourth is high and low to raise the gates, and the others are for car brake to hold the car in position while in operation, carburetor control, spark control, and transmission lever to move the car to the next gate or to the shed.

The engine runs on tracks with a 6 ft. 1½-in. gage, and about 60 ft. of track suffice for the operation of the five gates.

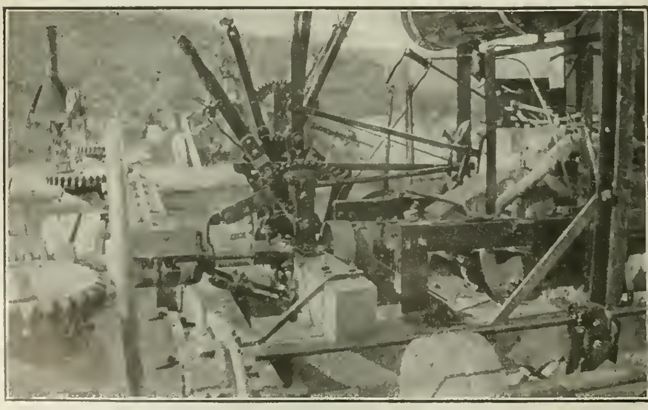
From Job and Office

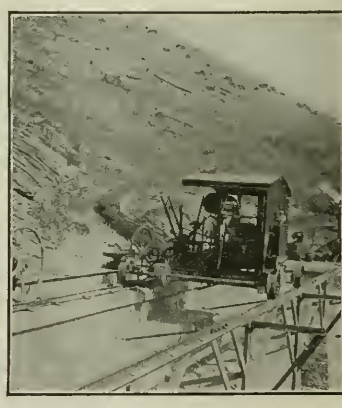
Hints that Cut Cost and Time

"Hump Switch Yard" for Power House Construction Job

Construction of power house No. 3 on the Big Creek project of the Southern California Edison Co. involved the excavation of a large amount of loose material from power house and penstock site. This material, added to a natural gravel bar at a bend in the river, made a practically level area several acres in extent, immediately adjoining the power house site. By dumping the material so as to leave the surface with an easy grade inclining upward toward a steam donkey engine in one corner of the area it was possible to lay out a material storage yard in which distribution of loaded cars was made without the use of a switching locomotive.

The accompanying illustration shows the arrangement of the material yard into which cars come from the main line railroad down a long steep incline onto the track in the foreground. Here they are left for





FORD ENGINE, MOUNTED AND RUNNING ON TRACK, GEARED TO HAND WHEEL CONTROLS GATES
At left, forked clutch in mesh to hand wheel to raise and lower gates. At right, headgate built 27 years ago out of native rock

From Job and Office

For Contractor and Engineer

distribution with the aid of only the steam donkey engine at *A*.

A cable from this engine first draws the car above any desired switch after which the switch is thrown, the car is released and, by means of its brakes, is stopped at the desired point. Reinforcing steel, lumber of various classifications, wood stave pipe, and other materials were delivered in this way.

GRAVITY SWITCH SYSTEM IN MATERIAL YARD

The same steam engine delivered crushed rock from the bunkers in the left foreground to the concrete mixers at the power house which is to the right beyond the limits of the picture. To accomplish this two pulls were necessary; the dump cars were first pulled up the incline from the bunkers, allowed to drop then by gravity to a position behind the warehouse at the right of the picture whence by means of a snatch block and return line the cars were hoisted up an incline to bunkers over the mixer.

Highway Bridge Built of Railroad Car Sills and Ties

By Crosby Tappan
Tyrone, Pa.

On the State Highway between Tyrone and Bellwood, Pa., there was an old covered truss bridge of about 120-ft. span. Last year a colored tourist in a Ford ran into one side of the bridge and knocked it down. As this is a heavily traveled highway the county commissioners of Blair County, who are responsible for the bridge and its maintenance, at once erected a temporary bridge, pending the construction of a new permanent structure. They obtained from the Pennsylvania R.R. twelve old steel car sills and some ties. They built two cribs with the ties, bolting them together and further bracing them with an 8-in. I-beam at each corner. These I-beams were long enough to extend about 3½ ft. above the floor of the bridge; and they carried two lines of steel cable as a guard fence. The cribs were filled with rock.

TEMPORARY BRIDGE MADE FROM RAILROAD MATERIAL

The bridge, as rebuilt, consists of three spans, 37.5 ft. c. to c., with a clear span of 32 ft. The floor is two layers of 3-in. plank, the upper layer being creosoted. The width of the floor is 12 ft. 8 in. between guard rails. To carry the floor and traffic four old car sills were used, spaced 4 ft. 6 in. c. to c. These car sills are 20 in. deep at the center and 12 in. deep at the ends and are braced together with tie-rods.

This bridge demonstrates engineering ability in meeting an emergency and in making use of available local material so as to keep traffic moving.

Determining Regulated-Flow Duration Curves Graphically

By Dr. George E. Lyon
Rensselaer Polytechnic Institute, Troy, N. Y.

The writer believes that the following graphical method for the determination of the regulated-flow duration curve will be of interest.

In the first place the construction of the natural-flow curve will be reviewed. Table I gives the mean monthly flow of a certain stream in second-feet for a period of four years—sufficient to illustrate the problem. The

TABLE 1

Year	Month	Mean Monthly Flow Sec.-Ft	Accumulated Discharge Billion Cu.Ft.
1909	Jan.	675	1 77
	Feb.	1,158	4 81
	Mar.	1,019	7 49
	Apr	992	10 10
	May	490	11 39
	June	258	12 07
	July	86	12 30
	Aug	124	12 62
	Sept.	184	13 11
	Oct.	97	13 36
	Nov.	139	13 73
	Dec.	476	14 98
1910	Jan.	963	17 51
	Feb	953	20 01
	Mar.	727	21 92
	Apr	1 267	25 25
	May	577	26 77
	June	233	27 38
	July	75	27 58
	Aug	75	27 77
	Sept.	202	28 30
	Oct	90	28 54
	Nov	337	29 42
	Dec.	303	30 22
1911	Jan.	451	31 40
	Feb.	514	32 76
	Mar.	1,108	35.67
	Apr.	649	37 37
	May	439	38 53
	June	374	39 51
	July	139	39 88
	Aug.	225	40 47
	Sept.	184	40 95
	Oct.	394	41 98
	Nov.	157	42 40
	Dec.	510	43 74
1912	Jan.	366	44 70
	Feb.	600	46 28
	Mar.	1,430	50 03
	Apr.	1 106	52 94
	May	713	54.81
	June	168	55 26
	July	139	55 62
	Aug.	150	56.01
	Sept.	154	56 42
	Oct.	255	57.09
	Nov.	225	57.68
	Dec.	480	58 94

From Job and Office

Hints that Cut Cost and Time

lowest value in the table (75 sec.-ft.) is plotted at 100 per cent time (Fig. 1), the second lowest value (also 75 sec.-ft.) is plotted at 97.9 per cent (= 47/48 expressed as a per cent), the third lowest opposite 46 48 (in per cent) etc., there being 48 months during the period under consideration. Any point on the curve will show the per cent of time during which the flow

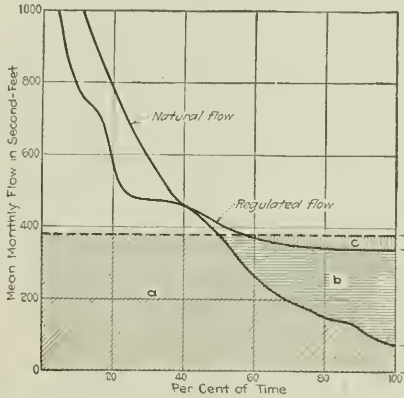


FIG. 1—DURATION CURVES FOR STREAM FLOW

has been "equal to or greater than" the value of the ordinate at that point.

For the construction of the regulated-flow line, the mass diagram must first be plotted; accumulative discharge in cubic feet vs. time in months. The ordinates for the diagram are given in the last column of Table I, each value representing the total number of cubic feet which has passed the point on the stream under consideration from the time the table was started up to and including the month opposite which this ordinate is plotted. The mass diagram is shown plotted in Fig. 2.

Suppose now that we are to construct the regulated-flow duration curve due to a storage reservoir of 3,000,000,000 cu.ft. capacity. Choose the first "summit" A on the diagram as the starting point and lay off the ordinate AB equal to the capacity of the reservoir to scale. Draw the line BC tangent to the next "valley" (at C) on the diagram, producing it to D, at which point the ordinate $DE = AB$. The slope of the line BD indicates the rate at which water may be discharged, starting with a full reservoir at B, just emptying it at C and having it full again at D. Repeat this construction at $A'B'C'D'E'$, $A''B''C''D''E''$, etc. To complete the regulated flow lines by joining D and B', D' and B'', etc., any combination of lines may be used, remembering that the greatest ordinate between the natural- and regulated-flow lines must not exceed the capacity of the reservoir. It will be seen that the ordinate between these two lines at any time is equal to the volume of water in the reservoir at that time.

To get the data from the regulated-flow lines in Fig. 2 for plotting the regulated-flow duration curve (Fig. 1) the time for each different rate may be measured in inches and the rate of discharge by the slope of the line. In the case at hand the horizontal scale used was 1 in. = 2 months; hence the total length of time (four years) may be expressed as 24 in. From this, Table II may be computed. The first column gives the regulated flow in second-feet, arranged in order of magnitude, and the second column the time in inches during which that rate occurred. Column three is found in the same manner as were the per cent times used in plotting the natural-flow duration curve. The first value (100 per cent) shows that for 100 per cent time the regulated flow would be "equal to or greater than" 340 sec.-ft. The second value (79.2 per cent) equals $\frac{24 - 4.3}{24}$, expressed in per cent, since the flow would be equal to or greater than 348 sec.-ft. except for 4.30 in. of time, etc. Having completed Table II, the regulated-flow duration curve may be drawn as shown in Fig. 1.

TABLE II

Regulated Flow Sec.-Ft.	Time In.	Per Cent Time
340	4.30	100.0
348	5.13	79.2
372	3.50	60.6
434	5.25	46.1
490	0.50	24.3
544	0.62	22.2
580	0.50	19.6
685	2.00	17.5
781	0.70	9.2
910	1.00	6.2
1,270	0.50	2.1
	$\Sigma = 24.00$	

In connection with water-power investigations, if the

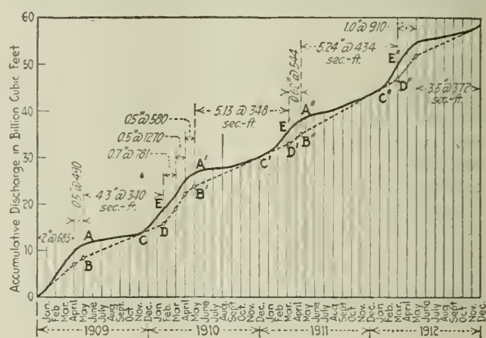


FIG. 2—MASS DIAGRAM FOR STREAM FLOW

head is constant, ordinates in Fig. 1 are proportional to power and areas are proportional to energy. Suppose for instance that a capacity of X *hp.* is considered. Without regulation the water station can develop Y *hp.* at its driest period. Due to regulation, Z *hp.* more can be added at low water. If the X *hp.* is to be continuous, the maximum capacity of an auxiliary station should be W *hp.* The area a represents the kilowatt-hours output of the water station without storage, area b the output added by regulation and area c the output supplied by the auxiliary station. These areas may be measured in kilowatt-hours per year, in which case the values would be the average yearly outputs over the same length of time as used for the construction of the duration curves. From the figure it will be seen that the auxiliary plant is operated on an average of 41 per cent time or 150 days per year.

Dredging Started for Vancouver Dry Docks

Extensive dredging operations required to provide sufficient depth for the operation of the new floating dry docks at North Vancouver are now well under way; the dredging and filling will take about four months and cost $400,000.

From Job and Office

For Contractor and Engineer

Device for Counting and Weighing Traffic on Roads

WEIGHTS and number of vehicles passing over a highway are automatically recorded by a new device employed in the traffic studies now being made on the Washington-Baltimore road by the Bureau of Public Roads and the University of Maryland. As indicated by Fig. 1, the apparatus consists of a rubber hose, filled

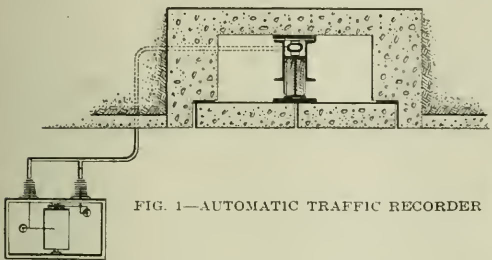


FIG. 1—AUTOMATIC TRAFFIC RECORDER

with water, which is placed beneath the pavement in such a way that the weight of a vehicle passing over it is transmitted to it. A small tube runs from the hose to a standard pressure recording device. A passing vehicle compresses the water in the hose and the pressure is transmitted through the tube to the recording device. There the pressure actuates a lever which makes a record, Fig. 2, on a cylindrical roll of paper and also actuates an attachment for moving the paper to receive a fresh record.

Two sets of apparatus will ordinarily be used, one for the traffic in each direction, and possibly a slight ob-

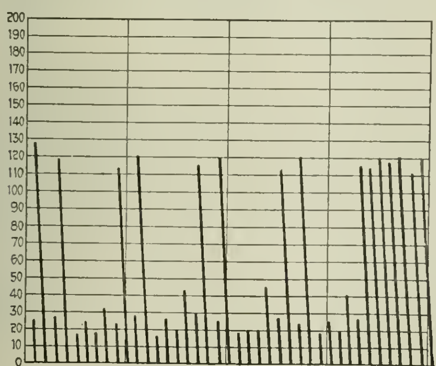


FIG. 2—TRAFFIC RECORD WITH TEST VEHICLE

struction may be placed in the center of the road to confine the traffic to proper lanes.

The instrument may be calibrated by driving vehicles of known weight over the place where the hose is installed and noting the height of line made on the record paper.

A record covering any desired period of time will show the weight of both front and rear wheels of all vehicles which have passed over the road. Should it be desired the apparatus can be further improved so as to show the time at which the vehicle passes.

Powder Magazine Made From Old Steel Tunnel Forms

IN BUILDING powder houses on the Big Creek project, the Southern California Edison Co. in two instances made use of steel tunnel forms brought to this work after they had served their purpose on another part of the system. These forms consist of steel plates, 2 ft. square, arranged to be set up in parallel rows supported on a steel frame and with internal means of holding inside and outside walls 2 ft. apart.

The powder house shown in the accompanying illustration is 20x60 ft. in plan, inside, and has walls 10 ft. high. The roof is supported on three rows of posts, one row inside each of the side walls and one down the center of the building. The walls were filled with earth

POWDER HOUSE MADE OF OLD STEEL TUNNEL FORMS

and a layer of earth was also placed in the roof, i.e., supported on planks and filling the space between purlins and rafters. The roofing proper consists of corrugated iron.

Powder houses built in this way have been found to be more satisfactory than those built under ground, which are very damp in wet weather.

Cutting Concrete Piles with Dynamite

IN BUILDING a reinforced-concrete wharf at the Pearl Harbor Naval Station, Hawaii, penetration of concrete piling was such that in many cases the refusal point was reached as much as 7 ft. above the desired grade. Lieut.-Commander S. Gordon, Civil Engineer Corps, U. S. Navy, devised a system of dynamiting the piles, says a recent issue of *Explosives Engineer*, which was an adaptation of means previously used on wooden piles.

After exploding a stick of 60 per cent dynamite in a 1-in. horizontal hole cored at the butt of a test pile, the shattered concrete was cut away, the surface smoothed with carborundum, tests for cleavage made on the concrete with magnifying glass and hammer, and the reinforcing bars subjected to bending tests. As both concrete and rods were found undamaged, holes were then cored around the butts of the remaining piles, which were shot in batteries of eight. In no case did the disruptive damage extend farther than 18 in. from the center of the charge.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Another Co-operative School

Sir—Under date of June 14, 1923, p. 1050, you published an article on "Developments in Co-operative Engineering Courses," by Dean R. L. Sackett of Pennsylvania State College.

In the article, he describes the plans in effect at the University of Cincinnati, Massachusetts Institute of Technology, Harvard University, New York University, and Antioch College. No mention is made of the School of Engineering, Northeastern University, although the co-operative plan was established here in 1909 and we will have during the coming year approximately one thousand students in the School of Engineering. The school is a recognized school of college grade offering curriculums in civil, mechanical, electrical, and chemical engineering, and awarding the bachelor's degree. CARL S. ELL,

Boston, Mass., Dean, School of Engineering,
July 24, 1923. Northeastern University.

Unification of St. Louis Terminals

Sir—In mentioning my talk on the St. Louis freight terminal situation in your report of the American Society of Civil Engineers' convention at Chicago you state that I advocated "improvement and ultimate unit operation" of the freight terminal facilities. This gives a wrong impression, in that it appears to imply my advocacy of operation of all these facilities by a single agency. I believe thoroughly in the consolidation of the classification and transfer of cars interchanged between railroads, but such consolidation need not be performed by a single agency. In fact, there is no reason why it should not be performed by several agencies. I believe that the complete unit operation of railroad terminals in large cities served by many railroads is unsound, and I do not want to be known as advocating unit operation.

It is true that the St. Louis committee on terminal improvements, of which I am a member, recommends a systematic arrangement of outer yards for car transfer movements. But my Chicago talk called particular attention to the fact that the proposal for leaving the St. Louis railroads alone in the individual operation of their local freight terminals was the backbone of our entire report and distinguished it from the reports on the Chicago situation by the Chicago Railway Terminal Commission and the Board of Economics and Engineering of the Association of Security Holders, in both of which reports complete unit operation was recommended. This is explained in the following quotation from the paper which I presented in abstract at the Chicago meeting:

"It is interesting to note that the Board of Economics and Engineering, appointed by the National Association of Security Owners, after a study of the Chicago situation, recommended practically the same kind of a group yard plan of classification and interchange of carload freight. The Board went farther, however, and recommended the complete unification under single control of the entire Chicago terminal. The St. Louis committee does not believe this to be practicable. The latter terminal might be unified if all the railroads possessed equal advantages in location and facilities, but unfortunately that is far from the case."

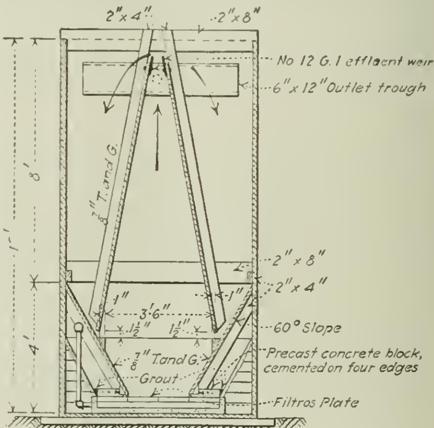
The words "unification" and "unit operation" have been surrounded by a sort of halo or glamor by those who have advocated the principle, and large sections of the public have come to believe that such operation offers the only remedy of terminal delays. That is not the case, and a great deal of false effort will be wasted along such lines until there is a clear conception of the difference between the consolidation of certain features of railroad terminal operation, such as the classification and transfer of interchange freight, which is most desirable, and the unit operation or unification of terminals, which may not be at all desirable, at least in some instances. C. E. SMITH.

St. Louis, Mo., July 27, 1923. Consulting Engineer.

[The paper by Mr. Smith pointed out that "unification of freight handling at St. Louis is in sight." Evidently there is need for a recognized definition of or distinction between the terms unification and unit operation, which at present are used indiscriminately by different writers.—EDITOR.]

Activated-Sludge Tank Under Test at Argo, Sanitary District of Chicago

Sir—In your issue of June 28, p. 1136, Prof. Harold A. Thomas outlines a variation of the activated-sludge tank, which resembles very much a type of tank which has been experimented with by the Sanitary District of Chicago and the Corn Products Refining Co. at Argo during the past year. I attach herewith a cross-section of the tank which



CROSS-SECTION OF ACTIVATED-SLUDGE TANK AT CORN PRODUCTS TESTING STATION, ARGO, ILL.

was suggested in 1920 by Dr. Mohlman to produce circulation, using the general features outlined by Professor Thomas. This tank was installed in the summer of 1921. During the past twelve months this tank has constantly produced a good effluent with 75 per cent of the amount of air used by the ridge-and-furrow system similar to the Milwaukee plant, operated in parallel. However, the eccentric type of plate placing, similar to that used at Manchester, England, and proposed for Indianapolis and the North Side sewage-works of the Sanitary District of Chicago, has been producing a good effluent with even less air. While this peculiarly baffled tank is an interesting one from a standpoint of study, its construction on a large scale would be somewhat expensive and very much more so than the type proposed at Indianapolis and in Chicago.

Our experiments at the present time are directed along the line of finding what the minimum amount of air is that can be used where the agitation is supplied by mechanical means, and further whether activated sludge can be made by mechanical devices alone, without blowing air. We have not yet obtained results sufficient to justify any statements, but believe that the line of investigation will be helpful in defining future lines of research.

LANGDON PEARSE,
Sanitary Engineer, the Sanitary District of Chicago.
Chicago, July 17.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Expenditure of Over $11,000,000 on the New York, Chicago & St. Louis R.R. and allied lines, including the Hocking Valley and the Lake Erie & Western, is announced by the president of the N. Y., C. & St. L. $6,000,000 will be spent on improvements to the system and $5,000,000 on equipment.

Further Improvement of Alligator and the Four-Mile Creeks to facilitate large traffic in the coastal area near Georgetown, N. C., is asked by a delegation which appeared before the Board of Engineers for River and Harbor Work of the Corps of Engineers. The Board has recommended that a survey of this area be made to determine the cost of such work.

An Early Test of the Constitutionality of the Act of 1921, which requires the licensing of civil engineers and surveyors in Pennsylvania, is forecast by George D. Stevenson of Scranton. Mr Stevenson stated that the action would be based on the decision against the Act by Judge Samuel Shull of the Monroe County Court. Governor Pinchot vetoed the bill repealing the act.

The Five-Span Wooden Bridge crossing the Delaware River between Stockton, N. J., and Centre Bridge, Pa., was destroyed by fire July 22. The bridge was a covered one and was erected 82 years ago. It was the only structure of its kind between Trenton and Easton, Pa., a distance of more than 50 miles, to withstand the great freshet of 1893. It is probable that the bridge will not be rebuilt.

A Supercable Between New York and Rome, with capacity of 50,000,000 words a year on a line 4,500 miles long by way of the Azores, will be built jointly by the Western Union Telegraph Co. and the Italian Submarine Cables Co. under a contract signed last week by the two companies. This will be the longest and highest capacity cable across the Atlantic and the direct line to Rome will save hours of time over indirect transmission via England and France.

River Gravel for Track Ballast is to be used extensively by the St. Louis Southwestern Ry., the state legislature of Arkansas having ratified an agreement giving the railway company a 10-year right for the removal of sand and gravel from the bed of the Ouachita River near Camden, Ark. It is stated that this is first class material and can be applied at less cost than any other ballast obtainable, while the supply is unlimited. A ballasting program has been outlined extending over a period of years, with a view of completely reballasting the main line already ballasted or ballasting where no ballast has yet been applied.

Road Bond Bill Causes Missouri Highway Department Concern

Attorney General Jesse W. Barrett, of Missouri, has been requested to construe the appropriation act passed by the last legislature providing for the issuance of $5,000,000 state road bonds in 1923, $10,000,000 in 1924, and $10,000,000 in 1925.

The legislature so worded the act to read that $10,000,000 be issued in bonds in 1924 and 1925. Worded in this manner the act might be construed to mean that only $10,000,000 could be issued during both years, while members of the State Highway Commission intended that $10,000,000 be issued each year.

To Build Two New Subways in New York City

The Board of Estimate and Apportionment of New York City, at its meeting on Aug. 3, approved the routes of the proposed Washington Heights and Brooklyn Crosstown subways. The Washington Heights subway will be from 162nd St. on St. Nicholas Ave. to 124th St., to Manhattan Ave., to 110th St., to Central Park West, and south to 59th St. where it will be connected with one of the existing subways. The Brooklyn Crosstown subway will extend from Newtown Creek in Greenpoint generally along Manhattan Ave., Roebling St., and Bedford Ave. to Halsey St., Brooklyn. The connections for this subway have not yet been decided upon. The estimated cost of the two subways is $54,250,000.

General Goethals to Report on Intracoastal Canals

In view of the favorable action upon the report of Col. G. M. Hoffman, district engineer at New Orleans, regarding the proposed inland waterway from the Mississippi River at New Orleans to Corpus Christi, Tex., the Intercoastal Canal Association of Louisiana and Texas has retained the services of Gen. George W. Goethals to investigate the commercial possibilities of this canal. General Goethals will make an exhaustive study of the commercial aspects of such a canal, not only as a local transportation facility in Texas but with special reference to its relation to the inland waterways of the Mississippi valley. The Intercoastal Canal Association is desirous to have this canal so constructed that it will accommodate the same class of traffic as is now using the Mississippi and Ohio Rivers. For this purpose the canal should have a depth of 9 ft. and a bottom width of 100 ft. Such a canal would mean that barges on these two rivers could be operated along the coast of Texas and Louisiana and eventually to the Mexican border.

The Corps of Engineers has ordered that a survey be made to determine the cost of such a canal between New Orleans and Corpus Christi.

Harding's Death To Affect Coal Situation

To Undertake Mediation In Present Situation Means Employment of Sympathetic Understanding

Washington Correspondence

The President cannot die without affecting all industries and most individuals. The death of Mr. Harding comes at the worst possible time in so far as it affects the coal situation. It is certain to have a very direct bearing on the questions of labor relations which are now in such an acute stage.

While those who are in a position best to appraise the situation are convinced that there will be no strike, they must admit that the situation is one in which a crisis might develop at any time. Government intervention is more likely now than ever before in peace time, due to the fact that the public is not inclined, after the experiences of the last few years, to be kept in suspense as to its fuel supply.

Diplomacy Required

Enough has been learned in the last few years of Government intervention to make it very clear that it is a diplomatic rather than an executive undertaking. To undertake to mediate in such a situation as exists today in the anthracite region means the employment of diplomacy such as is implied by the better sense of the word,— the use of sympathy and understanding. Such a task can be undertaken only by a person in whom each side has confidence. Whatever may be said about Mr. Harding's greatness as an executive, no single individual in the land will dispute that he was a man of friendship—a man with an intense desire to do the right thing. He commanded the respect of capital and labor alike because they knew he was big-hearted and would do his best to be fair. On the other hand, the public would have been satisfied with his mediation. People generally do not have an opportunity to go into the details of issues. They would have been willing to abide by his conclusions. The man so amply suited to undertake mediation has been removed suddenly. It is true that the country is to be spared the aimless drifting which marked the administration's policy just before and during the strike of 1919. At that time there was great uncertainty as to the extent of President Wilson's incapacity. No one was sure whether or not the pronouncements coming from the White House were those of the President or of someone else. Later it was established that some of these pronouncements, at least, did not come from the President himself.

In the present situation, the uncertainty is of a different character. There naturally will be delay before the new helmsman will feel confident to take the ship of state into the main channel. The situation is complicated by lack

of knowledge as to what the new President may do. The outstanding achievement of his career is his handling of a labor matter. His action at Boston in connection with the strike of policemen brought him into national prominence and secured for him the praise and support of those who believe a firm stand must be made against the exactions of labor unions. That act, however, antagonized labor. It is certain the United Mine Workers would hesitate a long time before they would agree to accept President Coolidge as final arbiter of questions which to them seem vital. Unquestionably labor unions are not at all sure, but that one of the principal opponents of their policies has been elevated to the presidency. They must recognize that since Mr. Coolidge first came to national notice because of his stand against unionism, it would be only natural were he to be of the opinion that the public approves of such a policy. His experience in Boston may have convinced him that unionism must be curbed and that nothing can be gained by temporizing with it. In such a case he might conclude that the anthracite situation offers a splendid opportunity to put his views into effect.

On the other hand, many think Mr. Coolidge will take this opportunity to demonstrate that he is not opposed to labor unions when properly conducted. He may admit the right of the United Mine Workers to demand all that they have and to strike if they do not get what they ask. At best, however, it is admitted on all sides that the prospect of agreement is less auspicious today than it was yesterday.

A Critical Time

Many doubt that the check-off is the real objective of the United Mine Workers. The rank and file of that organization is so much more interested in wage than in any of the collateral issues, that it is not probable that the necessary support will be forthcoming to insist upon the check-off. The check-off means a great deal to those who are responsible for the financing of the international union but it means much less to the member of a local. The heads of labor unions are like political leaders or the heads of European states in that they can go only so far in persuading their people to accept solutions which are distasteful to them.

Signs are multiplying that the anthracite workers are ready to insist on the increase. Apparently the more conservative leaders, like the heads of the international union, will have great difficulty in avoding a suspension unless they can promise a wage increase. During the last strike it was claimed at first that the anthracite workers were being held out to win for the bituminous workers, and that if they were left to themselves they would return to work. Exactly the reverse proved to be the case. It was nearly a month after the Cleveland agreement before work was resumed, and even then the terms of settlement were all but rejected when the ratification convention met in Wilkes-Barre. Steam roller tactics had to be employed to get ratification through and even then it carried by a small margin. New factors have entered since then to bolster up the determination of anthracite workers. They elected Capellini. They not only elected him but they did it by a large majority. For a time after his election, Capellini seemed to have joined hands with the conservative leaders but now that he has been accepted as a member of the negotiating committee, he has come out with a statement that he will not surrender any demand and that he will press each one of them. With the death of the President and with unmistakeable signs of increased determination on the part of the mine workers, the prevalent opinion in Washington is that the situation has taken on new seriousness.

Woman Succeeds as Highway Contractor in California

When her husband died three years ago and left a $175,000 road building contract to be finished Mrs. Ellen E. O'Brien of Martinez, Calif., decided that the business reputation which her husband had built up should not be impaired. So she undertook the completion of the contract. The job on which Mrs. O'Brien entered the field of highway contracting was the Franklin Canyon Highway, a 9-mile concrete road which she finished in August, 1921. Since that time she has undertaken numerous other contracts and completed them successfully, putting into her work genuine enthusiasm and love for the job. Contracts which she has completed in the past three years include the Marsh Creek highway, a short railroad for the Henry Cowell Lime & Cement Co., a 3-mile concrete road in Napa County, and the 4-mile Moraga Boulevard in Contra Costa County. This latter job was a $95,000 contract, and Mrs. O'Brien finished it thirty days ahead of schedule despite unusual difficulties met in prosecuting the work.

Mrs. O'Brien is an enthusiastic supporter of the Associated General Contractors of America, having attended its latest annual convention held in Los Angeles.

North Carolina Lets Contracts for 136 Miles of Road

The North Carolina State Highway Commission on June 27 let contracts on 21 highway projects totaling 136.23 miles. The total cost of the work, exclusive of the usual ten per cent for engineering and contingencies, is $2,567,254.

Of this 43.31 miles are of standard concrete or asphaltic paving, 16 and 18 ft. wide. The average cost per mile, including grading, draining, structures, paving, and all other construction items, is $34,953. There are 3.07 miles of penetration macadam, which costs, with the same construction items as above, $23,334 per mile. The remainder of the work consists of 89.85 miles of earth, top-soil, and one-course gravel roads, which cost $10,632 per mile, including clearing, draining, grading, surfacing, structures and all other construction items. The structures (reinforced-concrete bridges and culverts) included in the above figures cost $481,868, an average of $3,537 for each mile of road to be built.

Iowa Board of Engineering Examiners Organized

The Iowa State Board of Engineering Examiners has been organized with the following membership: Seth Dean. chairman, Glenwood; L. M. Martin, vice-chairman, Atlantic; Alvin LeVan, Des Moines; B. F. Fleming, Iowa City; and C. S. Nickals, Ames. All correspondence or business matters for the board should be addressed to W. C. Merckins, secretary, State House, Des Moines, Iowa.

Province Has No Jurisdiction Over Railway Bridge

In a decision rendered by the Supreme Court of New Brunswick on the suit by the provincial government to compel the Canadian Pacific Railway to raise the height of its bridge over Reversible Falls, St. John, it has been held that the province has no jurisdiction over the bridge. This decision was rendered after hearings occupying more than a year, in which alleged obstruction to shipping and the danger to the bridge in raising it to a higher elevation were points of contention.

City Planning Division, Am. Soc. C. E., Elects

At the organization meeting of the City Planning Technical Division of the American Society of Civil Engineers, at Chicago, on July 12, a temporary executive committee was chosen as follows: Chairman, N. P. Lewis, New York City; secretary-treasurer, Charles B. Ball, Chicago; together with Harland Bartholomew, of St. Louis, Mo., and E. A. Fisher, Rochester, N. Y. It was decided that it would not be practicable to provide the city planning program for the Richmond meeting of the society in October.

Opposition to Amendment of Transportation Act

Arguments against early amendment of the Transportation Act, as now proposed tentatively and particularly as to providing for compulsory consolidation of the railways, are being issued by the Railway Business Association. It is pointed out that permissive consolidations, as provided for by the Act, have not yet been tried and that the Interstate Commerce Commission is at work on an official plan to which mergers must conform. A sudden change to a compulsory requirement would undo much of the progress already made, it is believed. Furthermore, such a step would produce complicated litigation, or as the Association's letter says, "would guarantee not consolidations but lawsuits."

Conditions prevailing since the passage of the Act in 1920 have prevented any test of rate making, but under present rates a record-breaking business has been handled, railway credit is rising and a great program of improvement work has been undertaken. The Association urges further trial of the present Act without amendment, and suggests that the whole matter should be the subject of competent inquiry by a joint congressional committee to report to the next session of Congress.

Oregon Engineers Urge Congress Probe Ousting of Davis

Protesting against the recent dismissal of A. P. Davis, former director of the Reclamation Service and his replacement by C. W. Davis, not an engineer, the Oregon Technical Council, which is composed of delegates from local sections of the American Society of Civil Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, American Institute of Architects, National Electric Light Association, and the American Institute of Mining and Metallurgical Engineers, has sent a letter to its congressmen urging that Congress investigate reasons for Mr. Davis' dismissal. The Oregon Technical Council also calls attention to the fact that it believes "the civil service law was evaded since the abolishment of the office of director and the substitution therefor of that of commissioner, with identical duties and responsibilities, is a mere subterfuge which should not make it possible to do indirectly what the law forbids to be done directly."

"This is one of the cases," continues the Oregon engineer's letter, "where the enforcement of the civil service law would have been most beneficial to government service, and it is a phase which we believe deserves the closest scrutiny."

The Oregon engineers stand behind Mr. Davis both for his "ability and efficiency as a business man and as an engineer." The Oregon engineer's letter further states that allegations made that Mr. Davis is not a business man and that his office involved a duplication of work "appear to us so manifestly unfounded as to amount to mere excuses. The excellent showing made by the Reclamation Service, the loyalty and faithfulness of its employees, and the confidence of the people and the Congress in the Service, demonstrate clearly both the business and the engineering ability of the former director."

J. C. Stevens is president of the Oregon Technical Council and F. H. Murphy is secretary.

Street Widening Proposed in Philadelphia

A project for the widening of Ninth St. in downtown Philadelphia from Vine St. to South St., has been approved by the Board of Surveyors, and submitted to City Council in the form of an ordinance. The proposed widening is by taking 15 feet off each side of the street, increasing its width from 50 to 80 feet. The assessed valuation of the property required is $3,100,000. It is proposed that the widening shall be extended over a period of years so that the cost for condemnation shall be kept a minimum. The ordinance now before Council places the 80 feet width on the city plan, and all future building will be on the new line.

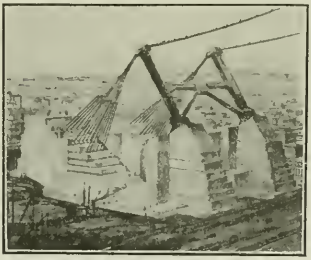
The Board of Surveyors some time ago approved plans for the widening of Vine St., 7th St., Pine St. and 20th St., to form a traffic circuit around the central business section. The proposed widening of Ninth St. is not a substitute for that plan, but an addition to it, affording an intermediate wide street. The ordinance for widening the other streets to form the traffic circuit has been in the hands of City Council for about six months.

To Measure the Water Diverted from Niagara River

The Canadian Government has agreed to the plan proposed by the United States for the measurement of the diversion from the Niagara River. The measurements are to be made under the supervision of a board to be composed of two members, one to be appointed by the Canadian Government and the other by the United States. The American member of the board undoubtedly will be Major P. S. Reinike, the District engineer of the War Department at Buffalo. Canada is expected to appoint William Stewart as its member of the board.

Steel Erection Begun on Delaware River Bridge—Philadelphia

The first shipment of steelwork for the main towers of the Delaware River Bridge, consisting of pedestal sections for the north leg of the tower on the Philadelphia side of the river, was received at the site of the work on July 9.



ANCHORAGE CABLE BENT FOR THE DELAWARE RIVER BRIDGE

Sketch showing how it will look at the end of the first stage. The anchorages will later be completed with an outside structure of granite. Anchorage of the cables is effected by a series of eyebar chains, shown diagrammatically in the drawing.

Erection was commenced at once, and is progressing rapidly. Each pedestal consists of eight fabricated sections, and is 5 feet 6 inches in height and 38 feet 8 inches by 26 feet 1 inch in outside dimensions. Fabrication of other portions of the tower steelwork is progressing rapidly in the shops and shipments will be made soon. The two towers are being constructed by the Bethlehem Steel Co., at its shops at Steelton, Pa.

Contract Let for Second Narrows Bridge at Vancouver

Contract was signed on July 26 for the construction of a railroad and highway bridge across the Second Narrows of Burrard Inlet at Vancouver, B. C. This structure, which has been under consideration for more than a decade, will connect the city with North Vancouver by a crossing whose total length will be about 3,000 ft. This will be made up of 685 ft. of steel spans, about 500 ft. of creosoted pile approach and the remainder of earth fill. The steel trusses will include one 300-ft. span, a 185-ft. single leaf bascule and a 150-ft. approach span. Shorter spans will also be required for crossing Lynn Creek. The structure will be at low level, clearing high tide by about 12 ft. There is a 90-ft. depth of water where the central piers will be sunk. The design will be for a single track railroad with Cooper's E-50 loading and a vehicular roadway cantilevered on either side.

Contract for the work is held by the Northern Construction Co. working in conjunction with J. W. Stewart. The total cost will be slightly over one million dollars, for most of which bonds will be taken by the contractors. The costs are being divided as follows: North Shore municipalities, $630,000; Vancouver, $200,000; Dominion of Canada, $100,000; Province of British Columbia, $100,000. Construction is to be started in the month of August, and it is estimated that two summer seasons will be required to complete the work.

Agree on Joint Board to Inspect Transit Facilities

In connection with the proposed inspection of the structures and equipment of the New York subways and elevated lines for which engineers of the Westinghouse Electric and Manufacturing Company and the General Electric Company and Dr. George F. Swain have already been engaged, the State Transit Commission and the City Transit Bureau have come to an agreement whereby a joint board will be constituted to proceed with this survey. The Transit Commission will be represented by Robert Ridgway and George Gibbs, the Board of Estimate by Dr. George F. Swain, and the Interborough Rapid Transit Co., by George H. Pegram, and the Brooklyn-Manhattan Transit Co. by Eugene Klapp and W. G. Gove.

PLACING THE PEDESTAL SECTIONS OF DELAWARE RIVER BRIDGE

Random Lines

Don't They Need No Bananas?

In Circular No. 1546. The Panama Canal asks contractors for proposals to furnish:

"Sheet Iron or Steel, Brass Tubing, Sheet Copper, Sheet Brass, Bronze, Wire Nails, Brass Valves, Sheet Zinc, Liquid Door Checks, Night Latches, Copper Tacks, Hinges, Carbolic Acid, Burnt Sienna, Putty, Mercuric Oxide, Metallic Zinc, Caustic Soda, Soda Ash, Powdered Milk, Turpentine Substitute, Rubbing Varnish, Poultry Netting, Wire Lath, Copper Insect Screen, Sledge-Hammer Handles, Grindstones, Scrub Brushes, Corn Brooms, Emery Cloth, Mattress Ticking, Tennis Nets, Shower-Bath Curtains, Linen Twine, Cotton Batting, Steam Packing, Onion-Skin Paper, Manila Tags, and Beeswax."

* * *

The British House of Lords has just rejected the Tooting Railway Bill. Aren't the noble members getting just a bit oversensitive as to noise.

* * *

And Still They Come

—"J. Kislak, 'The Live Wire,' Hoboken, N. J., *Insurance Engineer* and Real Estate."

—"Have one of our *wrapping engineers* call and show you some of the points he has picked up in his visits to shops and shipping rooms.—The Ad-Tape Co., Inc., of New York.

—"The study of these physical characteristics is the basis of a new profession, which Andre Tridon suggested calling *matrimonial engineers*, and whose business will be to diagnose the chances of happiness two human beings may have who plan to associate their destinies."—Chicago *Tribune*.

—"Ernest E. Lee Co., *Merchant Engineers*, Chicago, Ill."

* * *

What particular blasphemous or irreligious thing have the Chicago engineers been doing that would lead the Chamber of Commerce there to say that Heinie Van Loon is rewriting the Bible "for all kinds of plain people—chambermaid, waiter, postman, engineer, all sorts—who fight shy of the Bible because it is the Bible, but who like a good story as well as anybody else"?

* * *

Mental Hazard

"Governors Favor More Jersey Links," headlines the New York *Times*. Good news for metropolitan golfers, we thought until we read the subhead "Smith and Silzer Urge Additional Bridges or Tunnels as Soon as Possible."

* * *

Highway sign in small town in Ohio near Cincinnati—

"Drive slow—see our town;
Drive fast—see our jail."

Test Section of Automatic Train-Control Works Successfully

An automatic train-control system has been put in operation on the 50-mile branch of the Pennsylvania R.R. between Lewistown and Sunbury, Pa., and the twelve locomotives which constitute the equipment of this line have been equipped with the necessary apparatus, so that all passengers and freight trains are now subject to this control. For this system a track circuit operates cab signals and an air-brake connection on the locomotive. In the cab are three electric lamps. When lamp A is alight the engine man knows he has a clear track for at least two block sections, but if he should try to exceed the maximum speed allowed on the division the air brakes will be applied automatically. When lamp B is alight it indicates one clear section and the mechanism holds down the velocity of the train to an assigned "medium speed" limit.

The third lamp is a "slow" or "stop" signal as conditions may require, and its indication is given about 1,800 ft. before the train reaches a section occupied by another train or having an open switch. If this light burns and the engineman takes no action, the train control devices will apply the brakes and stop the train. But if the engineman acknowledges the signal by throwing a lever, he can proceed at an assigned "slow speed" with his train under perfect control. Any attempt to exceed this speed will result in application of the brakes. The Lewistown branch is chiefly single track, with automatic visual signals at intervals. On half the length of the line these signals operate in connection with the train-control system, but on the other half the dispatcher controls them.

C. & O. Ry. Betterments $14,800,000

The improvement program of the Chesapeake & Ohio Ry. for 1923 includes little in the way of extension but is based on the more intensive development of its existing lines with a view to handling maximum tonnage at minimum cost, as stated by W. J. Harahan, president of the company. The estimated cost of work authorized and under way, but exclusive of new equipment, aggregates $14,815,000, of which $12,777,000 is for road and the remainder for equipment improvement.

Freight yards and passing tracks will total $8,322,517, including $3,630,000 for a new yard at Clifton Forge, Va.; $380,000 for storage yard at Newport News, $285,750 for yard additions at Hinton and Silver Grove, and $4,025,767 for various yard work and for building and extending passing tracks and other side tracks. Next to this big item comes $1,586,266 for shops and engine terminals, shop machinery and coal and water stations. Grade reduction at Paynes, near Covington, Va., will cost $468,000 to reduce grades of 0.4 per cent eastbound and 1.13 per cent westbound to level track. Additional main tracks will cost $446,900, including ten miles of third track between Big Sandy Junction and Russell, Ky. Other items include $116,633 for track re-alignment at Hinton and Beckley, $500,752 for bridges, trestles and culverts, $424,738 for stations and office buildings, $368,764 for signals and interlocking plants.

Second Incinerator for St. Louis

Bids for the second of a proposed series of five garbage incinerators, with a capacity of consuming 100 tons of garbage in 24 hours, will be received by the Department of Public Utilities, St. Louis, Mo., on Aug. 28. The first incinerator has been in operation for about seven months with successful results and without any complaint from the public.

New Orleans Planning and Zoning Commission Appointed

A city planning and zoning commission of twenty members has been appointed by the Commission Council of New Orleans, under an ordinance adopted May 1 of this year. Of the twenty members, seven are appointed at large and thirteen represent various organizations. J. Frank Colemann, consulting engineer of the New Orleans Dock Board, and one of the members at large is a member of the executive committee of the Commission. Among the organization representatives on the Commission are: the Louisiana Engineering Society, J. W. Billingsley; Louisiana Chapter, American Institute of Architects, Allison Owen; New Orleans Contractors & Dealers Exchange, Richard McCarthy.

The planning commission is given wide authority to study all phases of city planning, including the laying-out of undeveloped real estate. It is also authorized to prepare plans for zoning the city into residential, commercial and industrial purposes. The powers of the planning commission extend to all territory three miles beyond the city limits. No recommendation of the commission has legal effect until accepted by an ordinance of the Commission Council.

Besides money appropriated for the use of the planning commission by the City Council the planning commission is authorized to receive contributions of money or materials to be expended at its discretion but subject to the audit of the Commission Council.

Passaic Valley Outfall Sewer Tunnel Contract Rescinded

Formal notice that it vacated its contract for the construction of the outfall sewer tunnel into New York Harbor was presented July 26 to the Passaic Valley Sewerage Commission by the contractor, the Holbrook, Cabot & Rollins Corporation of New York City. The action is based on refusal of claims made by the contractor for extra cost resulting from alleged misrepresentation by the commission at the time the bids were secured as to the character of the ground through which the tunnel passes. A total of $794,668 of damages is claimed by the contractor. Any payment is refused by the commission which also denies that it misrepresented the conditions in any way. Pending permanent arrangements the commission, by agreement with the contractors, is continuing construction with the contractor's plant and workmen. Twice previously this tunnel has been the object of trouble between the commission and its contractors. The original contract was let to John F. O'Rourke who abandoned the work and filed suit for damages as related in *Engineering News-Record* June 3, 1917, p. 268, and July 25, 1918, p. 191. The second contractor was Charles A. Haskins of Boston who abandoned his contract.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; Annual Conference, Chicago, Sept. 27-28, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga.; Nov. 12 to 16.

The Colorado Engineers Council gave a banquet in honor of R. H. Keays, chief engineer of the Moffat Tunnel Commission, on July 31 at Denver, Colo. W. F. R. Mills of the Denver Union Water Co. presided, and L. G. Carpenter, president of the Colorado Engineers, spoke on "The Engineer and His Position to the Community."

Personal Notes

CHARLES T. BRAGG has opened offices in the General Motors Bldg., Detroit, under the firm name of Bragg Engineering Co., for consulting service in chemical, civil, mechanical and electrical engineering. Mr. Bragg's professional record includes being president of the Detroit Board of Water Commissioners, director of the American Institute of Metals, technical director for Berry Brothers, chemical engineer for the Ohio Brass Co. and works manager for the Michigan Smelting & Refining Co. Associated with the company as consulting engineer is COL. T. A. LEISEN, who was the engineer in charge of construction of Camp Custer, past president of the American Water Works Association and former general manager of the Detroit Department of Water Supplies. Recently Col. Leisen has been designer and engineer in charge of construction of the new Detroit filtration plant, which was described in *Engineering News-Record*, May 17, p. 860.

FRED J. MILLER, Center Bridge, Pa., has been appointed engineer member of the Water and Power Resources Board of Pennsylvania, a new board created by the administration reorganization code in the Pennsylvania Department of Forests and Waters to take the place of the Water Supply Commission of the state.

MAJ. GEORGE H. NORTON, city engineer of Buffalo, N. Y., for the past 14 years, has been appointed chief engineer of the consolidated Terminal and Grade Crossing Commissions of Buffalo. Mr. Norton is a graduate of Cornell University. In his service in Buffalo he directed the Buffalo River improvement, the Scajaquada Creek storm water drain and harbor improvements. COL. CHARLES E. P. BABCOCK, formerly first assistant engineer of Buffalo, becomes city engineer, succeeding Maj. Norton.

W. C. BROWN, a former city engineer of East San Diego, Calif., has completed a course at Leland Stanford Jr. University and has gone to Sonora, Mexico, on an irrigation project.

PROF. CHARLES DAVID MARX, emeritus professor of civil engineering at Leland Stanford, Jr., University, has received an honorary degree from the Technical University at Karlsruhe, Baden, Germany.

BURGIS G. COY, civil engineer of Fort Collins, Colo., has been appointed resident engineer of the eastern portal of the Moffat Tunnel. Mr. Coy is a graduate of Rensselaer Polytechnic Institute, and after some time spent on tunnel work in New York State he went to Colorado where he was engaged on construction of the Laramie-Poudre tunnel; his paper on this tunnel won the Thomas Fitch Rowland award of the American Society of Civil Engineers.

MAJ. E. L. DALEY of the U. S. Corps of Engineers has been appointed engineer officer in Pittsburgh, Pa., succeeding Maj. J. Franklin Bell who some weeks ago was transferred to Washington as engineer commissioner for District of Columbia. Maj. Daley has for several months been doing Red Cross work in Greece and Russia and prior to his work abroad was an instructor at West Point.

ROBERT LLOYD, borough manager for the Borough of Edgeworth for the past three and one-half years, has accepted the position as manager of the Midland Improvement Co. and the Midland Water Co. at Midland, Pa., both subsidiaries of the Crucible Steel Company of America.

H. B. NOWLIN, civil engineer, has accepted a position with the George T. Wilhelm Co., construction engineers of Cedar Rapids, Iowa. Mr. Nowlin has specialized in engineering management and construction machinery. He is now located with the above firm at Elaine, Ark., where they are just completing a 61-mile concrete road.

HON. J. R. COOKE, M. P. P. for North Hastings, Ontario, has been appointed a member of the Ontario Hydro-Electric Commission, and J. G. Ramsden has been removed from membership of the Commission, which is being reorganized by the Provincial Government.

E. W. OLIVER, general superintendent of the Niagara, St. Catherine's & Toronto Ry., has been appointed manager of that road and of the Toronto Suburban Ry. and the Toronto Eastern Ry., and is now superintending the completion of the last named railway.

F. C. PALMER has been appointed town engineer and street commissioner of Bowmanville, Ontario. Mr. Palmer had been for many years engaged in municipal engineering work at Oshawa, Ontario.

GEORGE W. BORDEN, state highway engineer of Nevada, was elected secretary of the Western Association of State Highway Officials at the session held July 10 and 11 at Salt Lake City, Utah.

WILLIAM J. P. SIMPSON announces the opening of offices at 4447 White Bldg., Seattle, Wash., for the practice of civil and industrial engineering. Mr. Simpson had for the past three years been associated with the Continental Pipe Manufacturing Co.

I. KELLERT, formerly assistant town-engineer of St. Lambert, Province of Quebec, has been appointed town-engineer to replace E. Drinkwater, who has resigned.

W. BOYD JONES has opened offices in the Sunderland Bldg., Omaha, Neb., under the firm name of the American Construction Co. and will do a general construction business.

FREDERICK A. DALE, formerly with George F. Hardy, consulting engineer, New York, has become principal assistant engineer with L. F. Harza, consulting engineer, Chicago, whose principal work at present is on the design of the 270-ft. rock fill dam on the Dix River, Kentucky, for the Kentucky Hydro-Electric Co., a subsidiary of the Middle West Utilities Co.

Obituary

WALTER L. KEISER, traveling representative for the Pittsburgh Meter Co., Pittsburgh, Pa., died at his home in Waco, Tex., May 26, after a brief illness. Mr. Keiser was foreman of the company's water meter shops for a number of years before entering the sales field.

CHARLES D. BLANEY, of Saratoga, Calif., chairman of the original California state highway commission and long active in the good roads movement in the state, died July 25. Mr. Blaney was born in Chicago and graduated from Princeton University. In 1882 he moved from Chicago to California. As member and chairman of the state highway commission, he had a great deal to do with the laying out and construction of the highway system under the first bond issue of $18,000,000.

CHARLES J. CONNELL, president and founder of one of the oldest contracting firms in Chicago, the Fitzsimons Dredge & Dock Co., died in Evanston, Ill., Aug. 2, at the age of 84. In 1872 he gave up a position as bank cashier and formed a partnership with Mr. Fitzsimons, their first contract being the Dearborn St. bridge, the first in Chicago to be operated by steam. Since that time the firm has constructed 80 per cent of the bridges (or of their substructures) in Chicago, well over fifty in number. The California St. bridge is now under construction and work was started Aug. 5 on the Adams St. bridge. In 1875 the 12-ft. Fullerton Ave. tunnel, one of the largest water tunnels in Chicago, was driven by this company from the lake to the river. Other waterworks structures were the Carter Harrison, Four-mile and Wilson Ave. cribs, and several more tunnels.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Conference Discusses Standards for Tilting Mixers

At a second concrete mixer conference arranged by the Associated General Contractors of America and held in Chicago July 30 and 31, the main subject was the standardization of tilting mixers. This supplemented the previous meeting on standards for non-tilting mixers, as reported in *Engineering News-Record* of July 5, p. 36 and 19, p. 120. In addition, there was considerable discussion as to changes in the requirements for standardization of mixers in general.

For the tilting mixers one of the main points of discussion was the selection of sizes, which had been proposed tentatively as No. 3, No. 4 (or 5) and No. 7. The outcome was that the meeting did not adopt, but "recommended for adoption," Nos. 3½, 5 and 7. The manufacturer is to state the least angle at which the drum mixes its rated batch efficiently and the capacity of the drum is to be taken as its water level content at this angle. A schedule of the standardization requirements for tilting mixers will be issued shortly, and in many respects will be similar to that for non-tilting mixers, given in *Engineering News-Record* of July 19, p. 120.

In regard to mixers in general, a table was submitted giving the quantities of mixed concrete for the various proportions of mix and giving alsc the size of batch of various proportions for each standard size of mixer. It was decided that this table should be copyrighted. A schedule of charges for the Association's nameplates on standard mixers was also submitted.

To insure adherence to the adopted standard sizes it was proposed that all non-standard sizes should be eliminated by January, 1925, and that manufacturers continuing to make such non-standard mixers should forfeit the right to use the "standard" name plates for their entire line of mixers. This restriction will not apply to mixers above No. 28 and below No. 3½, which are the limits of the standard sizes.

Newaygo Co. To Build Cement Plant in Wisconsin

A million-barrel (annual) cement plant is to be built in Manitowoc, Wis., by the Newaygo Portland Cement Co. duplicating the recently enlarged capacity of the plant at Newaygo, Mich. Limestone will be shipped across Lake Michigan to Manitowoc from the company's quarries in the Calcite and Petoskey district of Michigan. The new plant is to be located near the site of the Manitowoc Shipbuilding Corp., the steel handling facilities of which will be used to expedite the construction of the cement works.

The Wisconsin plant is to be built and operated by a subsidiary, the Manitowoc Portland Cement Co. With the construction of the new plant new interests from the west side of the Lake enter the company, including the Manitowoc Securities Co. and the Manitowoc Ship Building Corp. Wellborn & Huntington, consulting engineers, Chicago, made the investigation and report on the marketing facilities available at Manitowoc as well as the supply of raw materials.

Program Outlined for Caterpillar Service School

For users of caterpillar tractors the Holt Manufacturing Co. announces that a service school at Wausau, Wis., will open Aug. 13 and continue one week under the supervision of H. H. Chambers, director of the company's service division. The object of the school is to acquaint tractor users with proper methods of operation and maintenance of their equipment. A carload of specially cut-away motors, transmissions, and other assemblies will be used to illustrate, disassemble, and reassemble. Cut-away models of carburetors, magnetos, air cleaners, and other parts will enable the students to learn about operation and adjustment. The company states that there will be no tuition or registration fee charged for the school.

Census Figures Show Scope of American Industry

The Department of Commerce announces that a summarization of the reports made to the Bureau of the Census by the manufacturing establishments in the United States shows that the value of their products aggregated $43,653,283,000 in 1921, as compared with $62,041,795,000 in 1919 a decrease of 30 per cent. Compared with the value of products reported for 1914 there was an increase of 80 per cent due largely to the rise in prices.

A better index of conditions will be found in the figures relating to persons engaged in manufacturing. The average number of wage earners employed in 1921 was 6,946,564, or 23 per cent less than the number reported for 1919, while there is very little difference between the figures shown for 1914 and 1921.

The census statistics for 1921 relate only to establishments having products valued at $5,000 or more.

Gives Course in the Best Use of Forest Products

Demonstration courses in the best and most economical use of the products of our forests are offered by the Forest Products Laboratory, Madison, Wis.

Details of the several courses offered for personal instruction are given in Miscellaneous Circular No. 8, just issued by the United States Department of Agriculture. These courses are given in the kiln drying of lumber, boxing and crating, gluing of wood, and wood properties and uses. They are arranged to be completed in from one to two weeks and so that a fee of $100 to $150 will be sufficient to cover the cost of the course.

Stress is laid on the practical aspects of the subjects, so that no one need hesitate to enroll because of a lack of technical training. Copies of the circular may be secured from the United States Department of Agriculture, Washington, D. C., as long as the supply lasts.

Road Work Organized in Brazil—Foreign Construction Reported

A number of important public and private works planned or under way in foreign countries have been reported to the Department of Commerce. Road improvement ranks high among these projects.

Plans have been formulated by the Minister of Public Works of the Province of Buenos Aires, which will put highway construction in that province on an organized basis, with funds regularly appropriated for the purpose. Only $370,000 a year will be available at first, but it is planned to levy a land tax to increase this amount.

The city of Sao Paolo, Brazil, has made a contract with a local firm to asphalt 100,000 sq. meters of its streets.

The province of Quebec, Canada, will spend $5,000,000 on roads during the coming summer.

The Brazilian government has awarded a contract to a Brazilian company to construct a naval base in Rio Grande Do Sul with a training school. The total cost is estimated at 8,000,000 milreis. The city of Sao Sebatiao do Paraiso, Brazil, plans to contract for a loan of 1,000,000 milreis for civic improvements.

The Greek government has asked for proposals for the partial construction of the port works planned for the improvement of Piraeus, the port of Athens.

SUMMARY OF MANUFACTURING PLANTS FOR THE UNITED STATES: 1921, 1919, AND 1914

	1921[1]	1919[2]	1914[2]
Number of establishments	196,267	214,383	177,109
Persons engaged	8,257,376	10,688,849	8,117,895
Proprietors and firm members	172,871	250,571	259,172
Salaried employees	1,137,941	1,438,219	962,533
Wage earners (average number)	6,946,564	9,000,059	6,896,190
Salaries and wages	$10,763,442,000	$13,342,655,000	$5,342,157,000
Salaries	2,563,118,000	2,880,868,000	1,274,438,000
Wages	8,200,324.000	10,461,787,000	4,067,719,000
Paid for contract work	451,580,000	462,994,000	198,720,000
Cost of materials	25,338.617,000	37,288,731,000	14,358,935,000
Value of products	43,653,283,000	62,041,795,000	23,987,860,000
Value added by manufacture[3]	18,314,666,000	24,753,064,000	9,628,925,000

[1] Statistics for 1921 do not include 54.054 establishments employing 40,865 wage earners (average number) with products valued at $136,715,000, each reporting products under $5,000 in value.

[2] Data for establishments with products under $5.000 in value have been eliminated from certain of the items shown, as follows: For 1919—number of establishments, 60,215; wage earners (average number), 41,252; value of products, $151,631,000. For 1914—number of establishments, 95,409; wage earners (average number), 127,495; value of products, $228,654,000. For the other items in the table, separate data for this class of establishments are not available, and deductions cannot be made. Also, data for establishments engaged in automobile repairing in 1919 and 1914 have been omitted from all items shown in the table, as statistics were not collected for establishments of this class for 1921.

[3] Value of products less cost of materials.

Midwest Terra Cotta Firms Fined

Six terra cotta manufacturing concerns, charged with violations of the Sherman anti-trust act, entered pleas of guilty last week before Federal Judge Cliffe, sitting in Chicago, and fines ranging from $1,500 to $3,000 each were imposed. The firms are located in Chicago, St. Louis, Kansas City and Denver.

Business Notes

McWane Cast Iron Pipe Co., Birmingham, Ala., has opened an office in Dallas, Texas, with J. L. Hill as manager in charge. This office will cover the entire Southwest and Mexico. The firm makes the McWane pre-calked joint and a complete line of cast-iron pipe.

Elk Manufacturing Co., of New York City, has been taken over by the Ell. Machine Tool Corp., with increased capitalization. The new company will continue to manufacture and sell precision tools under the Elkin patents. The line of tools consists of machine tools for shaving, burnishing and squaring bearings used in internal combustion motors, valve-lifters, air-compressors, Elk terminals and other precision tools. J. G. Elkin, inventor and mechanical engineer, is president of the new company and will have entire charge of the manufacturing and production.

Equitable Equipment Co., Inc., New Orleans, announces the purchase from the Santa Fe R.R. of approximately 16,000 tons of relaying rail varying in size from 50 to 60 lb. per yard

Contractors Equipment Co., Inc., Detroit, has just completed a large addition to its warehouse and service station for the handling of road and general construction machinery. The location of the new plant is central to the building activities of Detroit.

Thomas H. Dallett Co., Philadelphia, manufacturer of pneumatic stoneworking machinery and supplies, has purchased a new factory at 165-189 West Clearfield St., Philadelphia, and moved into its larger and more modern plant July 1.

White Co., Cleveland, announces the recent purchase by the City of New York of 100 2-ton motor trucks on a single order. The trucks are equipped with dumping bodies and are for the use of the Department of Street Cleaning. The grand total of White trucks in the city's service is now 551.

Kerr Turbine Co., Wellsville, N. Y., has just undergone a reorganization through the acquisition of practically all its common stock by new interests. Paul B. Hanks, the former president, having disposed of his holdings, has resigned and has been succeeded by W. T. Hamilton of Pittsburgh.

A. J. Swanson, district manager at Atlanta, Ga., for the North Western Expanded Metal Co., has been transferred to Los Angeles to take charge of the company's Pacific Coast territory.

Equipment and Materials

German Metal-Spraying Process Exhibited at Leipsig Fair

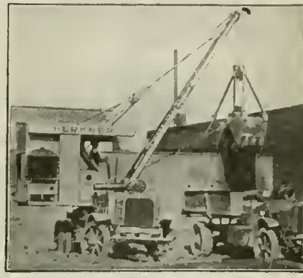
The growth of metal spraying processes in Germany was evidenced by the interest shown in the exhibits of Meurer'sche A. G., of Berlin, at the recent Leipsig Fair, according to reports received by the U. S. Department of Commerce. The devices are claimed to be improvements upon the M. A. Schoop (Swiss) patents of 1909-1911, which covered the process of fusing various metals by means of a hydrogen gas blow pipe or electric current and spraying the molten particles with compressed air. A special company was formed which conducted extensive researches and finally in 1920 N. Meurer obtained about twenty patents which the exhibiting firm now controls. The process is intended to spray aluminum, lead, bronze, iron, copper, brass, nickel, zinc, tin, gold and silver upon the surface of cement, textiles, glass, porcelain, cast-iron, wood, stonework, cardboard, paper, wrought iron, or any other metal articles, covering them with a layer of 1/40 mm. or thicker if desired.

The apparatus is made in the shape of a hand pistol or a tumbler drum with one or more spraying pistols in action. A wire of the required metal is automatically fed through a nipple at one end and as it approaches the other end it is melted by a current of oxyhydrogen gas under high pressure or oxyacetylene gas and the atomized particles are forced out in a jet through a nozzle. The hand pistol is guided in whatever direction work must be done. The jet does not scorch paper or any other inflammable material. It is claimed that the sprayed surface will readily lend itself to polishing and buffing. The primary object of the process is to weatherproof or otherwise protect surfaces subject to oxidation or corrosion.

Truck-Mounted Crane Kept Busy on Variety of Jobs

How one contractor kept a truck-mounted crane busy on a variety of jobs is illustrated by the case of the Peter Herkner Motor Trucking Co., Cleveland. The equipment consisted of a full-circle swing crane, with separate 40-hp. gasoline engines, manufactured by the Universal Crane Company, Elyria, Ohio, and mounted on a used 5-ton motor truck. The outfit handled a ½-yd. clamshell bucket with teeth.

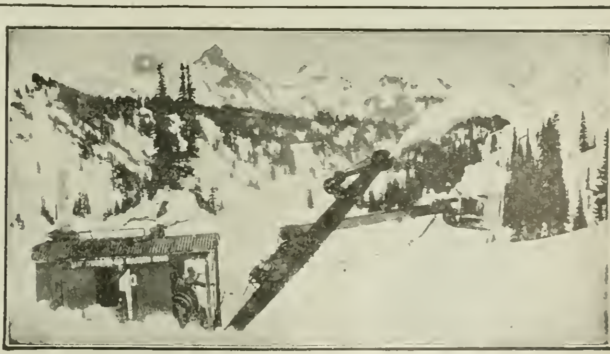
One of the first contracts on which the crane was used was the removal of a 100-yd. ramp in a large building



excavation which had been left in order to get the steam shovels out. The crane, located at the end of the excavation, dug out the material with the clamshell bucket and loaded it into trucks.

Two cellar excavation jobs each involving 300 cu.yd. of excavation, followed. The mobility of the crane reduced to a minimum the time lost in getting from one job to another. When this work was finished the crane was sent to a gravel pit for loading trucks. While this work was in progress there occurred a garbage strike in Cleveland and the truck-mounted crane was drafted for the emergency work of unloading garbage from cars to pit or trucks.

Instead of laying this crane up for the winter, the owner arranged with



Steam Shovel Clears Snow-Blocked Road

With the aid of a steam shovel the six-mile road from Narada Falls to Paradise Valley in Mt. Ranier National Park, Washington, blocked by snow 7 ft. deep, was opened up to traffic this spring a number of weeks earlier than usual. The equipment, illustrated above, consisted of a ⅝-yd. Osgood shovel of the revolving type mounted on crawler traction. Similar use of a steam shovel for handling snow was noted in this journal June 7, p. 1022, for clearing the Snoqualmie Pass through the Cascade Mountains in Washington.

the city to handle coal for schools, thus demonstrating the all-year-round service of this equipment. Various odd jobs also were found in and around industrial plants in handling scrap iron to and from cars, pig iron. With the aid of a special bucket an attempt will be made to use it on snow-removal work.

Illuminated Traffic Control Unit

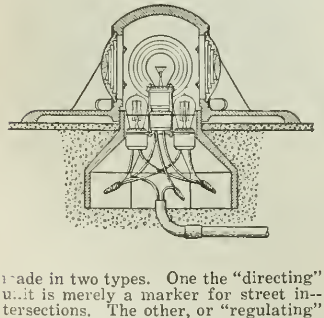
For the control of motor vehicle traffic at street intersections, the Line Material Co., South Milwaukee, Wis., has developed an illuminated unit known as the "Traficon," consisting of a steel casting in the form of a hood extending 8½ in. above the street surface. At each side of the hood facing the intersecting streets a bullseye lens

is set in a recess perpendicular to the pavement. On either side of the lens, as shown in the accompanying illustration, a heavy flange protects the glass from injury and its recessed position in the hood is such as to reduce to a minimum the possibility of damage by vehicle wheels.

To serve its purpose most effectively, the manufacturer states, the traffic marker should be lighted by day as well as by night. To this end the inside of the casting is equipped with two sets of electric lights, one of 25 watts and two of 10 watts each, making possible a minimum charge for lighting during the day.

The casting has a base diameter of 22 in., weighs 115 lb., and requires no bolts to hold it in place. It is painted in bright yellow weatherproof paint. The lenses may be adapted to any color code.

These illuminated traffic guides are



made in two types. One the "directing" unit is merely a marker for street intersections. The other, or "regulating" unit, carries a panel in which the word "Stop" is made to appear and disappear either automatically or under manual control.

New Gasoline Hammer Drill

A gasoline impact drill of the air hammer type which is self-contained, portable and operated by one man, has recently been developed by the Pennsylvania Gasoline Drill Co., Philadelphia.

The drill, which is named the Somervell, weighs only 70 lb. and although developed originally for drilling rock, is applicable to such work as cutting asphalt pavements, ramming backfill in trenches, breaking concrete, driving spikes and drilling holes in masonry.

The mechanical principle of the gasoline hammer drill, as explained by its manufacturer, combines the action of an air hammer and a gasoline engine in such a manner that the drilling unit has but two working parts, the hammer piston and the fly-wheel assembly. No crankshaft or connecting rod is employed and there is no spring or other yielding member used in the internal construction. No inlet or exhaust valve or cam shafts are used, as the air and gas passages are fixed ports, cut through the solid steel of the cylinder. The drill delivers about 1,800 blows a minute; the fly-wheel which returns the hammer piston on the upward or compression stroke.

Since the drill is a self-contained power unit it is not limited in the radius of its action by the length of an air hose or an electric cable. These drills are already being used by the Philadelphia Electric Co., the Western Union Telegraph Co., and the Edison Electric Illuminating Co., of Boston.

Publications from the Construction Industry

Cranes—INDUSTRIAL WORKS, Bay City, Mich., has published a handsome 161-p. book illustrated with reproductions of photographs and drawings in color on the general subject of cranes. The volume, commemorating the fiftieth anniversary of the company has an introduction in the form of a history of the development of cranes dating back to the primitive methods used by the Egyptians in the construction of the pyramids. The text dealing with the modern machinery manufactured by the company is divided into six sections, dealing with locomotive cranes, locomotive crane accessories including buckets, grapples, magnets, and draglines, wrecking cranes, special railway equipment in the form of electric and hand-operated tiller and transfer cranes, pile drivers and cranes constructed for export in accordance with special requirements. The text is fully illustrated and an index aids in finding information on any specific type of crane or accessory. There is an interesting series of photographs of railroad wrecks showing the uses of cranes in rescue and repair work. The application of locomotive cranes to a wide variety of industrial and construction uses also is featured. For the user of cranes the volume contains a wealth of information presented in an attractive form.

Rail Steel Reinforcement—FRANKLIN STEEL WORKS, Franklin, Pa., as a member of the Reinforcing Bar Division of the Rail Steel Products Association, is in a position to distribute the booklet "Rail Steel for Concrete Reinforcing," in addition to those companies listed in the notice of this publication appearing on p. 604 of the March 29 issue of this journal.

Concrete Reinforcement—DAVID W. MORROW, Cleveland, Ohio, describes in a 15-p. illustrated pamphlet his patented three-way system of reinforced-concrete flat-slab construction. The system, in comparison with other types of flat-slab design, it is claimed, results in better distribution of panel area which produces a minimum bending moment and secures a shorter length of steel and an equalization of stresses that could not otherwise be obtained.

Excavator and Loader—T. L. SMITH Co., Milwaukee in a 20-p. catalog, describes and illustrates its excavator and loader with particular reference to basement, bank excavating and loading of sand and gravel, stock piles, stripping, and grading of streets and alleys. The loader is a portable gasoline-driven dragline excavator, designed to fill the gap between the large power shovel and the gang of hand-shovel laborers.

Steel Windows—TRUSCON STEEL CO., Detroit, has issued a folio of "Drafting Room Standards" in loose-leaf form showing typical installation details of steel windows of all types. The information is given on 8 x 10½-in. sheets with drawings to scale. These sheets are accompanied by others carrying specifications for all types of windows shown in the drawings. In offering this portfolio of drawings and specifications the company has endeavored to answer in graphic form every question an architect or an engineer might ask about steel windows and industrial steel doors. Details from the loose-leaf sheets may be traced for incorporation on building plans.

Steam Shovel Costs—ERIE STEAM SHOVEL CO., Erie, Pa., has presented in at 71-p. booklet, illustrated, the results of the prize contest it conducted recently to secure data on the performance and upkeep cost of its shovels. The records cover only those shovels which have handled at least 200,000 cu.yd. of material. On this basis the figures cover 48 shovels. The data are segregated according to the kind of material handled—earth, rock, clay, sand and gravel. Particularly interesting is the general summary giving total upkeep figures and averages for all of the 48 shovels included in the survey.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Production and Materials Stocks in Eight Cities

Midsummer Slow-Down in Iron, Steel and Cement Output—Lumber Above Normal—Fewer Burned Brick Than Year Ago

Iron and Steel—Pig-iron production during July averaged somewhat over 118,000 gross tons per day as against 122,000, during the preceding month. This rate represents a falling off of nearly 5 per cent from the May average, which was the heaviest recorded in the history of the industry. The July output, however, was slightly heavier than that for April; 2 per cent under the June average and 52 per cent greater than a year ago.

There has been some accumulation of pig-iron and steel ingot reserve stocks. Sheet mill operations continue at almost 75 per cent of capacity with finishing mills going at a slightly higher rate.

Lumber—Production is proceeding at a rate nearly 7½ per cent above normal, or at about the same rate as prevailed one month ago. Shipments represent 95 per cent and orders 85 per cent of normal production. While there has been no perceptible falling off in output, shipments have been fewer and orders a trifle heavier than a month ago, despite the general downward trend in lumber prices. One year ago, production was 6 per cent below normal, shipments, 90 per cent and orders, 87½ per cent of normal production. The following table shows lumber movements during the four weeks ending July 21, compared with the preceding four weeks.

	Four Weeks Ending July 21 Ft. B. M.	Four Weeks Ending June 23 Ft. B. M.
Cut	1,013,633,602	1,101,749,298
Shipments	902,519,673	1,003,405,099
Orders	778,785,990	810,722,740

Cement—Reserve stocks, throughout the entire country July 1, amounted to 9,219,000 bbl. as against 10,718,000, for the corresponding period in 1922, according to the Geological Survey. Production totals for the first half of the current year reached 62,320,000 bbl., against 46,918,000, for the same period in 1922. Shipments during the first half of 1923, totaled 62,226,000 bbl., compared with 48,029,000 during the corresponding period last year. Compared with this time last year, the cement situation is one of increased production and shipments with smaller reserve stocks on hand.

Brick—Report of the Common Brick Manufacturers' Association of America, as of July 1, shows production of new brick for the month, at 128,942,000, with shipments totaling 116,761,000. This leaves the quantity of burned and unburned brick on hand at the plants, approximately the same as for the month preceding. Demand fell off 2 per cent in one month. Stocks of burned brick on hand July 1 were 8 per cent under the amount available for the same period in 1922.

San Francisco—Large stocks of road oils, asphalt, cut nails and manila rope. Plenty of sewer pipe, clay drain tile and other clay products. Fairly heavy reserves of track supplies, lime, triangle mesh, steel structurals, black steel sheets and wire nails. Dealers' stocks of metal lath, steel bars, brick, tile, lumber and galvanized steel sheets, in good shape. Stocks low, however, on cement, structural rivets and blue annealed steel sheets.

Los Angeles—Enough sewer pipe to fill requirements. Cement situation easier, owing to improvement in mill shipments. No shortage of lime in this district. Dealers' stocks able to take care of steady lumber demand. Structural steel demand slightly in excess of supply. Supplies sufficient in other building materials.

Minneapolis—Stocks of brick, tile, lime and cement are reported ample, with no trouble in supplying demand promptly. Some shortage of low grade lumber is said to exist, a condition obtaining through much of this season, with the higher grades in good supply.

Detroit—Lime, lumber and sewer pipe stocks normal for season. Small reserves of asphalt and hollow tile. No shortage of cement; mills at high production rate. Plenty of common brick and structural steel.

Cincinnati — Scarcity of cement. Plenty of other construction materials.

New Orleans—No reserve stocks of wood paving blocks kept on hand during the last year. Made up as ordered. Stocks of Southern pine much below normal. Plenty of other building materials.

Atlanta—Plenty of brick and lumber. About seven cars of steel structurals; sixty, of lime and seventy-five each of cement and asphalt, on sidings. Sewer pipe and hollow tile deliveries take from four to five days.

New York—Brick scarcity continues, although volume of new business has been considerably reduced. Brickyards, in districts supplying this market, running at full capacity with heavy orders on books. Small reserves of any building materials kept within the city, owing to limited space. Shortage of finishing lime; plenty of common. Small warehouse stocks of steel.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Cement, Atlanta, about seventy-five cars); time required for delivery M carload lots from mill of "alongside dock," example: (Lumber, New York, four weeks); and stocks on hand in general terms, example: (Brick, Cincinnati, ample.)

	San Francisco	Los Angeles	Minneapolis	Detroit	Cincinnati	New Orleans	Atlanta	New York
Sewer pipe	Plenty	Enough to fill requirements	Demand met promptly	Stocks normal	Plenty	Abundance	Del. take 4 to 5 days	Small reserve in city
Cement	Stocks low	Situation improved in month	Ample	No shortage; mills active	Scarcity	Dealers' stocks large; demand ebbing	About 75 cars	Stocks in city small; mill del. prompt
Lime	Fairly well supplied	No shortage	Plenty	Supply normal	Sufficient	Plenty	About 60 cars	Shortage of finishing lime; plenty common
Common brick	Stocks in good condition	Supply sufficient	Sufficient	Plenty in local yards	Ample	Enough to fill requirements	Plenty	Scarcity
Hollow tile	Plenty	Requirements being met	Enough	Small reserve; del. take several days	Enough	Ample for "off season"	Del. take 4 to 5 days	Shipments keeping up with demand
Lumber	Heavily stocked	Dealers' stocks heavy	Higher grades in good supply	Yard stocks large	Well stocked	Below normal	Plenty	Del. improved; take 4 weeks from mill
Asphalt	Large native reserves	Well supplied	Ample	Small reserve	Plenty	No market	About 75 cars	Heavy reserves in New Jersey
Structural steel	Bar stocks large; structurals fair; low on rivets	Supply trifle under demand	....		Slackening in demand; plenty in warehouses	......	Between 5 and 7 cars	Warehouse stocks not large

Construction Equipment Exported

According to figures given out by the Department of Commerce, the following exports of construction equipment, from the United States, occurred during the month of May: 95 concrete mixers costing $74,530; 747,015 lb. of other construction and road-making equipment, valued at $85,348; 452,991 lb. of construction equipment not classified, valued at $97,190; 50 conveyors of the bucket, chain or belt type, valued at $49,850; 11 steam shovels valued at $133,677; 59,508 lb. of dredging machinery, valued at $11,174; 19 cranes, valued at $77,174; 744 hoists and derricks (except mining), valued at $68,865.

Japan was the biggest importer of concrete mixers, taking 53 valued at $32,145; the provinces of Quebec and Ontario, Canada, came next with 20 mixers, at $14,819. These two Canadian provinces also brought miscellaneous road-making and construction equipment valued at about $61,000, in addition to 5 steam shovels valued at $47,000. Other steam shovel exports included one each to Poland, Cuba, Belgian Kongo, British South Africa and two to Algeria and Tunis. Four cranes costing $24,000 were shipped to Canada and two, valued at $17,000, to Colombia. Japan took about $14,000 worth of hoists and derricks during May.

Bids Wanted On Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 75 to 87, are the following:

Double track steel bridge, Jacksonville, Fla., for Florida East Coast Ry. Co., $1,800,000.

Hotel, Coney Island, N. Y., for Sea Gate Hotel & Bath Corp., New York, $1,000,000.

Hospital, Brooklyn, N. Y., for Bikur-Cholin Hospital, $1,000,000.

Slump in Brick Orders

The slump in building is apparent in the report of the Common Brick Manufacturers Association published Aug. 1 (information as of July 1). Gross orders on books June 1 amounts to 403,691,000 brick as against 395,447,000 July 1. Production of new brick in June was 128,942,000 and shipments were 116,761,000.

The falling off in new business, the report states, is most apparent in some of the centers that have been the busiest during preceding months. In New York, Cleveland, Detroit, Chicago, and even in Southern California districts, manufacturers, while well stocked with old orders and running at full capacity, have reported that the volume of new business has been considerably reduced. The condition is generally viewed by the manufacturers as seasonal and while all admit that is is possible that the last six months of 1923 will not pile up a volume in new construction equal to the first six months, this still will be a banner year.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the the issue of Aug. 2; the next, on Sept. 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	—$4 00	$4 20	$3 40	$3.55	$4.20	$3.60	$4.10	$4.25
Structural rivets, 100 lb.	4.40	—4 75	4 90	3 75	4 25	5.40	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	—4.00	3.80	3.20	3.45	3.85	+3.65	4.10	4.00
Steel pipe, black, 2½ to 6 in. lap, discount	44%	52%	45%	47%	53–5%	36%	+33.2@42.2%	40%	+47.43
Cast-iron pipe, 6 in. and over, ton	62.30	—54 00	63.00	60.20	60.50	69.00	62.00	70.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.70@2.80	2.85	2.25	2.20	2.50	2.84	2.63	2.90	2.25
Gravel, ¾ in., cu.yd.	—1.75	1 90	+2.38	2.00	+1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	—1.87	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	+2.83	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	63.00	40.00	52.25	—56.50	—42.50@43.75	—42.75	41.00	—28.00	70.00
Lime, finishing, hydrated, ton	18.20	—22.50	22.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	2.35	1 50	1.50	2.70	2.10	2.80	10.00
Common brick, delivered, 1,000	24.60@25.70	—12 00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	— 102	.115	.0724	.0816	.065	. . .	.11	.115
Hollow partition tile 4x12x12, per block	.1573	—.102	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	—1.05	1.10	—1.19	—1 14	—1.13	—1.25	—1 19	.86	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	—.50@.55	.35@.50	.50	.50@.62½	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93⅜c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.78). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in., $119.

Changes Since Last Week

The general downward trend in prices, particularly of raw materials, reflects the policy of restricted buying which has characterized the market during the last three months.

Lumber and linseed oil lead the decline for the current week; the former reacting to the decrease in demand, and the latter to changes in the flaxseed market. Yellow pine timbers declined $2 per M. ft. in Chicago; Douglas fir dropped $1 in Seattle and Minneapolis. Denver also reports a severe drop in fir timbers during the last two weeks. Raw linseed oil declined 3c. in New York and Minneapolis; 4c. in San Francisco and 5c. per gal in Dallas and Denver.

Atlanta reports declines in structural steel, cast-iron pipe, finishing lime, common brick and hollow tile. Dallas reports adjustments in sand and gravel prices and a rise in crushed stone, due to higher labor and freight rates. Minneapolis also quotes an advance in ¾-in. gravel, while New York shows a downward trend. Reinforcing bars and steel pipe went up in San Francisco during week.

The iron and steel situation may be briefly outlined as follows: Pig-iron market stronger in several producing centers; inquiries show improvement. Increased activity in steel plate demand. Tank and car construction, as usual taking bulk of output. Plates and structurals holding firmly at $2.50 per 100 lb., Pittsburgh. Demand largely for immediate shipments; some makers demanding above $2.50 for quick deliveries. Improvement in general tone of finished steel market.

The General Contractors' Association of New Orleans is still holding out against the carpenters' unions. About 90 per cent of the vacancies have been filled by strike breakers and no wage concessions are expected from the contractors.

Freight rates on all clay products shipped by rail from various points in the Mississippi valley to New Orleans, will be increased from 2 to 5 per cent per 100-lb., effective Aug. 15.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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Real Wages Rising

STATISTICS too often emphasize the average man—who doesn't exist. A low death rate is no comfort to the man who dies; the average income of all the workers in the country does not provide necessities for the group who fall below it. At the same time, such average statistics are the only means for measuring conditions and they are so used. It is interesting, therefore, to find that the National Industrial Conference Board has found that though the cost of living is still high the American wage earner is better off today than during the peak wage period of 1920. Balancing the cost of living against average wages—using 600,000 specific workers—the board finds that the comparative excess of wages over living costs was 18 per cent greater in May, 1923, than in June, 1920. In other words the workman can get more for his daily labor than he could when wages were highest. Specific demands for higher wages will, of course, have to be answered by specific studies of similar nature but the general fact reported here deserves wide appreciation.

Power Act Interpretation Delayed

AS A RESULT of a conference with the Federal Power Commission the Governor's committee of New York officials have advised Governor Smith not to press New York's suit contesting the constitutionality of the Federal Water Power Act. In so doing the committee sets up for its own demolishment a straw man of federal usurpation when it says that the commission has been prevailed upon to relinquish the federal government's "proprietary right to share in profits" from power on the border rivers. So far as its record goes, the Federal Power Commission has never claimed such rights. Certainly the power act does not confer them; it merely gives the government the right to say who shall use such waters and to see to it that they are not used to the detriment of navigation or to the continuing rights of the people to get reasonable benefits from the flowing water. The federal law hinges on co-operation between state and nation and the people of the state are deprived of no rights under it. There are, however, some questions as to the extent to which the nation may stretch the interstate commerce clause of the constitution to cover power development and these questions can best be settled by Supreme Court ruling. Until New York or some other state chooses to pursue to a finality an attack on the law its full interpretation will not be assured.

For Safety of Contract Records

EVERY so often there comes a report of a fire which either destroys or seriously threatens necessary records. The latest comes from the Borough of Queens, New York City, where last week a midnight fire in a blueprint department came near destroying the records which control about $3,000,000 worth of construction contracts in highway and sewer work in the borough. Such happenings need to be brought to the attention of every one responsible for public work. Not only should duplicate records of every transaction be kept in separate places, but every effort should be made to insure properly fire safe repositories for such records. Building fireproof halls of records after fires have destroyed all previous records comes in the category of locking stable doors after the horse is stolen.

Tarred With the Same Brush

IN THE summer the mills of justice grind slowly; that is the reason little has been heard lately of the government suits and indictments against those who built the cantonments in the early days of the war. In the suits for recovery against the contractors, however, several district court judges have ordered the government to bring a bill of particulars detailing the wastes, which the government charges amounted to from four to seven million dollars at the various camps. Two such bills of particulars recently returned by the Department of Justice are significant, first, because in each the government admits its inability to itemize the wastes which it quite readily totals at seven million dollars and, second, because the detailed wastes, covering several pages of typed manuscript, are identical in the two bills, though one is for a camp in Virginia and the other in South Carolina. This blanketing of a number of different and unrelated men with a common crime is characteristic of the whole procedure of the Department of Justice in the cantonment cases and casts doubt both on the sincerity behind the action and the validity of the cases themselves.

Publicity for Motor Accidents

WHETHER with conscious intent or merely by excellent journalistic instinct a number of metropolitan newspapers have lately taken to grouping each day the increasing grist of automobile accidents. This is one of the best steps toward traffic safety that can be devised. Many motor accidents are unavoidable; they are the inevitable result of our growing traffic congestion. Too many, on the other hand, are due to carelessness, or worse still to an overweening confidence in one's own immunity from accident. Carelessness is an individual and not universal trait, but the assumption that the individual can get away with what spells disaster for others seems to be inherent in the driving of automobiles. Laws and regulations can do little to correct this evil. The best corrective is an accident, but that is somewhat too severe a remedy. The next best thing is continually emphasizing the occurrence of accidents and there are few better ways of doing that than the repetition of grouped accidents in the daily press. Sooner or later this will begin to tell and it will penetrate the consciousness of every automobile driver, provided he or she can read, that crossing occupied rail-

way tracks, passing street cars or other automobiles, speeding around curves and other common but foolhardy driving stunts are more than ordinarily hazardous performances. Perhaps every driver will become as foresighted as that one whose passenger said when they were approaching a railway track that he was afraid the train would beat them to the crossing. " That's all right," said the driver, "What I'm afraid of is a tie."

Snow Removal and Road Damages

SYSTEMATIC study of damages to paved roads from snowfall and removal of snow has not proceeded far. Observation indicates, however, that the effects of snow are more varied and their causes more complex than first assumptions would indicate. There is more for consideration than normal frost action. Frost damages are not novelties to highway engineers but there have come about conditions modifying frost action which are in a measure new. Year-around traffic, heavy loads and snow removal, which formerly did not have to be considered, are now common conditions. Altogether there is before highway engineers a largely new problem of road maintenance as affected by snowfall.

Any conclusions which can at the moment be drawn of the possible damaging effect on paved roads of snowfall and snow removal are necessarily indefinite, if not wholly speculative. Winter damage is evident whether we consider the records of Massachusetts and Connecticut or those of Wisconsin and Minnesota. It is evident too that heavy truck traffic has increased the destruction of road surfaces affected by frost. Again the injuries are different when the road is kept clear of snow and when it is left untouched or is only partially cleared. This is about as far as one can arrive at present. Even this slim array of conclusions, however, indicates a situation which is worth investigation.

Winter freight haulage by motor truck and winter passenger transportation by motor bus must be accepted as certainties. They will moreover extend far beyond thickly populated regions though naturally they will be most intensive where cities and towns abound and industry is intensive. There are today active bus lines in the mining regions of northern Minnesota and Michigan and all through the rural regions of the Middle and Far West as well as in Connecticut and Massachusetts. They are maintaing regular winter schedules. Truck transportation is equally as general, where paved roads exist, though it is customarily less regular.

Where this winter traffic prevails the road will be cleared of snow to provide for its movement. If the clearing is not done by state or county maintenance departments it will be done by the carriers themselves. Indeed carriers generally are doing it. The bus transportation companies today in every state in the North have better organizations for fighting snow and more costly and powerful units of equipment for snow removal, within the fields of their activities, than have most public roads maintenance departments.

Snow removal means different things in different instances. It means completely cleaning the full width of the pavement and also cleaning a path along the center of the paved surface and again only the removal of depth enough to allow traffic to get through. If carriers do the clearing they will, unless they are controlled, carry removal only far enough to serve their purposes. If a single-track path is enough for their purposes this is all they will keep open. If they can maintain schedules with a mat of snow and ice covering the pavement they will not remove this mat. The significance of these facts is, quite certainly, that different damages to road surfaces may be expected according to the practice of snow removal.

If only a single track path in the middle of the road is kept clear, observation indicates that two things happen, (1) Vehicles follow the same tracks and wear is concentrated in ruts and (2) the subgrade under the exposed center zone freezes differently than under the pavement flanks and on the road shoulders which are covered with piles of snow. The second condition is emphasized when there is a heavy fall of snow before the ground is frozen deeply as was the case in some of the New England states last winter. The result is a deep frost crust under the middle of the pavement and shallower frost crusts under the sides and when the frost goes out in the spring the pavement is hung up on a center ridge and under heavy traffic breaks down at the sides and cracks along the crown. If all the snow is not removed down to the pavement, whether it is cleaned full width or not, the covering mat becomes rutted down to the pavement and it is worn in grooves.

These then are some of the indications of the bearing which snow removal may have on damages tc paved roads carrying heavy traffic in winter. It is obvious that they are far from exhausting the possibilities. They are, however, enough to demonstrate that a study of road damages from snowfall and removal of snow is a profitable undertaking for highway engineers. Indeed the coming winter, it is hoped, should see it carried well forward. Until the effects of snow removal on damages to paved roads are learned, correct practices of removing snow cannot be established, and they are important if commercial truck and bus lines are to continue their present snow-cleaning operations.

Sewage-Works Progress at Indianapolis

INDIANAPOLIS is contributing materially to the development of sewage-works practice by the 50-m.g.d. plant described elsewhere in this issue. In point of size the plant will be several times the largest in the world when it goes into operation, although soon afterwards it will be surpassed in capacity by the Milwaukee plant and still later by Chicago's large projected plant.

At Indianapolis, Mr. Hurd states, a variety of local conditions favored the activated-sludge process. Some of these made a considerable degree of pre-treatment of the sewage seem desirable before activation. This led to the adoption of the interesting revolving barrel screens, sedimentation tanks, and sludge concentrators which are features of the Indianapolis plant. Sewage-works engineers will await the results of this pre-treatment in order to see whether it may be advantageous elsewhere to lighten the burden on the activated-sludge plant. The working of this type of screens, too, is a matter of wide general interest, for present indications are that fine screening will come into much more extended use than formerly, either where it alone is sufficient for a time or where lessening the load on some more thorough process of treatment is considered advisable. Adherence to compressed air instead of adopting mechanical agitation for activation, although the latter was tested at Indianapolis, is in line with American practice, but it is significant to note that

the filtros plates are set at one side instead of all the way across the bottom of each channel of the aeration tanks, thus giving a spiral motion to the air and sewage.

Dehydration, at Indianapolis and elsewhere, seems to be the subject on which further light is most needed. This need is greater with activated than with other types of sludge, partly because of the peculiar character of this sludge, but largely because the hoped-for end is the production of a commercial fertilizer base, of unusual promise because of the high nitrogen content of the activated sludge. Unlike Milwaukee, Indianapolis will not make use of acid conditioning in its sludge dehydration process—another example of divergence in practice due to local conditions and perhaps somewhat to variations in personal judgment.

Altogether, the Indianapolis plant, both in itself and as a contribution to the development of sewage treatment in general and of the activated sludge process in particular is most commendable.

Engineers for Bridges

FOR an engineer to argue the superiority of the engineer over the architect as a builder of bridges is most difficult. Called upon to do so he feels just as a doctor would who had to defend his profession's right to tend the sick or as would a mathematician when confronted with the statement that two and two make five. It is one of those obvious things that ought never to be questioned. And yet every so often it is questioned and in such a way that engineers in person and in groups are required to restate the obvious. Such an occasion has now arisen in Pittsburgh.

Through a combination of circumstances the county commissioners there are now being importuned to turn over to architects the control of three new and large bridges required by federal order. The circumstances include a doubtless well meaning but misdirected campaign on the part of an eminent Pittsburgh artist to insure, by architectural control, the proper artistic co-ordination of the three bridges with the future development of the city and the efforts of the local chapter of the American Institute of Architects to capitalize this campaign to the advantage of their own profession. In so doing they have repudiated the report of one of their own committees, which collaborating with a local engineering committee recommended a workable scheme for engineering control of the bridges with proper architectural advice, and have gone so far as to submit to the commissioners a list of architects who would be willing to undertake the design and construction of these bridges at a 6 per cent fee. It is possibly only incidental that this list consists not of a selection of architects necessarily qualified for the work, but of those architects who have offered their services for it.

The movement in Pittsburgh to develop the new bridges as commanding elements in the general picture of the city will meet hearty welcome on the part of all engineers. Too frequently in the past the prevailing attitude, forced more generally than not upon the engineer by the public bodies in charge of bridges, has been that whatever would do for the moment's needs at lowest cost was the proper bridge to build. The result was the erection in too many cases of impoverished structures having short life and subject to rapid obsolescence and depreciation. No one knows this better than the engineer. No one realizes better the impoverished art which results from such lowered standards of design. Fortunately, however, the engineering profession is so concerned with safety in structures that in most cases it has been able to resist the low ideal of cheapness and to insist that every bridge shall be the most perfect adaptation of materials to the needs of the type and the service.

Those who are urging the architect's predominance in bridge design, however, seem to consider that safety is something which can be readily obtained by employed experts and that the crowning necessity of a bridge is that it shall be beautiful. The engineer's answer to that is first, that it is essentially vicious that the safety of the public should be made subordinate to the esthetic sense and second, that true beauty results from the proper adaptation of the material to the service and that the engineer who must be responsible for that adaptation can better insure that beauty than can the one whose primary desire is to attain it.

Further than that, the issue is a practical one, for the engineer can point to the many bridge structures which adorn our waterways and cities which achieve true beauty by true adaptation of the material to the service. He is sometimes astonished at the calm assumption frequently made that everything that the engineer builds is inherently ugly and everything that the architect builds is inherently beautiful. So general a rule cannot be demonstrated. The streets of our cities, for whose adornment the architect is solely responsible, are its refutation. One recalls, for instance, the horrible example of the almost interlocking Singer Building and City Investment Building on lower Broadway, New York, built some fifteen years ago by two of the leading architects of their time, built simultaneously, each with the knowledge that the other was being built and yet designed with apparent studied effort for discord between the two in line and tone. Taking the country over it is to be questioned whether the buildings erected by our greatest architects are more beautiful, more adapted to their purpose and to their location, than are the bridges built by our greatest engineers. There are many ugly bridges. There are, on the other hand, many ugly buildings. Appropriateness of a bridge design is a matter of the individual and not of the profession. The question of its safety is distinctly a question of the profession which has it in charge.

It should be farthest from any engineer's efforts to dissociate the competent architect from the design of a bridge. Nor should that association be confined merely to superficial decoration, for in that direction lies the greatest artistic danger. The fact remains that the safety of the bridge should be the prime consideration and for that safety the engineer alone should be responsible, which means that he should have primary control. Having that control he may have to work with him in almost co-ordinate responsibility for outline and general appearance an architect trained in the niceties of adaptation of line and tone. Such collaboration is by no means uncommon, and the resulting structures have been most successful. It can be worked out in Pittsburgh, if the County Commissioners are not stampeded into unwise action by an exaggerated conception of the architect's ability and functions and an insufficient appreciation of the importance of safety in public structures.

Concrete Caissons Sunk in Place for Wharf and Seawall

Seawall for China Basin Terminal on San Francisco Bay Consists of Caissons 57 Ft. Deep Connected by Concrete Arches Placed in Precast Sections

By Frank G. White
Chief Engineer, California Board of State Harbor Commissioners

THE CHINA BASIN terminal, which is under construction on the San Francisco waterfront by the Board of City Harbor Commissioners, consists of a combined transit shed and warehouse located on submerged land about one mile south of the Ferry Building. The terminal building will be 812 ft. long and six stories high, supported on a pile foundation which is protected by a concrete seawall. The seawall consists essentially of a series of precast reinforced-concrete caissons set as piers and between which the openings are closed by curved curtain walls. The caissons, which extend to a depth of 57 ft. below the deck of the wharf, were cast in a nearby yard, floated to place and sunk to footings prepared under the inspection of a diver. Outside this seawall dredging is to be carried to a depth of 36 ft. below mean lower low tide.

FIG. 1—LAUNCHING CAISSONS FROM CASTING YARD
Caissons were started down the ways by block and tackle from a hoisting engine. Note temporary concrete bulkhead just inside bottom, which was broken out after caissons were placed.

The terminal is located on the northerly side of a small indentation of the shore line known as China Basin, with a hard bottom of cemented sand and clay at a depth of 22 to 40 ft. below mean lower low tide. Overlying this hard bottom is a blanket of soft mud from 12 to 25 ft. in thickness and from borings and soundings it was decided that piles could be driven from 12 to 25 ft. into the sand and clay substrata. In order to add to the stability of the foundation, before any piles were driven, this mud was dredged out and replaced with clean sand. The dredging was done by the commission's own equipment, using a $3\frac{1}{2}$-cu.yd. clamshell bucket dredge and 250-cu.yd. bottom-dump scows.

The caissons, 40 in number, were cast on the side on wooden launching cradles, the casting yard being laid out to accommodate 20 caissons at a time. The cradles were supported on skidways, along which they were moved by hoisting engines to a position in front of the launching ways which were located at one corner of the yard. The caissons were built with three compartments, the outside walls being 7 in. thick and the partitions 6 in. in thickness.

The concrete mix consisted of 1 part of cement to 5 parts of graded aggregate. Concreting was done in two operations; the sides upon which the caissons rested were first poured and after these had set up the inside and outside forms were installed, the remainder of the reinforcing was placed, and the sides, partitions and top were poured. Special care was taken in preparing the contact surfaces and no difficulty was experienced in making watertight joints. The lower ends of the caissons were closed by reinforced-concrete bulkheads in which the reinforcing bars did not project into the side walls or partitions. The upper ends were closed by wooden bulkheads bolted to position from the outside and made tight by asphalt joints.

The concrete in the caissons was allowed to set for at least 28 days before they were launched. After launching they were towed to the site and set in holes excavated to depths of 6 to 18 ft. in the hardpan. In excavating these holes the contractor used cartridges made up of sections of old boiler tubing, 3 to 5 ft. in length. After being loaded each cartridge was wedged into a hole in the bottom of a heavy steel spud which was dropped through the water driving the charge into the hard bottom. After being shot the material was removed by an orange peel bucket operated from a floating derrick. This method of loosening the bottom proved to be an inexpensive means of doing what would otherwise have been costly. The contractor was expressly forbidden, by the specifications, to follow the cheaper method of dredging a channel for the row of caissons because it was desired to gain the advantage

FIG. 2—FILLING AND SINKING CAISSON TO POSITION
At stage shown, the weight of the caisson, partly filled with water, is carried by the pile driver. Later the weight was transferred to four chain blocks on the traveler at the right.

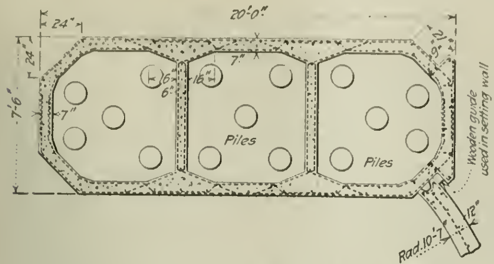


FIG. 3—PLAN OF THREE-COMPARTMENT CAISSON

of the side support that could be expected from putting the caissons in holes. The excavation was carried approximately 12 in. below grade, the holes being gaged by lowering a templet made of steel angles. A diver inspected each hole as the templet was lowered, trimmed off any irregularities or high spots, and supervised the placing of the crushed rock which was used to level up the bottom and bring it to grade.

The setting of the caissons was done by the combined use of a floating pile driver and a traveler mounted on pile falsework. The traveler was of timber supported on 18 double-flanged wheels running on three rails, the gage of the outside rails being 15 ft. This traveler was also used for placing the crushed rock in the bottoms of the holes, hoppers being constructed on top of the frame from which the rock was distributed through a jointed pipe. The caisson to be set was towed to position with the lower end toward the hole in which it was to be placed.

By pumping water into one side compartment and taking a lift with the pile driver on U-bolts set in the top in line with the opposite partition, the caisson was turned on edge. The lower end was then placed between bents of the falsework and the filling and hoisting continued until it was suspended in a vertical position. The load was then transferred to four chain blocks on the traveler by means of which the setting with the faces truly vertical and to line could be very closely controlled. When set in final position the caissons were

FIG. 5—TRAVELER SETTING CAISSONS IN FINAL POSITION
Traveler on falsework at the left carried crushed rock hoppers and also chain blocks for placing caissons. At right steam hammer is driving piles through bottoms of caisson already set.

14.5 ft. apart with the 20-ft. sides at right angles to the axis of the wall. The average weight of the caissons was approximately 150 tons, but the displacement was so accurately controlled by water ballast that they were readily placed by four 5-ton chain blocks.

The spaces between the caissons and the sides of the holes in which they were set were filled with crushed rock thoroughly tamped into place, using a heavy steel tamping bar handled by a floating derrick. Water was then admitted to the caisson. If any unequal settlement occurred jacks on timbers laid temporarily across adjacent bents lifted the lower side of the caisson by raising timbers carrying chains to the caisson U-bolts. With the jacks thus holding the caissons plumb, crushed rock was dumped and tamped around the lower side until the caisson stood plumb without the aid of jacks. When firmly bedded in final position the lower bulkheads were broken out and the concrete was thoroughly pulverized by the use of the steel chisel and tamping bar already referred to. By means of a follower a pile driver mounted on the falsework then drove fifteen piles in the bottom of each compartment, securing in all cases a penetration of 12 to 20 ft.

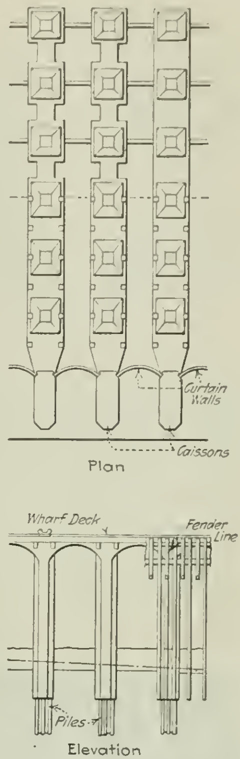


FIG. 4—PLAN AND ELEVATION OF FOUNDATION AND SEAWALL

The caissons were sealed by depositing about 10 ft. of tremie concrete around and over the heads of the fifteen piles, which were left projecting approximately 8 ft. into the bottom. The tremie rig was equipped with a tower and hoisting engine for handling the 18-in. pipe and with three concrete hoppers, each of sufficient capacity to permit of filling a compartment to the required depth with one charge. After this concrete had set, the caissons were unwatered, the laitance and separated materials, having a thickness of 1 to 2 ft., were removed and the pouring of concrete used to fill the caissons was completed. The concrete used in the tremie work was 1:4 and in the remainder of the caisson fill, 1:9, the aggregate being proportional in both cases for maximum density.

The reinforced-concrete curtain walls closing the spaces between the caissons are arches 1 ft. in thickness. The curve is an arc of a circle and each section comprises a quadrant, i.e., has a central angle of 90 deg. Three sections of these curtain walls were used to complete the required height of 34 to 40 ft. The curtain walls were cast in a vertical position on barges, the forms being set for complete circles with partitions at the quarter points to separate the four quadrants. They were cast with tongue-and-groove horizontal joints. The arches were set with the aid of a floating pile driver, wooden guides being used to hold the curtain wall tight against the bearing surface of the caisson.

After the three sections required to make a complete

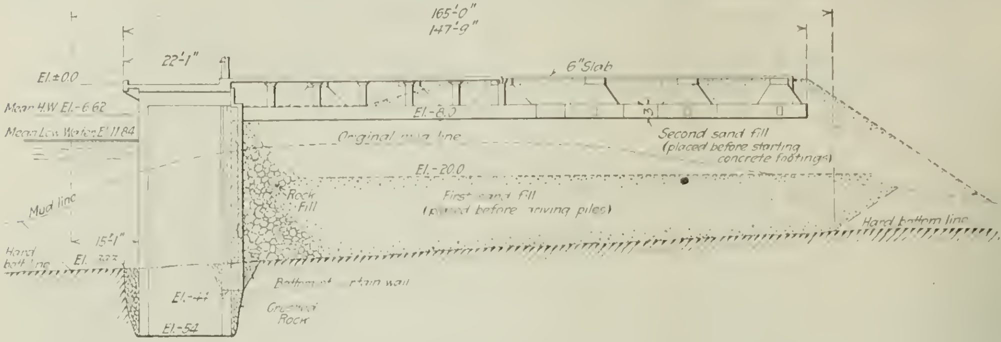


FIG. 7—TYPICAL SECTION THROUGH SEAWALL AND FOUNDATION

closure between adjacent caissons were in position, the vertical groove on either side of the curtain wall was filled with grout. To prevent the grout from escaping through the cracks along this groove, it was deposited inside a canvas bag or "stocking." When the sections of the curtain wall were all placed, a 2-in. iron pipe was lowered down the groove to make sure it was clear. The pipe was then withdrawn, the canvas "stocking" was slipped over it, and pipe and "stocking" were lowered into the groove. The upper end of the pipe was connected with a hopper containing grout, hopper and pipe being slung from hoisting tackle on the pile driver leads. When pipe and stocking had been lowered to

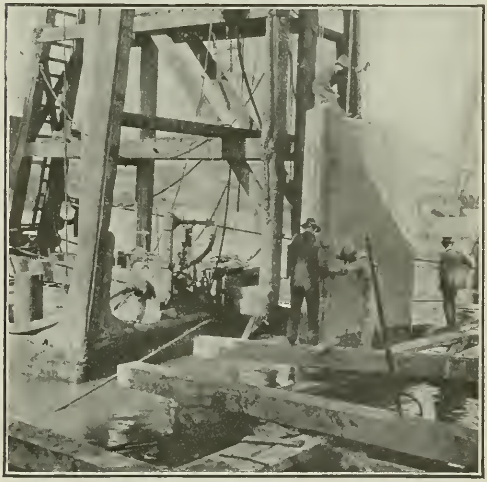


FIG. 6—LOWERING TO PLACE SECTION OF CURVED CURTAIN WALL

These sections 12 ft. long and weighing about 16 tons were delivered on barges and placed with tackle from the driver leads.

the bottom of the groove, grout was admitted to the pipe and as the stocking filled, the pipe and hopper were lifted. This proved to be a very effective means of making a tight joint between curtain and caisson. After the curtain walls were grouted a rock fill was placed against the inside face and between the caissons on the outside of the curtain wall.

The building foundation consists of concrete footing supported on clusters of piles which were driven through the sand fill and into the underlying hardpan. Combined with these footings are a series of heavy reinforced-concrete ties, 3 ft. deep and 8 ft. wide, which serve to anchor the tops of the caissons to the heads of the piles across the full width of the building. Steel tie rods were used, hooked into notches provided in the second lift of the caisson fill, and the last lift of the caisson fill was poured with the footing.

The first floor over the outer half of the building is of flat slab construction and is supported by the column footing; the remainder or inner portion of the floor is laid directly on the sand fill. The floor or deck of the wharf along the channel consists of a series of arches extending from caisson to caisson and designed to carry two railroad tracks.

Past Year Shows Increase in Federal Water-Power Permits

The Federal Power Commission closed its fiscal year on June 30 with a total of 425 applications for preliminary permits and power development licenses. One hundred and four of these were received during the past year, 51 of which were applications for preliminary permits for investigatory purposes. The remaining 53 were for licenses covering construction, and included 17 major projects, 13 projects of less than 100 hp., and 23 transmission lines. During the three years of its existence the commission has authorized a total of 97 preliminary permits and 105 licenses. Of the 42 major projects included in these licenses, all but eight are either constructed or under construction, and all but three or four will go ahead within the time limit of the license. With respect to the preliminary permits, however, the progress has not been so marked. Only five of the 97 issued have been followed up with applications for licenses, twelve have been cancelled, and the others have been extended to the full time limit of three years. This time limit will expire on several important projects next March. Among them is the White River project of the Dixie Power Co. in Arkansas, the 350,000-hp. development of the Washington Irrigation & Development Co. at Priest Rapids on the Colorado River, and the proposed Niagara Gorge development of the Lower Niagara River Power & Water Supply Co., a subsidiary of the Niagara, Lockport & Ontario Co. This latter development is being held up at present by the failure of the State of New York to grant the company the necessary permit.

Variations in Floor Load Requirements of Building Laws

IN THE STUDY of building law requirements now in progress by a committee of the U. S. Department of Commerce, the wide variation in ordinance requirements as to the loads for which floors must be designed has had special attention. The committee has also endeavored to collect such scanty data as exist concerning actual loads which occur or may be expected in different classes of occupancy, and in this connection brought about the conduct of a special set of load weighings in the Equitable Building as reported in *Engineering News-Record* of March 29, p. 584. Its work requires much further collection of data on actual loads, however, and the committee is anxious to enlist the co-operation of technical organizations and individuals throughout the country in obtaining such data. To exhibit the unsatisfactory present conditions the committee has compiled a table of the floor loads specified for building design by 109 city building laws. A summary of the table is reproduced herewith.

MINIMUM FLOOR LOAD REQUIREMENTS IN 109 CITY BUILDING LAWS

Occupancy	Number	Aver. Load	Minimum Load in Pounds per Square Foot																																	
			20	25	30	35	40	50	60	62.5	65	70	75	80	85	90	100	105	108	110	112.5	115	120	125	130	140	145	150	160	175	180	200	250	300	350	500
Dwellings: 1st floor	107	52.2		1	2		28	31	38			3	1	2			1																			
above	103	49.7		1	2		40	28	26			3		2			1																			
Tenements: 1st floor	10	55.8			1	1	21	32	37			4	2	8		1	2																			
above	105	50.6			1	1	37	33	25			4	1	2			1																			
Stores: light, 1st floor	10	119.4												1			26						41	29				9				1				
light, above	102	115.0						1					1	1		1	34						39	18				6				1				
heavy, 1st floor	98	162.8															12						12	6		1		31				21	11	1		
heavy, above	94	136.9														1	13						11	7		1		29		2	1	18	9	1		
Warehouses: heavy	98	184.2															8						4	1				28				39	16	1	1	
light	100	137.7															22						28	14	2			16		2		12	3	1		
Factories: heavy	97	177.0															10						8	5	1			28		1		23	20	1		
light	10	121.8															27						37	25	1			10				2	1			
Roofs: less than 20 deg.	10	39.2		6	26	1	40	27																												
more than 20 deg.	88	31.0	7	9	56		12	4																												
Assembly: moveable seats	102	110.3										1		1		14	38						22	20				6								
Halls: fixed seats	102	95.9						1	1			2	8	15		33	22						3	14				3								
drill halls	93	137.0										1				4	17		1	1			17	13				27	1	1		3	7			
dance halls	94	115.9										1				4	18		1	1			26	14				25		1		2	1			
Schools: corridors	96	92.5						1	3			7	13	11		26	18						7	7				3								
assemblies	101	99.5							1			2	12	7		26	23	3				1	7	15				4								
class rooms	96	69.9					3	10	21	1		9	41	3		5	1							1				1								
Office buildings: first floor	101	114.0					1	3	1			3		8		2	30						12	14				27								
above	106	69.7					4	14	22			6	49	3		2	4											2								
Public buildings	80	105.8					1					1	3	1		9	37				2		6	14				5								
Garages: public	90	126.6						1					2	5	1		24						8	11	1		1	30		2		3	1			
private	80	73.9			1		3	4	5		2		24	7	1		18						8	3				1				2				
Hotels: rooms	104	57.3			1	1	15	30	40		1	4	7	1		1	2											1								
corridors	88	87.7					5	3	8			5	7	13		17	14						6	7				3								
Hospitals: wards	96	61.0			1		13	24	35			4	7	4		1	4						1	1				1								
corridors	84	83.6			1		5	4	10			2	4	16		20	11						5	5				1								
Side walks	63	272.0																										4				9	9	40		1

As the table shows, first floors of dwelling houses must be designed under the rules of one city for 25 lb. per square foot, under those of another for 100 lb. per square foot, and according to the most common building-law requirement for a load of 50 to 60 lb. per square foot. The loading for assembly hall floors ranges from 70 lb. to 150 lb. per square foot; that for school rooms from 40 to 150 lb. per square foot; that for public garages from 50 to 250 lb. per square foot, and that for the ward rooms of hospitals from 30 to 150 lb. per square foot.

The committee believes that such variations correspond to no essential differences of practice or of conditions in different parts of the country, and that they largely arise from actual ignorance of the loadings to be expected. The collection of loading data should, therefore, prove a preliminary toward the elimination of unnecessary and wasteful diversity of practice.

Gassing of Enginemen in Railway Tunnels

ACCIDENTS to locomotive crews in tunnels on the Union Pacific R.R., due to pollution of the air by gases from the engines, has led to an investigation by the U. S. Bureau of Mines. A report by S. P. Kinney, assistant metallurgical chemist of the bureau, states that in thirty-four out of forty trips through the tunnels carbon monoxide was found in the air: twenty-nine tests showed 0.01 to 0.20 per cent and five showed 0.21 to 0.35 per cent. In a normal running time of six minutes for 2,000-ton trains through the Aspen tunnel, 5,941 ft. long, the cab temperatures reach 114 and 111 deg. F. on the dry and wet bulb thermometers respectively, with a relative humidity of 90 per cent. The maximum temperatures recorded were 136 and 124 deg. respectively. Actual running time was ranged 4½ to 25 min.

It was found that asphyxiation due to carbon monoxide and exhaustion due to high temperature and humidity are the main causes of the accidents in these tunnels. Pocket respirators and other types of gas masks packed with soda-lime-charcoal mixtures afforded protection against smoke and sulphurous gases, and carbon-monoxide masks against all gases encountered, though there was some discomfort in wearing gas masks in an atmosphere of high temperature and humidity.

Air from the train pipe of the brake system showed no carbon monoxide and is cooler than the cab air. It is recommended that the engines carry respirators which can be attached to the train pipe, giving a supply of air sufficient for ten minutes, or thirty minutes in combination with the air-brake tanks. Deflectors on the smokestacks, which deflect the smoke and gases away from the cab, are reported to be efficient in reducing cab temperatures 20 to 30 deg. As carbon-monoxide poisoning requires special treatment, it is suggested that engine crews, signal repair men and men working in the vicinity of the tunnels should be instructed in first-aid treatment for such cases. It would be advisable to shorten the time of passage through long tunnels.

Highway Progress and Problems in the Mid-South—IV

South Carolina	North Carolina
Virginia	West Virginia
Kentucky	Tennessee
Missouri	

Seven Southern States Contemplate Road Expenditures Approaching a Billion Dollars — Automobile License Fees and Gasoline Taxes Will Provide the Money—Editorial Review Based on Studies in the Field

This is the closing article of the series. The other articles which have appeared, in "Engineering News-Record," are: Group Problems and the two Carolinas, July 26, p. 128; the two Virginias, Aug. 2, p. 168; and Kentucky and Tennessee, Aug. 9, p. 228.

Missouri

Speeding Construction

Missouri has under way one of the largest road building programs of any state in the Union. In developing its work it has laid down the principle that highway improvement is a process. Progressive construction and full-system maintenance, as practiced in other states, are included in highway improvement as a process, but in Missouri the thought is carried farther to a definite plan of popular education. "Highway development is a process" has been made virtually the official slogan of the state highway administration.

Missouri's present large road building program first assumed definite shape in 1921 when the state legislature in a special session designated the 7,630-mile state road system, and the people by popular vote authorized the sale of $60,000,000 worth of bonds for the purpose of financing the construction of these state roads.

It is a construction and maintenance task being rapidly accomplished that we have to consider at present. On April 1, 1921, there had been completed 141 miles of the roads comprising the state system, of which 7 miles were of graded earth. Stating this result in terms of the entire system there were then 1.75 per cent of the system surfaced and .094 per cent of the remaining portion of the system graded preparatory to surfacing. On April 1, 1923, there had been completed 1,448 miles of state roads, of which 775 miles were of graded earth. Again expressing these results as percentages of the whole, there are at this time 8.885 per cent of the system hard surfaced and 11 per cent of the remainder graded preparatory to surfacing.

On April 1, 1921, the rate of progress was 1.2 miles of graded earth per annum and 72 miles of surfacing per annum. On April 1, 1922, the rate for graded earth had increased to 248 miles per annum and the rate for surfacing had dropped to 60 miles per annum. On April 1, 1923, the rate of progress had reached the figure of 702 miles of graded earth per annum and 94 miles of surfaced highways per annum. Production of graded earth roads increased faster than surfaced roads.

There are at this time 429 separate road projects under way, totaling nearly $29,000,000 worth of work under contract, calling for the grading of 987 miles of earth road and for the surfacing of 1,006 miles of paved highways. The funds available for further lettings in 1923 consist of $1,632,000 of federal-aid and $4,900,000 of bond issue money. There are now 261 miles of primary roads under contract at a price of $6,306,650, averaging $24,200 per mile. There are also under contract 413 miles of secondary roads to be built out of bond issue money, aggregating a total cost of $4,199,110 or about $10,150 per mile. Bond issue projects are under way all over the state with the exception of 23 counties. There have already been established in 86 counties county-maintenance organizations headed by a county-maintenance superintendent who reports to the division maintenance engineer. Contracts are being made for maintenance work with local parties, special road districts and county courts to cover principally the dragging of roads at a price of $40 to $50 per mile per annum. The county maintenance superintendent is furnished with a Ford roadster or a Ford truck and is supplied with picks, shovels and other small tools which are on hand as part of the War Department equipment allotted to the state. Also one or two tractors are being distributed to each county for use in the maintenance of its state roads, such tractors being a part of the above mentioned War Department equipment. A further impetus to maintenance operations will be given by the new equipment for which orders have been placed. This equipment includes 106 graders of varying sizes and weights, 239 drags, 123 road plows and 219 scrapers.

Out of the necessities of the work there has grown up the organization indicated on the adjoining chart, Fig. 7. In order to relieve the executive head of the large burden of routine operations, much of the detail of the administrative work of the department has been subdivided and alloted to the following bureaus: (1) Bureau of Surveys and Plans; (2) Bureau of Bridges; (3) Bureau of Construction; (4) Bureau of Maintenance and (5) Bureau of Audits.

Each bureau is in the charge of a bureau head, who is in close contact with the chief engineer. Weekly reports by each bureau chief are made to the chief engineer. These reports are bound together and supplemented by a report of the chief engineer and then transmittd to the commission. In this manner each member of the commission is regularly informed of the operations of the department during the period between meetings of the commission.

Speed in getting a large construction program under way as described, in establishing maintenance and in creating a direction organization is the salient characteristic of the moment of road development in Missouri. With maintenance proceeding, road grade is being produced first and then surfaced road. Two types of paved road present unusual practice; one is bituminous surface on sledged stone base and one is base of 1:3:5 concrete used as a road until traffic warrants addition of the bituminous surfacing. An outstanding structural feature of Missouri road work is

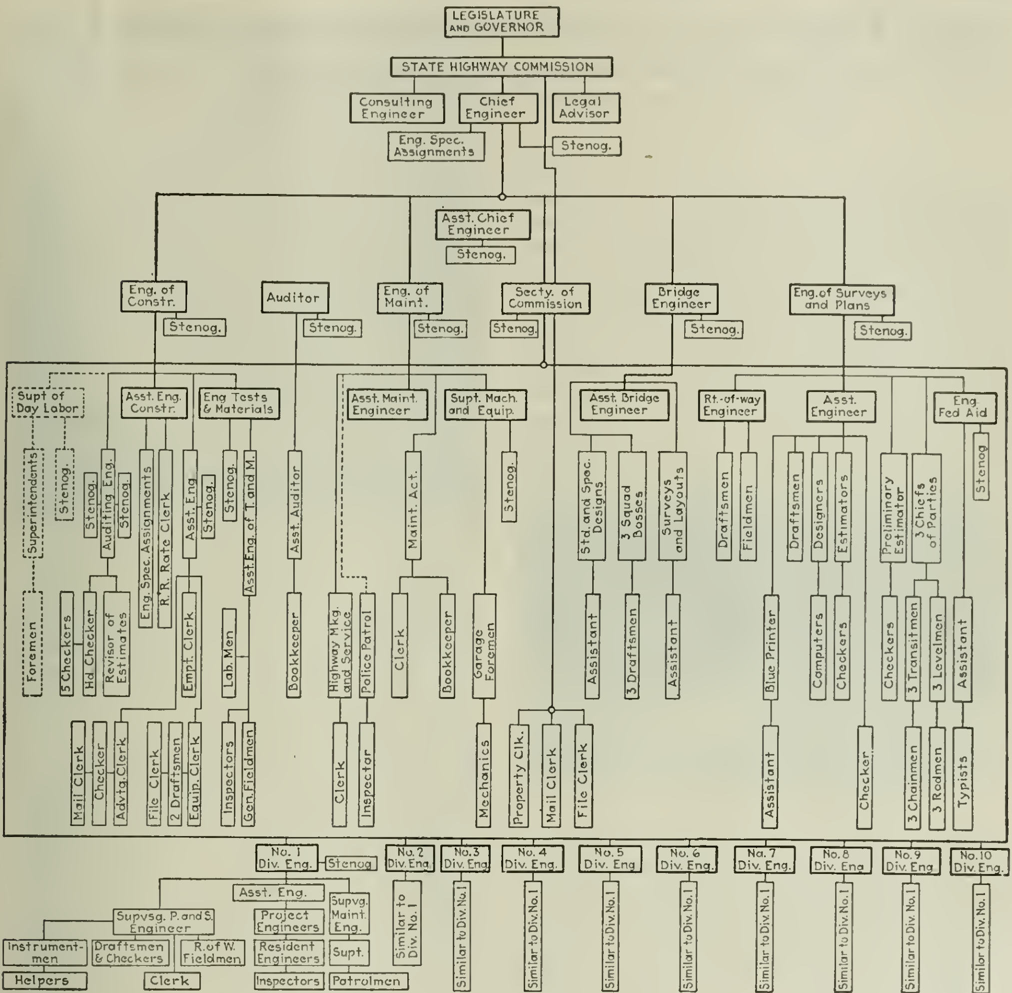


FIG. 7—MISSOURI HIGHWAY COMMISSION ORGANIZATION CHART

bridge building. Missouri is a state of many streams and notably of one great stream, the Missouri River, dividing the state into two parts. Present highway work includes no less than four Missouri River bridges, with steel structures, respectively 2,665 ft., 1,524 ft., 1,955 ft., and 3,071 ft. long, to cost $2,847,212.

Recognition of the fact that successful highway administration is in part the task of holding the faith of the people in highway improvement is the vital spark of Missouri highway department practice. There is no state of the group, that has been considered in this series of articles, in which the people are being so candidly and continuously told what is being done and why, what the fundamental processes of highway development are, what excessive speed and overloading signify and what the part of the public is in managing its great highway property. "Tell the people" is almost the cardinal commandment of the road administration decalogue.

Vermont Reorganizes Its Government

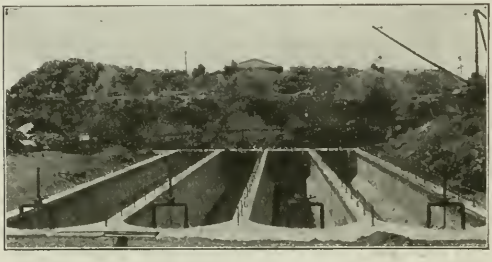
The administrative departments of the State of Vermont have been consolidated so as to replace over twenty boards, commissions, officers and agencies by seven departments. Of these the departments of highways, public service, public health, and education are placed under small boards, while the finance, public welfare, and agricultural departments have a single head. The Department of Public Service includes utility regulation, weights and measures, regulation of labor disputes, and the general regulation of the industries of the state. The Department of Finance has charge of budget making, banking and insurance, taxation, accounting and purchasing. All the department heads and commission members are appointed by the governor. The tenure of office for the single commissioners is the same as that of the governor, but the terms of members of the boards, in the four departments named, expired at different times.

Design Features of the Indianapolis Activated-Sludge Plant

Circulating Aeration Effected by Deflecting Baffles Giving 6-Mile Travel at Rate of 2 Ft. per Second—Rapid Removal of Sludge in Deep Tanks with Settling Cones Near Inlets

By Charles H. Hurd
Consulting Engineer, Sanitary District of Indianapolis, Ind.

SEWAGE treatment at Indianapolis will be a combined system of partial clarification by fine screens and rapid settling followed by an activated-sludge process. The primary treatment portion of the plant was described in *Engineering News-Record,* March 23, 1922, p. 484. This article deals with the activated-sludge plant and the bearing which the experiments at the testing station of the last year have had on the design. In general it has been found that the rapid and early removal of suspended organic solids is a large factor in the aeration process and that a circulating aeration induced and speeded up by proper baffling gives better results and at greatly reduced cost than the conventional types of air plate distribution. Deep sludge settling tanks with the cones placed close to the inlets are preferred. Present methods of sludge dehydration procedure leave so much to be desired that final designs and choice of apparatus will be fully developed under actual working conditions.



CONCENTRATE THICKENER TANKS FOR CONTINUOUS SLUDGE REMOVAL

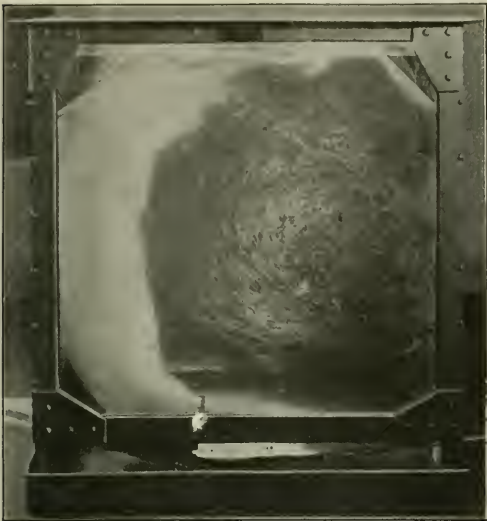
The sludge removal mechanism consists of chain-driven flights which scrape the sludge toward concentration cones at the inlet ends. The framework to support the upper returning flights will be placed near the top of sloping sides in the recesses shown.

From sewer gagings it has been estimated that the average dry-weather flow for the Sanitary District of Indianapolis will be 50 m.g.d. for 1930, 64 in 1940 and 72 m.g.d. in 1950, with maximum day flows at rates of 75, 96 and 108 m.g.d. respectively. In the plant design, all structures which are placed below ground and which cannot be easily extended or expanded are constructed for the calculated 1950 condition; all structures which may be more readily extended or expanded, and in which there would not be considerable economic loss due to expansion, are built for the assumed capacities for the 1930 condition.

Rapid Sedimentation Tanks—As was described in the article mentioned, the concentrate thickener tanks perform a most important function. Briefly, these tanks are four in number, 15 ft. wide, 120 ft. long and 12 ft. deep. They are constructed with sloping sides at the bottom and provided with sludge removal mechanism and concentration cones at the inlet end. In operation, the heavy sewage containing the suspended solids, which have been retained by the fine screen filters, flows by gravity directly to the inlet of the tanks. In this operation it is important not to break up the individual masses or to separate the adhered colloids from the solids in suspension. The four tanks have a volumetric capacity of 500,000 gal. and when operating at a rate equal to 30 per cent of the total flow to the screens (equivalent to 15 m.g.d. for the 1930 conditions) will have a subsidence period of 48 minutes. The velocity of flow through the tanks corresponding to this rate is 2.5 ft. per minute. The sludge removal flights operate at a velocity of from 5 to 7.5 ft. per minute. The returning flights which pass through the sewage about 3 ft. from the bottom, move in the same direction as the sewage flow. In the preliminary design, it was considered advisable to operate the flights at the same velocity as the flow of sewage. Subsequent tests, however, have proved this to be unnecessary. The high efficiency of these tanks is undoubtedly due to the freshness of the sewage treated and the means of conducting the sewage through the screen channels and connecting conduits without agitation. The high rate can be accounted for by the absolute control and the uniform and continuous flow from one end of the tank to the other. This complete displacement prevents counter or conventional currents resulting from short circuiting or changes of temperature. Two 3-hp. motors are provided for operating the four tanks.

Activated-Sludge Development—Experience has shown that in the activated-sludge process the rate of treatment depends largely on the freshness of the sewage and the total organic solids contained. With Indianapolis sewage the aeration rate is governed largely by the removal of organic solids in the thickener tanks. During the year 1922 experiments were continued at the demonstration plant to determine the most economical operating rate as well as the quantity of air necessary to produce the required stability. Five aeration tanks were used for this purpose, all of which were 15 ft. deep. Four of these tanks were circular in plan and 12 ft. in diameter. The fifth tank was originally constructed as a section of a proposed full size unit and was 15x15 ft. in elevation and 5 ft. long.

Subsequent to tests that were made on screened and unscreened sewage and a demonstration of mechanical agitation, Tank 1 was continued as a control unit with the conventional arrangement of diffuser plates and with a total plate area 25 per cent of the tank area. Tanks 2, 3 and 4 were equipped with different systems of vertical baffling and diffuser plates, with 10 to 12 per cent diffuser area, set eccentrically in the bottom to give over-and-over circulation in the tanks. Tank 5, designated at the plant as the "circulating tank," contained six diffuser plates independently controlled and set in two rows within 30 in. of one side. Five plates were in operation during the greater part of the demonstration runs, which gave a 6.66 per cent diffuser area. Throughout these tests on the tanks above described the average rate of operation per acre was 25 m.g.d. and the use of air varied from 0.5 to 1.25 cu.ft. per gallon of sewage. The composite results of these tests



TRANSLATION OF AIR BUBBLES IN GLASS CIRCULATING TANK

Water velocity at 2 ft. per second sweeps across bottom of tank and deflects incoming air rising from air plate to the left. Baffles at corners give the rotary motion which in a large tank (of which this is a miniature transverse cross-section) would be a spiral, with the pitch determined by the detention period and the length.

indicated that a stable effluent could be obtained at the above rate of operation with an approximate use of 1 cu.ft. of air per gallon of sewage treated.

As a summary of the experimental work on aeration at the demonstration plant during the past two years and a comparison of the types of tanks used it may be stated that the most satisfactory operation was obtained by the use of the rapid circulating tank. This tank was operated in parallel with the conventional types and followed experiments on mechanical agitation. The conventional tank produced a stable effluent, but required a slightly greater quantity of air than the circulating tank to keep the sludge in suspension. The mechanically agitated tank was not consistent and dependable in operation and did not produce a good quality of sludge nor a satisfactory effluent.

Tests on Circulation — Following the comparative study of the three types or methods of aeration, extended experiments were made to determine the best and most economic system of deflecting baffles for the circulating tank. The greater number of these experiments were made with air supplied at the rate of 0.5 cu.ft. of air per gallon of sewage and the operating rate at 20 m.g. per acre. Generally speaking, the use of deflecting baffles increased in the circulating velocity almost proportionally to the area up to about one-fourth the distance across the tank. The angle and total deflector area which seemed most economical in construction and service is shown in the sectional elevation of the aeration plant. It should be noted that this method of baffling increased the circulating velocity practically 100 per cent above the velocity produced without baffles.

The preliminary design of the aeration plant provided for units with circulating channels 15 ft. wide and 15 ft. deep. While the plans were being developed more extended experiments were made by increasing the width of the circulating tank section to 20, 25 and 30 ft. The purpose of these experiments was to determine the greatest width which would be practicable (maintaining sufficient bottom velocities to prevent deposition of sludge), in order to reduce the construction costs. As shown in Table I, all of these various widths of section apparently gave sufficient bottom velocities. The 20-ft. section was adopted as most advantageous for construction.

FINE SCREEN CLARIFIERS IN PUMPING STATION

Rotary screens are revolved by vertical motor at left through a jack shaft to which any one screen of three in a set can be connected by clutch.

Aeration Tank Design—Consistent with rates established in experimental operation the present aeration plant is being constructed with an area of 2.5 acres and for an average capacity of 50 m.g.d., equivalent to 20 m.g.d. per acre. The diffuser area is 7.5 per cent of the tank area, but provision is made to increase this area to 10 per cent or more if found desirable or necessary. The plant is divided into seven units, five of which are full size and two half size. The first half tank is placed in a position and connected so that it may be used for re-aerating or re-tempering sludge. All tanks are 238 ft. long, 15 ft. deep and have a channel width of 20 ft. The full size units have four complete passes, which give a total longitudinal travel of the sewage of about 950 ft. With the baffling shown and the use of 1 cu.ft. of air per gallon, the surface

TABLE I—MEASUREMENT OF VELOCITIES IN CIRCULATING AERATION TANKS

15-Ft. Tank						30-Ft. Tank						
Air per Gallon, Cu.Ft.	Ft. from Bottom	Distance from Filtros End-Ft. 5	7.5	10	15	Air per Gallon, Cu.Ft.	Ft. from Bottom	Distance from Filtros End-Ft. 5	10	15	20	25
0.90 c.f.	7.5	....	....	0.38		0.90	7.5	0.31	0.48	0.73	0.52	0.61
	5.0	0.21	0.19	0.43	.		5.0	0.31	0.48	1.03	0.49	0.42
	2.5	0.40	0.46	0.58	.		2.5	0.28	0.38	0.85	0.88	0.90
	0.5	1.42	1.91	1.85	.		0 5	0.96	1.56	1.53	1.80	1.88
0.75	7.5	...	....	0.38		0 75	7.5	0.37	0.40	0.31	0.33	0.48
	5.0	0.21	0.37	0.47			5.0	0.31	0.35	0.31	0.50	0.88
	2.5	0.49	0.55	0.64			2.5	0.49	0.35	0.64	1.09	1.03
	0.5	1.58	1.84	1.64			0.5	0 89	1 30	1.72	1.79	1.59
0.50	7.5	....	...	0.47	..	0.50	7.5	....	....	....	....	....
	5.0	0.29	0.24	0.76	....		5.0	..	0.53	0.29	0.44	0.53
	2.5	0.47	0.53	0.85	....		2.5	0.34	0.45	0.33	0.67	0.83
	0.5	1.55	1.64	1.64	....		0.5	0.72	1.22	1.34	1.53	1.53
20-Ft. Tank						25-Ft. Tank						
0.90	7.5	0.49	....	0.29	0.49	0.90	7.5	....	...	....	1.05	....
	5.0	0.49	....	0.44	0.37		5.0	0.23	0.47	0.85	0.72	....
	2.5	0.44	....	1.07	0.94		2.5	0.37	0.61	1.57	1.03	....
	0.5	1.25	.	1.79	1.89		0.5	1.01	1.79	2.17	1.85	....
0.75	7.5	0.44	..	..	..	0.75	7.5	....	....	....	0.80	....
	5.0	0.44	.	0.34	0.46		5.0	0.31	0.31	0.53	0.94	....
	2.5	0.70		1.09	0.73		2.5	0.21	0.31	0.91	0.97	....
	0.5	1.42		1.94	1.78		0.5	1.13	1.46	1.82	1.73	....
0.50	7.5	....			..	0.50	7.5	....	....	....	0.79	....
	5.0	...	.	0.39	0.35		5.0	0.28	0.28	0.35	0.91	....
	2.5	0.67		0.91	0.76		2.5	0.31	0.37	0.85	0.85	....
	0.5	1.43		1.64	1.55		0.5	1.08	1.21	1.54	1.48	....

and bottom velocity of the tank will approximate 2 ft. per second and when operating at the rate of 20 m.g.d. per acre this will be equivalent to a spiral travel of more than six miles within the length of the tank.

The principal saving in construction of the type of aerator adopted over the usual type (with diffusers distributed over the entire bottom) is the lesser number of diffuser plates required and the elimination of a very expensive diffuser and floor system. The advantage of air circulation over such mechanical agitation as we have knowledge of is that with equal opportunity for economy due to the surface adsorption of oxygen there is an assurance of always having a sufficient quantity of entrained air to give positive oxidization throughout the sewage mass.

Construction Details—The diffuser plates in the aeration tanks are set in and above recesses cast in the floor and are inter-connected by 4-in. vitrified-glazed pipes imbedded in concrete in the 12-in. space between the individual plates. Fifty plates are operated from each air-control valve. The air is introduced in the middle of each section and by means of continuous circulation prevents the accumulation of water underneath any section of the plate area. The recesses are formed in the concrete by the use of cast-iron cores joined together by structural-steel framework to insure alignment and uniformity in settling.

TABLE II—OPERATING RESULTS OF EXPERIMENTAL ACTIVATED-SLUDGE PLANT

1922 Week Ending	Cu.Ft. Air per Gal.	Sludge Returned Per Cent	M.G. per Acre per Day	Oxygen Consumed	Oxygen Dissolved	Oxygen Demand	Suspended Solids
Aeration Unit 1—Conventional Type with 25 Per Cent Diffuser Area							
1-14......	0.93	23	25.8	32	2.4	4.	28
1-21......	1.03	27	23.1	29	2.1	3.1	20
1-28......	1.37	25	22.9	23	3.	4.	21
2-4	1.17	30	21.8	15	3.2	4.3	24
2-11......	1.30	26	23.	17	2.2	2.5	20
2-18......	1.10	22	24.4	18	4.2	4.9	23
2-25......	1.13	20	26.4	18	3.9	4.5	25
3-4	1.09	20	26.6	13	4.1	4.9	20
3-11......	1.20	20	26.2	14	3.9	4.5	21
Average...	1.15	23	24.5	20	3.2	4.	22
Aeration Unit 2—Circulating Tank with Middle Baffle and 12 Per Cent Diffuser Area.							
1-14......	0.96	21	21.1	27	3.	4.	27
1-21......	0.50	23	24 5	31	2.	4.	24
1-28......	0.67	30	16.5	20	2.6	4.3	21
2-4	0.45	31	18 2	15	3.6	5.3	23
2-11......	1.08	25	16.9	17	2.3	2.6	17
2-18......	0.62	22	24 4	18	3.5	4.2	23
2-25......	0.53	21	26 0	20	2.9	3.6	22
3-4	0.50	20	26.8	15	3.1	4.1	20
3-11......	0.66	21	25.8	14	3.4	4.3	19
Average...	0.66	23	22.2	20	2.9	3.8	22
Aeration Unit 3—Circulating Tank with Middle Baffle and 10 Per Cent Diffuser Area.							
1-14	0.41	25	25.3	31	1.6	4.3	52
1-21......	0.49	27	20.4	39	1.6	7.6	47
1-28......	1.25	35	13.7	21	2.7	4.	19
2-4	0.81	25	21.1	19	2.7	...	24
2-18......	0.41	22	23.8	20	3.	8.1	25
2-25......	0.68	21	26.2	19	2.8	3.7	23
3-4	0.72	20	26.8	14	4.	5.	21
3-11......	0.59	20	26.2	14	2.6	3.3	20
Average...	0.66	24	22.9	22	2.6	5.2	29

All tanks operating on screened sewage.

In the construction of baffle and dividing walls in and between the tanks an attempt has been made to take care of expansion and contraction entirely by use of temperature steel. These walls are designed as vertical cantilevers and are horizontally reinforced for temperature with percentages averaging 0.5 per cent of the sectional area and distributed from 1 per cent in the thin sections at the top to 0.25 per cent in the heavy sections at the bottom. Copper expansion joints of special construction are located in the influent and effluent channels. The maximum length of continuous wall in an east and west direction is 200 feet.

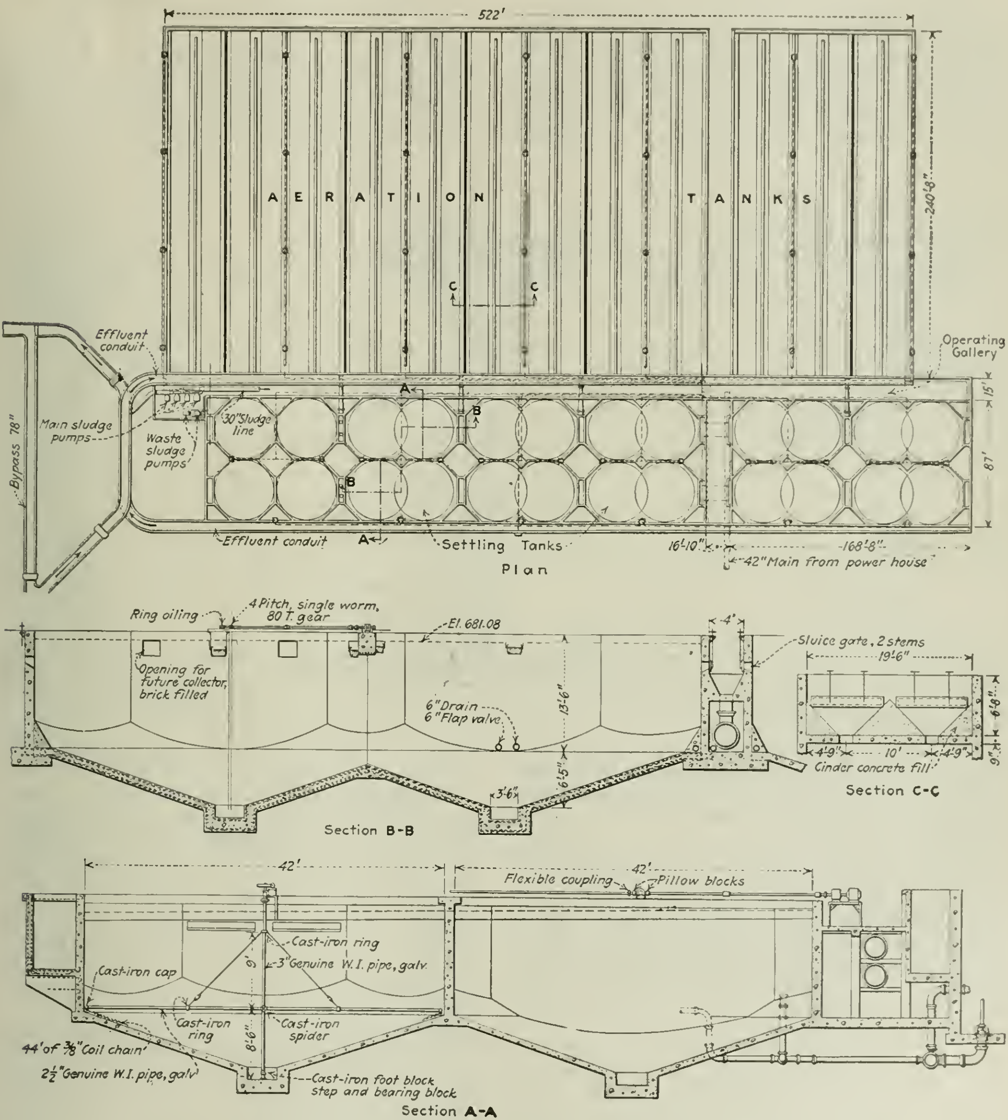
Operating Gallery—In the design and construction of the operating gallery, which includes the mixed liquor channel and the aeration effluent and sludge piping, special provision has been made for the distribution of mixed liquor without air agitation. This has been accomplished by careful proportioning of the channel sections and taking advantage of the short and direct connections between the aeration and settling tanks. The main air-supply line passes through this gallery and individual meters are provided with indicators and recorders for each tank. The aeration effluent is measured by Venturi meters placed in the connecting lines. Indicators and control devices are placed on the separate settling tank sludge lines in order to control the sludge returning to the system.

Activated-Sludge Settling Tanks—Considerable study has been given to the separation or settling of the suspended solids from the aeration effluent. It has been realized from the work done that this problem is only indirectly related to the settling of raw sludge and the type of equipment which will operate satisfactorily on one may not produce good results in the other. We are convinced from our experience that activated-sludge settling tanks should be relatively deep and that the sludge should be removed promptly and without agitation. The influent should enter at either end and near the top and the settling cones be located as close as possible to the influent openings. This arrangement permits vertical settling and allows the coarse and heavier particles in falling through the partially settled sewage to carry down the fine solids and colloidal matter which may have a tendency to rise or remain in suspension. The clarified effluent should be drawn from near the middle and at the surface with sufficient weirage provided to take advantage of surface tension.

ADMINISTRATION BUILDING WITH OFFICES BELOW AND LABORATORIES ON SECOND FLOOR

The Indianapolis plant has been designed with liberal settling capacities. Two settling tanks are provided for each full size aeration unit. Each tank is 78 ft. long, 42 ft. wide, oblong in plan, and has an area of about 3,020 sq.ft. Two settling cones are provided for each tank, with slopes one vertical to three horizontal. The final effluent is withdrawn from the tanks by three surface skimming troughs, each provided with two adjustable weirs giving a total length of 250 ft. for each tank.

Under normal or average operating conditions, each settling unit will receive sewage at the rate of 4.16 m.g.d. plus the returned sludge. On this basis they will



PLAN AND SECTIONS OF ACTIVATED-SLUDGE PLANT FOR CITY OF INDIANAPOLIS

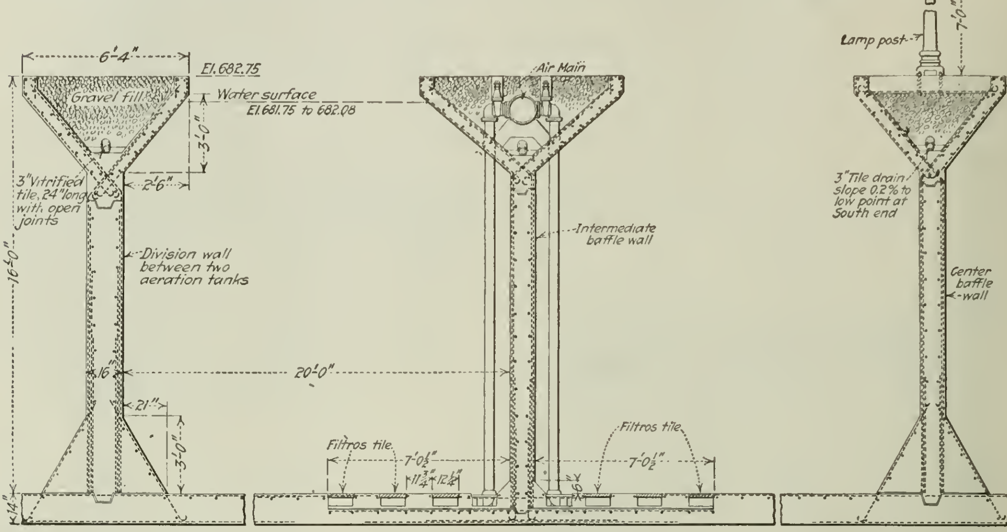
operate at 1,380 gal. per day per square foot of area or, including 20 per cent returned sludge, 1,650 gal. per day per square foot. With an assumed maximum demand of 50 per cent this rate will be increased to 2,340 gal. per square foot of area. The settling period under average conditions and including 20 per cent returned sludge will approximate 97 minutes and for the extreme maximum condition 53 minutes.

The sludge removal mechanism consists of two revolving elements for each tank (two units being driven from a single motor). Sweeping chains are provided to keep the sludge from adhering to the bottom. By producing a slow rolling movement of the sludge these chains assist in concentration in the cones. Each double tank is equipped with one 2-hp. electric motor which is direct-connected to the revolving element through spur-reduction and worm gear drives. The rate of rotation of the elements is one revolution each 19 minutes.

Main Power Plant—Electric power and air for the plant operation are furnished from the main power building located adjacent to the activated-sludge plant. In this building provision is made for eight 400-hp. water-tube boilers, four steam-turbine blowers and three steam-turbine generators and necessary auxiliary equipment. At the present time three boilers, three blowers with a capacity of 18,000 to 24,000 cu.ft. per minute and

two 500-kw. electric generators are being installed. The boilers will furnish steam at a working pressure of 225 lb. per square inch with a superheat of 100 deg. F. The guaranteed economy of the turbine blowers is 7.67 lb. of steam per 1,000 cu.ft. of air at 7.5 lb. gage pressure and of the electric turbines, 15.3 lb. of steam per kilowatt-hour delivered at the switchboard. An important part of this plant is the air-washing equipment for the air supply to the blowers. It is guaranteed by a double system of washing to remove at least 99 per cent of all dust and floating particles contained in the air before washing.

Air Piping—The connecting air main between the power plant and the aeration units is 42 in. in diameter and contains the master air meter for integrating and recording the total quantity of air furnished. All air lines are cast-iron hub-and-spigot pipes in which provision is made at various points for expansion and contraction. These pipes are all heavily coated with a high-grade pipe varnish to prevent the air coming in contact with the iron. No steel is used in any of the air lines.



ENLARGED CROSS-SECTION OF ACTIVATION TANK: DETAILS OF PIPING, FILTROS PLATES, BAFFLE WALLS

TABLE III—RESULTS OF DEHYDRATION OF ACTIVATED SLUDGE WITH OLIVER FILTERS

1922	Drum Speed r.p.m.	Run, Hr.	Solids: Influent Per Cent	Solids: Cake Per Cent	Solids: Effluent p.p.m.	Wet Cake Total, Lb.	Sludge 10 Per Cent 100 Sq.Ft. per 23 Hr.
July 14-16.....	6.5	57	2.21	18.81	31	3,397	2,760
17-22.....	10.5	126	2.50	18.56	29	4,923	1,903
July 27-Aug. 3.	10.5	97	1.66*	18.80	27	2,593	1,272*
Aug. 29-Sept. 5	10.5	104	1.54*	18.17	22	3,181	1,172*
Averages........			1.98	18.59	27	....	1,777

*The low production of the last two runs is accounted for by thin sludge due to insufficient settling capacity during this period.

Sludge Dehydration—It is agreed that dehydration of activated sludge is a troublesome problem. Much research work has been done but as yet no universal method has been developed or adopted. Hydrogen-ion control seems to offer encouragement with some classes of sludge but with the character of sludge produced at Indianapolis, the problem is believed to be largely biological. From the records obtained from dehydration of sludge at other laboratories and demonstration plants, it is apparent that the Indianapolis sludge is of superior quality. This, together with the low cost of fuel and the absence of objectionable odors, was one of the determining factors in deciding on the activated system of sewage treatment.

Throughout the work at the demonstration plant many tests and experiments were made on sludge filtering. Both plate presses and continuous filters were used for this purpose. Either of these types gave reasonably good results when the sludge was properly conditioned, but did not produce a dense or satisfactory cake when the sludge was under aerated or otherwise out of condition. During the summer of 1922 sludge was dried on sand beds. In favorable weather a cake 1.25 in. thick containing an average of 88 per cent moisture was removed from the beds each 24 hours.

Dehydration Plant—On account of the uncertainty of this operation and the lack of experience on full size units, it has been considered advisable to construct the building for the dehydration plant, but without complete filter equipment. Dryers are to be installed for the concentrate thickener sludge and for activated sludge removed from sand beds which are intended to be used temporarily or until final dehydration methods are determined. This building will be 100x120 ft. in plan and will include two indirect rotary dryers 88 in. in diameter by 60 ft. long, equipped with induction fans, chain grate stokers, vapor condensers and dust collectors. Provision is made in this building for an additional drying unit and floor space 42x120 ft. for sludge filters or other means of dehydration. At present two full size continuous filter units have been purchased. One of these is a vacuum filter, the other of gravity type. It is intended that these units will be placed in service and the dehydration system fully developed under actual working conditions of the plant.

Some Notes on a Brazilian Hydro-Electric Plant

Special Correspondence

ELECTRIC energy for the use of the city and State of Rio Janeiro and the federal district of Brazil is generated in a high-head hydro-electric plant about 45 miles from the city. An account of a recent trip to the plant arranged by the Club de Engenharia may give some idea to the readers of *Engineering News-Record* of the development in water power in this part of South America.

The railway transportation for the 45-mile trip over the Central of Brazil Railway was arranged by the club, with Fred Huntress, vice-president in charge of the Rio Janeiro Tramway Light & Power Co., as chief host for the visitors. From Lages station on the railway (gage 1.68 meters) the trip to the power house was made by a special car and locomotive of the company. The distance is about 13 miles, and the line is generally through very low land that was a hot bed of sickness, malaria and other fevers when the company began construction. Men sickened and died so quickly on the other railway construction near by that it was almost impossible for the company to employ men when their railway construction began. Steps were taken as rapidly as possible to kill mosquitoes near the company works but it was very difficult to secure co-operation from the land-owners near by. It therefore became necessary to purchase an enormous tract of land and put a mosquito expert in charge. At the present time fevers and mosquitoes are practically unknown anywhere near the company works.

The party left Rio de Janeiro at 7:30 a.m. and reached the power house at 10 a.m. where inspection was made of plant and equipment.

Hydro-Electric Plant—The electrical equipment is principally Westinghouse. There are some Escher Weiss hydraulic equipment and Pelton wheels. The working head is of course variable with the season but at present it is about 304 meters. One of the wheels was idle for a short time and it was very interesting to note the conditions of the buckets. In many instances they had been very badly worn out but had been built up by electrical welding and later ground smooth with abrasive wheels. The phosphorus bronze nozzle center showed signs of considerable wear, both as uniform channels and as a succession of small ovals which would ultimately form channels. There are now eight wheels and the load in Rio de Janeiro averages about 900,000 kw.-hr. per day. At times it is over 1,000,000 among the 80,000 light and 4,000 power customers. An outdoor substation supplies the State of Rio de Janeiro, in which the plant is located, and there is a small interior department of the power house distributed to the works, the near-by farms and towns.

Water is wasted through the nozzles at times and strikes a small hill across the river where some very neat cylindrical tunnels have been driven into the rock with water at about 400-lb. pressure. It is in no sense a novelty to those who have similar barriers but is one of the things which always interests the visitors.

The power house employees have very fine quarters near the plant, entirely screened as at Panama with beautiful gardens round about.

To reach the upper plateau from the power house, a 66 per cent cable incline over a stone-paved roadbed is used. The faces of the cuts are painted with a gas house tar to protect the earth against vegetation, rain and the burning sun. It has given general satisfaction and is a well established custom in various parts of Brazil.

From the top of the incline to the general office and home of the director of the works the distance is about three kilometers by a very good earth road. This is the ideal country home with a farm and excellent orchard alongside, telephone connection to nearly every city, town or farm within 200 miles, radio receiving set for the opera in Rio and the best papers and magazines from a half dozen countries.

Fast teams of round little mules took us to the dam which is on a radius of 100 meters and 45.50 meters high. It was built under the direct supervision of C. H. Kearny of San Antonio, Texas, and stores 210 million cubic meters. The lake is very surprising as it follows a narrow canyon for nearly 20 miles and runs back into many tributary gulches. One can throw a stone across in many places. The company's power boats travel along rapidly and one can see most of it in a short time.

The property is exceedingly well managed and throughout the organization an esprit de corps exists which many managers might well envy.

Relation of Railway Wheels and Rails

THAT THE TAPER of wheel treads is a very small factor in the relation of rail heads to wheel treads is shown in the report presented by the committee on Wheels at the recent Chicago convention of the mechanical division of the American Railway Association. The note in question, abstracted below, relates to a joint meeting of this committee with the American Railway Engineering Association's committee on Track Stresses.

In a full discussion of tread design of wheels and its relation to the canting of rails, it developed that there is little information as to small or large taper of wheels in its effect on the rail. It was brought out that the spreading of rails and the wearing into tie-plates and ties on the outside is a serious problem and that many railroads are meeting this by canting the rails. Some of the engineers have felt that the wheel tread should have a lighter taper than 1 in 20 in order to help relieve this condition. But wheels and rails both wear quickly after being put into service and any relation between the tread contour and the contour of the rail is soon lost. Thus it would not appear likely that a slight alteration in the taper of the wheel would remove this condition. Furthermore, the main cause of the spreading of the rail is entirely independent of the tread taper.

The committee of the engineering association asked as to the possibility of any change in the taper of the wheel, in order that it might have a permanent basis for a recommendation for canting the rails. The committee on Wheels stated in reply that it has received no data which would warrant making a change in the taper of the wheel tread. The present taper is thought to be most advantageous, as regards flange wear. The last change made was in 1907, when the taper was changed to 1 in 20 from 1 in 25. At the present time, practically all wheels (except those for a few roads) are being made with this standard taper. The committee advised the A. R. E. A. committee that it had under consideration the making of the tread with a single taper of 1 in 20 instead of the present double taper, and this procedure met with the approval of the latter committee.

Geology and the Decatur Dam and Reservoir Project

Glacial Formation Explains Why Sheet Piling Could Not Be Driven to Intended Depths —Watertightness Assured

BY MORRIS M. LEIGHTON
With Illinois Geological Survey, Urbana, Ill.

EXPERIENCE has taught the engineer that the construction of a dam across any valley in the glaciated area must be undertaken with unusual caution. The materials beneath the dam must have sufficient bearing power to support the weight of the dam, and must be tight enough to prevent seepage from beneath. The materials at the ends of the dam and in the natural walls of the reservoir must also be such as to prevent excessive leakage. In order to pass judgment upon the character of glacial formations at a given locality, having in view a reservoir project, the engineer desires to know the kinds and thickness of materials present, their texture and compactness, the relationships of the porous to the non-porous and their relations to the bedrock. Obviously a full knowledge of these things involves an understanding of the principles of glacial and aqueo-glacial sedimentation and in some cases the differentiation of drift-sheets.

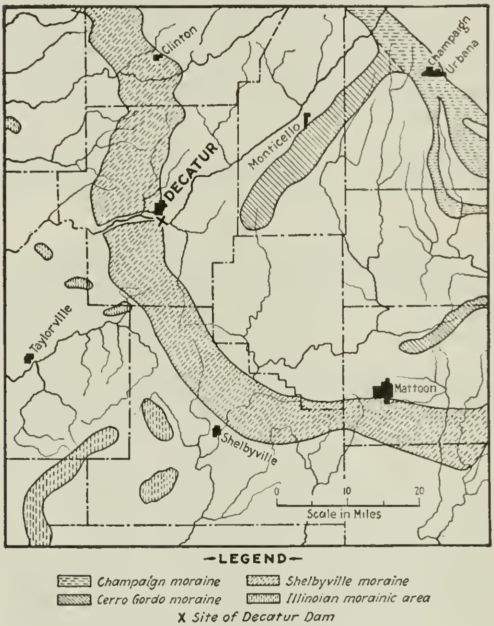


FIG. 1—THE GLACIAL GEOLOGY OF THE DECATUR AREA

At Decatur, Ill., a new dam has been constructed across the Sangamon River, which flows through the city, thereby creating a reservoir in the upstream portion of the valley for a distance of 12 miles and covering 3,900 acres of territory. The specifications called for a dam 15 ft. high above the old river level; and for the base of the dam to be 72 ft. wide, which is inclusive of a concrete apron but exclusive of a 30-ft. clay apron on the upstream side. The base was to extend to a depth of 3½ ft. below the lowest part of the river bed, below which cutoff sheeting was to be driven to a maximum depth of 30 ft. below the base of the concrete portion of the dam. The middle section of the dam was to be of concrete, but the end sections of earth, with the cutoff sheeting reaching to somewhat less depth than in the middle section. The supervision of construction was entrusted to the firm of Pearse, Greeley & Hansen, consulting engineers, of Chicago, who assigned J. Albert Holmes to the position of resident engineer.

Before formulating the specifications, a preliminary series of test-holes was made across the valley to ascertain the character and thicknesses of materials. Samples were collected, but due to the fact that these were from a churn drill nothing but sand and gravel was reported. Upon these data the specifications were drawn and the work was undertaken. Later in driving the cutoff sheeting, a "hardpan" at varying depth was encountered which was impossible to penetrate and which prevented the driving of the sheeting to the depths specified.

The question then arose as to what this "hardpan" might be—is it solid bedrock, or cemented gravel, which might be porous enough to permit excess leakage, or some other kind of material which might or might not menace the success of the dam construction or the reservoir project. Obviously it was necessary to have these questions answered, and a geological examination was accordingly requested.

Geological Phenomena—Decatur is situated on the eastern border of the Shelbyville Moraine (see Fig. 1), which here has a width of several miles. No bedrock is exposed in this vicinity. The altitude of the moraine at the river bluff is reported to be about 650 ft. above sea level. The valley at Decatur is about 50 ft. deep, but farther west in the moraine it is 75 ft. or more. West of the moraine it is scarcely over 50 ft. but is much wider than in the moraine. This seems to indicate that the portion beyond the moraine is pre-Wisconsin in age, quite in harmony with the fact that some of the tributaries are beheaded by the Wisconsin deposits. The incision of this part of the valley in Illinoian drift would therefore make its age post-Illinoian and pre-Wisconsin.

Frank Leverett ("Illinois Glacial Lobe": U. S. Geol. Surv. Mono. 38, p. 518, 1899) states that the average thickness of the Shelbyville drift is 100 ft., an estimate based on the relief of the moraine. If this were the case, it would seem that the valley through the moraine must have been completely filled, but this figure seems excessive, and there are reasons for believing that the valley was not buried.

After the hardpan was discovered a new series of

TABLE I—GENERALIZED SECTION OF THE STRATA IN THE SANGAMON RIVER VALLEY NEAR DECATUR, AS DETERMINED FROM BORINGS AND TEST PITS

Description of Strata	Thickness, Ft.
3. Soil and flood-plain alluvium, a brownish sandy silt toward the valley walls, becoming darker near the stream	5–10
2. Sand and gravel, distinctly sandy, thins out toward the valley walls, thickens toward the stream, maximum thickness	35
1. Till, called "hardpan" by the drillers, dense, compact clay with scattered pebbles and boulders, difficult to penetrate; contains a few thin layers of sand, most of them limited in thickness from 1 to 2 ft., but one on the south side having a maximum thickness of 13 ft. Maximum thickness of till penetrated	54

well borings was made—this time in such a way that cores of the material, as it actually occurs, were taken at desired intervals. Credit for the admirable way in which this series of borings was made belongs to Mr. Holmes. Twenty borings were put down across the valley in line with the proposed dam. These revealed the strata, as shown in Fig. 2.

A short distance farther west, in the moraine, a new sewage ditch had exposed some excellent sections of drift for study. Here the till contained thick lenses and considerable bodies of gravel and sand, some of which show marked contortion by the overriding ice. One of these lenses was about 200 yd. long. If such a lens were to occur in the till beneath the dam, it might permit excess leakage. But the till beneath the dam appears in the main not to belong to the Shelbyville terminal moraine, like that shown in the sewage ditch, but to belong to the Illinoian ground moraine. If so, place was not completely filled by the Shelbyville ice deposits, and (2) that of the amount which was deposited on the north side, little remains from the erosion of the present stream. By projecting the contact into the valley, its position would be such as to make most of the till beneath the gravel filling referable to the Illinoian deposit. Hence, it appears that the sand and gravel filling rests almost directly on Illinoian drift with but little Wisconsin drift intervening. Further evidence was found by a study of the excellent series of core samples from the later series of borings. Some of those from the middle portion of the present valley showed brown till, partly below blue till and partly directly below the sand and gravel filling.

The South Side of the Valley—The south side of the valley was filled with greater quantities of drift, which accounts for the present valley being narrower than one would expect, judging from the width of the valley

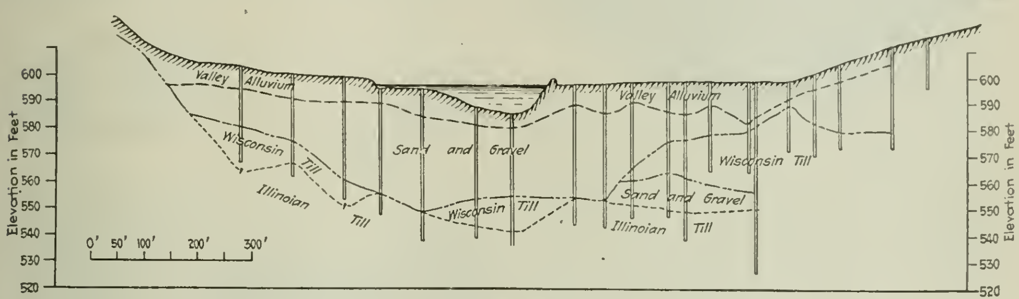


FIG. 2—CROSS-SECTION OF THE SANGAMON RIVER VALLEY AT DECATUR

then by virtue of its mode of origin chiefly beneath the ice, it would likely contain but little gravel. Instead, its constitution would be chiefly till, possessing a clayey matrix nearly impervious to water. The evidences that the till beneath the dam is chiefly Illinoian in age will now be considered.

Superposed Drift-Sheets in the North Valley Wall—In the north valley wall at the dam site, the construction company opened a clay pit for securing clay filling. An unusual section was exposed, showing the following sequence:

3. Till (probably Wisconsin) overlain by "wash" from the slopes and capped with soil; upper part, including "wash," is leached 3 to 4½ ft., the underlying 0 to 2½ ft. being calcareous; total exposed .... 4½–7 ft.
2. Old soil .... 6–8 in.
1. Till (probably Illinoian), gray below the soil, brownish below, leached 3 to 4 ft., calcareous below, compact; total exposed .... 6 ft.

Quite clearly, this section shows two distinct till sheets, separated by an old soil and the lower till exhibiting decisive evidence of leaching and oxidation before the deposition of the overlying till. The upper till doubtless belongs to the Shelbyville terminal moraine of Early Wisconsin age, the lower to the Illinoian drift-sheet.

A short distance west, there was a ditch excavated for the cutoff sheeting, which transects the valley slope Upon examination this was found to show the same sequence of materials. Here, fortunately, the trend of the exposure is at right angles to the valley and shows the relation of the pre-Wisconsin surface to the valley. The contact between the two tills dips steeply toward the valley in conformity with the present north valley wall, strongly suggesting at least two things: (1) That the north side of the old Sangamon valley at this

beyond the moraine. No exposure of an old till or no evidence of the old valley wall was found on the south side. All of the material, save for a thin mantle of loess, appears to belong to the Shelbyville drift. As will be seen in Fig. 2, there is a body of sand and gravel, revealed by four borings, separating the blue Shelbyville till above from the brown Illinoian till below. This is interrupted as a part of the outwash of the advancing Shelbyville ice, which later was overridden and buried by the deposits of blue till.

The sand and gravel filling in the Sangamon Valley has already been noted. No distinct terrace is shown at the dam site, but on the south side of the valley slightly above the present flood plain, gravel underlies alluvium and "wash" from the south slope. All of this gravel filling is believed to be correlative with the remnants of gravel terraces which occur both upstream and down, and which appear to have been deposited as a valley train from the ice during its recession from the Shelbyville moraine and during the building of the next younger Cerro Gordo moraine. (Fig. 1.)

Summary of the Sangamon Valley History at Decatur—The valley dates back to the Sangamon interglacial epoch, probably even to the close of the Illinoian glacial epoch. Upon the melting of the Illinoian ice, the area was a flattish ground moraine, and the Sangamon River was formed by the consequent drainage. During the Sangamon interglacial epoch a relatively broad, shallow valley was carved at Decatur commensurate with that portion of the valley beyond the Shelbyville moraine. Contemporaneous with the valley cutting, the Illinoian till above river level was leached and oxidized and soil was developed, extending down some parts of the valley

slope. To some extent beneath the old flood-plain the till was oxidized to a brownish color but scarcely leached.

The change of climate from warm to cold and the accumulation of a great thickness of ice over eastern Canada resulted in the Wisconsin ice invasion, which reached its extreme limit a few miles west of Decatur. During the ice advance glacial waters deposited the body of sand and gravel which lies between the two tills on the south side of the valley. Later this was overridden and for a time the ice edge remained within the zone now occupied by the Shelbyville moraine and radically changed the contour of the Illinoian surface by depositing a notable moraine. Some of the débris was released directly from the ice upon its melting and deposited as unassorted drift or till, while some was deposited by glacial waters, forming gravel bodies. Readvances of the ice contorted the gravels and buried them with till. As a result, the moraine was formed of both till and bodies of sand and gravel with complex unpredictable relations.

The amount of drift deposited across the valley was not enough to fill and eradicate the valley. A depression was left to serve as a drainage line upon the retreat of the ice front. In this inherited depression, after some modification by the glacial waters, a valley train was deposited, which came from the ice during its melting back from the Shelbyville moraine and during the building of the Cerro Gordo moraine. Since the disappearance of the ice, the sand and gravel fill has been partly eroded away and a flood plain of varying width has been developed on both sides of the stream.

Relation to the Reservoir Project—According to the foregoing interpretation, the hardpan, or glacial till, on the north side of the valley, which is to receive the cutoff sheeting, is drift of the Illinoian ground moraine and not drift of the Wisconsin terminal moraine. Since the drift belongs to the ground moraine phase, it was deposited chiefly beneath the ice and consequently has a maximum content of impervious clay matrix and a minimum of sand and gravel layers which might serve as avenues of sub-surface leakage.* On the south side of the valley, the cutoff sheeting ends in the Wisconsin drift. The gravel body, 6 to 13 ft. in thickness, which separates the Wisconsin and Illinoian tills, is apparently the only one which menaces to any degree the success of the dam. Due precaution was taken by the resident engineer, who, realizing the possibility of some excess leakage at this place, made provision for such an emergency.

Vancouver Dock Work Revived

The Vancouver drydock project, which was suspended for several months, has been revived and the Wallace Drydock Co. has been awarded the contract. The drydock will be of the floating type, to cost $2,500,000, and will be built on the north shore of Burard Inlet, opposite Vancouver. The construction program is subsidized by the federal government. The plans call for a 15,500-ton drydock, 500 ft. long by 132 ft. wide, in two sections, each containing five pontoons 44 ft. long, constructed of heavy timbers; a third section will give a total length of 700 ft. A 700-ft. pier, 50 ft. wide and placed on concrete cylinders, is to be built alongside the drydock. Steel machine shops, to be erected, will house a 30-ton traveling crane, and the pier will have a 7-ton traveling crane.

An Optical-Lever Extensometer of Wide Utility

Abstract of a paper by L. B. Tuckerman, Bureau of Standards, at the recent Annual Meeting of the American Society for Testing Materials.

A STRAIN-GAGE or extensometer of small size, high sensitiveness and convenient adaptability to various uses has been developed by Dr. L. B. Tuckerman, of the Bureau of Standards. It uses a Martens tilting mirror, but with a triple mirror in place of the single mirror of the Martens instrument, and couples with it a combined illuminator and reading telescope which eliminates the great

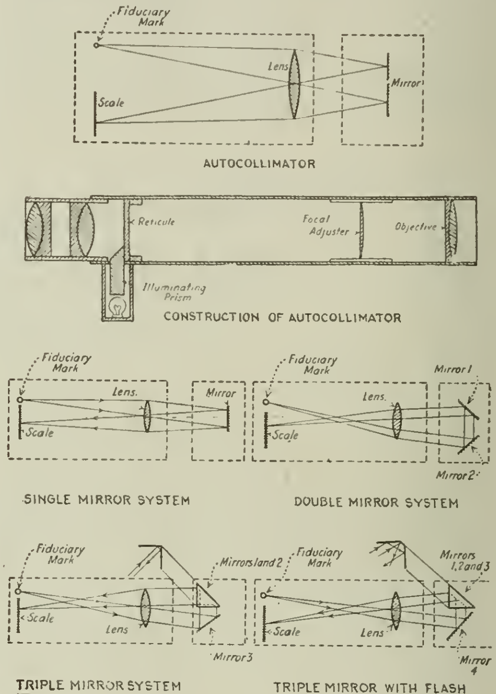


FIG. 1—AUTOCOLLIMATOR AND TRIPLE MIRROR

degree of susceptibility to disturbance of the ordinary optical-lever system. In the instrument as constructed a single scale division represents 1/25,000-in. change of length, and tenths of a division may be read.

In Fig. 1 is shown at the top a diagram of the illuminator and reading telescope combined in a single unit called the

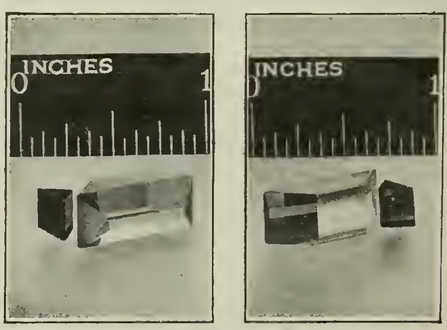
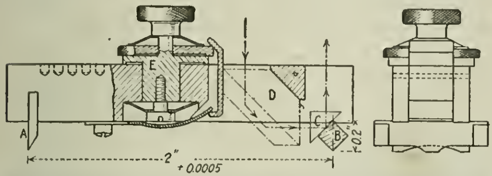


FIG. 2—BACK AND FRONT OF MIRROR PRISMS

autocollimator, a full drawing of which, somewhat diagrammatic, is given just below. This combination makes the reading system entirely self-contained, but the reading is still dependent on the mirror position.

With a single mirror, as shown in the left-hand sketch in the lower part of Fig. 1, the reflected light ray misses the reading telescope upon even a minute shift or tilt. This difficulty is obviated, in part, when a double mirror system is used, as shown just to the right; the telescope then is able to take a reading in any position at right angles to the line of intersection of the two mirrors. In order to make the arrangement also insensitive to disturbances in the other direction, a third mirror is introduced, as shown in the left of the lower line of diagrams in Fig. 1. This is the arrangement used in the Tuckerman instrument, except that for auxiliary purposes a fourth mirror is formed by grinding away the corner of the double mirror unit, as shown in the right.

Prisms are used instead of mirrors, because accurately plane surfaces are more easily obtained in them. Fig. 2 shows the actual prism system used in the Tuckerman



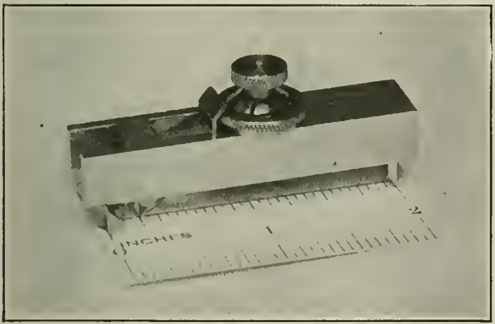


FIG. 3—TWO-INCH STRAIN-GAGE

strain-gage, comprising an ordinary 45-deg. prism as a single mirror (mirror 4 of the diagram), and a roof prism with its corner cut away.

The complete strain-gage is shown by drawing and photograph in Fig. 3. The knife-edge *A* is fixed, that at *B* is the tilting knife-edge carrying the mirror prism. The roof prism *D* is carried on a lever whose position may be adjusted by a double cam *E*, giving a coarse and a fine adjustment in order to bring the fiduciary mark of the vernier to zero on the scale. The Martens lozenge *B* is 0.2 in. high, and with this construction one scale division represents 0.00004 in. deformation.

A photograph of the field of view obtained with the collimator is reproduced in Fig. 4. The image of the scale and the vernier reflected alongside it is seen in the center of the field; as will be seen, tenths of a division may be read. The bright patch at the top of the field is the "flash," which is an image of the collimator field reflected from the beveled corner of the roof prism. So long as this flash is in the field of view, the autocollimator is close enough to the true right-angle relation to the strain-gage mirrors to make the cosine error negligibly small.

Several of these small strain-gages have been constructed by the Naval Gun Factory, Washington, for tests on large riveted joints for the navy. It is planned to place thirty of the strain-gages at various points on the riveted joint, and read them by means of two autocollimators.

It is believed to be possible to apply this strain-gage to

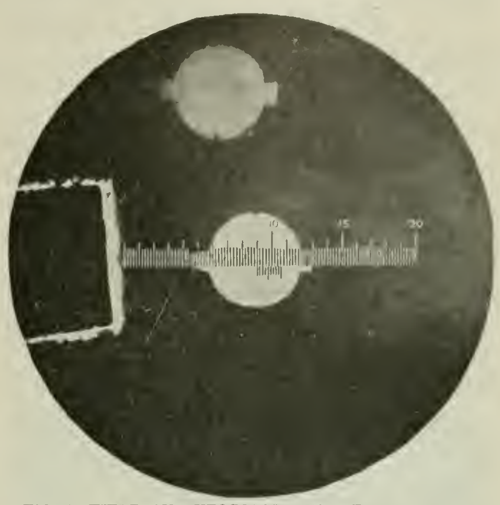


FIG. 4—FIELD OF AUTOCOLLIMATOR, FLASH AT TOP

gage lengths even as small as ½ in. for fuller exploration of deformations in strained members. The light weight of the gage also makes it applicable to many cases of strain measurements where heavier instruments cannot be used, as in the case of thin sheet metal or wire. The gage is now being adapted to a torsion dynamometer for rotating shafts at the Bureau of Standards, and still other applications are in contemplation.

Another Cross-Connection Typhoid Outbreak

Only seven months after the typhoid outbreak at Franklin, N. J., due to cross-connection between a municipal and an industrial water supply, states the New Jersey *Public Health News* for June, 1923, another typhoid outbreak has occurred that seems to be due to almost identical conditions. The record outbreak was in Rockaway. From the onset of the first case on May 25 up to June 25 there were 41 cases and 4 deaths. The record down to July 31, according to D. C. Bowen, chief of the Bureau of Local Health Administration, was 46 cases and 6 deaths. The cases are confined to the eastern end of the borough, beyond a point where there was a cross-connection with the fire mains of an industrial plant, separated from the potable supply by a single check valve. Examination showed that this valve was "stuck open and so encrusted with dirt and rust that the flap could be moved only by the use of a bar." Formerly the town pressure exceeded that in the industrial water-supply system. Examinations made under the direction of Mr. Bowen showed that the industrial water supply received the effluent from a septic tank located only some 200 ft. upstream from the pump intake. It was also found that at the time the infection occurred the excretions from a typhoid carrier of three years' standing were going into the septic tank. Action taken to control the outbreak included severance of the pipe forming the cross-connection, which was done on June 16, abundant use of bleaching powder in the privies of the borough, disinfection of the discharges of all typhoid patients, and free inoculation with anti-typhoid bacteria of all residents of the borough who would accept it, the latter being offered by the local board of health

Recent Railway Location in Southern Colombia

Difficult Problem of Linking Up Cities in the Andes Mountains—Providing an Outlet to the Sea—Lack of Transportation Facilities—No Local Subsistence

By F. R. Molther
Former Office Engineer, D. E. Wright Construction and Engineering Co., Inc., Panama

ALTHOUGH the theory of railway location rarely comes up in present-day engineering practice in the United States, it has never diminished in importance nor been backward in development. It is believed, therefore, that the following article will be of some technical interest describing as it does some location problems presented by the difficult topography of the Andes, where as much as anywhere in the world the country calls for a good understanding of railroad requirements. In addition to this, the fact that American engineers and American capital are continually finding Latin-America a broader field for their development may also add to the interest in the discussion.

THE VALLEY OF THE GUAMBUYACO RIVER BETWEEN PASTO AND POPAYAN

Transport Situation in Colombia—The Republic of Colombia, situated at the northern extremity of the South American continent, possesses great natural resources the development of which is limited, however, by the extreme lack of transportation facilities.

It is to be expected that plans for the betterment of such limiting conditions are both numerous and extensive. Because of a loosely jointed central government, unable to project its influence to the more distant and inaccessible states, plans for better transportation vary greatly and each of them is sponsored by those areas which would be best served by it. The decision as to the encouragement of some plan or another is a problem that confronts every administration at Bogota.

Recent Railway Projects—One of the earliest railway projects was that of connecting the capital, Bogota, a city of 150,000 people on the great Cundinamarca plateau 8,000 ft. above the sea, with the Pacific Coast at the port of Buenaventura. This work was commenced in 1877 by Francisco Cisneros, the most prominent railway engineer in the history of Colombia, and the road is now in operation as far as Buga. At the important city of Cali, in the heart of the extensive and fertile valley of the Cauca, a branch toward the south has been constructed to within 50 kilometers of Popayan, an active city of 15,000 inhabitants, capital of the department of Cauca, and a thriving center in a cattle and coffee producing region, with a climate suitable for raising potatoes and wheat. Recent consideration of the importance of better communication among the departments of the country has given rise to a study of the continuation of this branch to the frontier of Ecuador, by way of Popayan, Pasto, capital of the department of Nariño, and the important towns of Tuquerres and Ipiales in the same department.

Another, but wholly new proposal for railroads in the isolated department of Nariño, which is now without a single kilometer of railroad, is that of connecting the capital city of Pasto with the Pacific at the port of Tumaco.

The contract for the location of these two lines, from Pasto to Tumaco, and from Popayan to Ipiales, on the frontier, was let in September, 1920, to the Wright Engineering and Construction Co., Inc., of Panama, and the work was completed in August, 1922. The purpose of this article is to indicate the location problems and solutions applied on the surveys for these lines, without consideration of their particular importance, the discussion of that question requiring recognition of all the many routes proposed for better transport facilities in Colombia.

These surveys were made by three organizations operating independently each consisting of a chief of party, transitman, levelman and topographer. In very rough country, of which these routes were required to cover many kilometers, two topographers were employed, and the use of a field draftsman in one party seemed to justify this addition to the staff. Two Colombian engineers were employed in each party, as required by the contract, usually as topographers or

levelmen, and despite the limitations of rudimentary training and inexperience they generally gave satisfaction. Several Panamanian negroes were brought down to serve as chainmen and rodmen, but proved to be of greater value in the kitchen, and finished the work as cooks. Native peons were developed into competent chainmen and rodmen.

Because of the isolation of these commissions while in camp, away from towns and traveled roads, it was necessary for each camp to be self-sufficient, and to carry all of the supplies needed for any contingency, in addition to the technical equipment.

All supplies that could be so accommodated were packed in wooden boxes 31 x 17 x 12 in. deep, experience having determined that these were of the most convenient size and weight for the little Colombian pack animals to carry in pairs. Each man on the staff was allowed one such box of personal equipment, without shoes, which alone constituted half a cargo, for no amount of hobnails could prevent cutting the best boots and shoes to pieces on the rocks, or pulling out the seams on the steep slopes.

In territory infested with mosquitoes or gnats, each man had a mosquito bar of thin muslin, and not only was sleeping made quite comfortable, but most of the party also escaped malaria. The peons, however, who slept without mosquito bars, suffered greatly from fever, and many pounds of quinine were required to keep them in working condition.

The cook had horses and pack-animals for trips to market—held weekly in the small villages that were usually two days' trip from the camp—which afforded fresh meat, fruit and vegetables. Staple groceries were obtained monthly from the nearest large town, sometimes a journey of two weeks away. For several months the inaccessibility of markets, and the large force of peons employed, required butchering in the camp. Beef was usually killed at the end of the week, and pork or sheep at more frequent intervals. Chickens, sheep and pigs were carried by the camp party, and driven from camp to camp if not consumed at once. For several months game solved the question of fresh meat, one peon serving as hunter. Often deer or antelope were brought in three or four times a week. Wild turkey and ducks also were available for food.

Camps were built at intervals of about every 15 km. as it appeared undesirable to have the field parties cover a greater distance in so precipitous a country, with no paths other than cattle or antelope trails. Occasionally the topography recommended the use of temporary "fly" camps in which the party sometimes stopped for a night or two to avoid a particularly dangerous journey through canyons and over precipices to the main camp. Camps were built of wild cane, using the stalks to form the walls and one end of a rectangular structure having a ridge roof thatched with cane leaves. This resisted the rain in the arid country through which much of the survey was run. As the rainy season advanced, however, it was occasionally necessary to reinforce the roof with a tent fly lashed over the thatch. Beside such a house for the staff, a shelter was also constructed for the cook and his helpers, and two for the peons, or laborers.

All moves from camp to camp were made by pack-trains, which by reason of inadequate roads often were unloaded to pass the cargoes around some narrow section of trail which a loaded animal could not pass.

Although the topography of the route was very broken, and several times the line ran close to those traditionally inaccessible sites selected by eagles and condors for their nests, the familiar method of reading angles with a transit and chaining the distances was employed in location. Levels were taken with a wye-level at every 20-m. station, except when steep canyons justified the location of an elevation on the far side with the instrument, and the use of a Locke level to fill in the descent and the rise. From these elevations the topography was taken in a 200-m. belt, half on each side of the line, the even contours being picked up with the Locke level, and located by pacing or measuring with the rod. For a stretch of seven kilometers in the Guambuyaco Canyon, the route of the projection was impossible for the instrument and chain. Here the survey line was run at the bottom of the canyon, on

MOVING THE DRAFTING OFFICE

such banks as the stream offered, but often in the river itself. Topography was taken by stadia, employing the vertical and horizontal angles, and the mapping was done by interpolation between these miscellaneous elevations at the tops of banks and noses of ridges, to arrive at the even contours.

In order to accommodate as much of the line as possible on comparatively narrow sheets, the latitude and departure of each course were determined from a chart, and all critical hubs, at points where the general direction of the survey changed greatly, were computed and plotted at 1:10,000 scale. Selecting a meridian for each sheet, the hub for starting was located in the most advantageous position for accommodating as much line as possible, and the hubs were plotted at 1:2,000 for the detail study. The courses were run off by determining their angle with the meridian of the sheet, and by drawing in their direction, with respect to this meridian, by the method of tangents and co-tangents (*Engineering News-Record*, Dec. 14, 1922, p. 1032). The topography was then spotted on at each station where sections had been read and the contours were sketched on from the field book, which contained the contours drawn in between the sections where elevations were read. This permitted the covering of all small breaks in the ground, without location contours oftener than every hundred meters, in normal country with regular slopes. Some stretches, however, of badly complicated topography required locating the contours at every 20-m. station. When the slopes permitted, contours were drawn at 2-m. intervals, but much of the line permitted the showing of 10-m. contours only, at the scale employed.

The survey line was inked in red before the topography went on, and all contours and streams were inked before location was begun. The projection was made according to the method described in the late A. M. Wellington's classic work on the "Economic Theory and Practice of Railroad Location." This method consists of drawing in the grade contour, for the grade as predetermined or suggested by the country, and approximately run by the transit line, and of fitting this grade contour as nearly as possible within the limitations of acceptable alignment.

A profile was then taken off on Plate A paper, at scale of ¼ in. to 20 m. horizontally, and ¼ in. to 2 m. vertically. Decision was then reached as to the means of crossing all openings, and estimates of all material were made.

A general map at a scale of 1 : 500,000 was made to show the general routes, from which the map accompanying this article was sketched.

Pasto - Tumaco Location — Little previous work had ever been done in this section of Colombia, no railroad route from Pasto to Tumaco had ever been considered, and available maps and information were unreliable.

The general features of the location required reaching by one of the several river routes from Pasto the plateau of Tuquerres, which lies to the south of Pasto and extends roughly from the Sapuyes river to that bend in the Andean Cordillera which includes the peaks of Cumbal, Chiles, and Troya. Accordingly, leaving the point selected in the outskirts of Pasto, for yards and terminal, at an elevation of 2,590 meters, the location proceeds 17 kilometers upstream in the valley of the river Pasto, and employing the slopes of the western cordillera, reaches the pass known as the Cruz de Amarillo, at an elevation of 3,172 meters. This pass affords access to the watershed of the river Bobo, which is followed down to its junction with the river Guaitara, where the line crosses the latter stream at an elevation of 1,797 meters, 300 meters above the level of the water, which is here sharply enclosed in a vertical box canyon. The crossing selected is the same as that chosen by Doctor Uribe for the Pasto highway. It requires the only steel bridge in this location with but 36 m. of span, and also affords a passage for the highway. The Guaitara bridge is 50 km. from Pasto by the railroad location, and grades up to 4½ per cent compensated are employed to this point. The Guaitara canyon is followed upstream to the mouth of the Sapuyes river, and the valley of that stream and of the small creek, Los Molinos, takes the location to the important town of Tuquerres, 82.5 km. from Pasto, at an elevation of 3,040 m.

From this point the country dictated crossing the Tuquerres plateau, rising at its edge to the best pass between the Sapuyes drainage and the watershed of those rivers flowing directly westward to the Pacific. For this purpose the pass of Chimingual, 106.5 km. from Pasto, was selected. This lies at an elevation of 3,226 meters, the highest point touched by any of the surveys on this work, and is reached by 4 per cent compensated grades.

From this point, the only remaining problem was to reach the coast by the most favorable and direct route and as the pass of Chimingual suggests the use of the valley of the Guabo river, a precipitous descent of 1,200 meters is made at Chambu, the most favorable place for the necessary development, 27 km. in length but so spiralling as to cover but 11 km. in horizontal distance. At one point near the top of this development the line appears below seven times in a horizontal distance of 3.5 km. and a vertical drop of 627 m. The length of this part of the spiral is 16 km. and here are required the only tunnels on the route, one 170 m. long and one 360 m. long. Once in the valley of the Guabo River—also known as the Calera, and farther downstream as the Guiza—the route continues dowstream to a point where the river boxes up in a vertical canyon, and the line climbs out to the valley of the Güelmambi. The grades from Chimingual to this point do not exceed 4½ per cent compensated. Soon catching the divide between the Mira and Rosario rivers, the location proceeds by its crest to avoid crossing the tributary small streams on each side of the ridge. The fact that the topography here is that of the Pacific coastal plain makes the use of this ridge acceptable, and preferable to the bottom of the valleys. This divide is followed as far as a point opposite Tumaco called El Pindo, where the crossing of a narrow estuary gives access to the island on which that city is located, 313 km. from Pasto, and 4 m. above sea level. The last 130 km. of this line are all below the elevation of 1,000 m., and no grade is greater than 3 per cent compensated.

No grade on this location was permitted to exceed 4½ per cent compensated. This was one of the predetermined limitations of the contract, as was also the alignment limitation to curves of not less than 16 deg. metric, equivalent to about 6 deg. 6 min. English, which gives a radius of 71.85 m. The minimum of tangent between curves of opposite flexure was 40 m.

Pasto - Popayan Location — The situation north of Pasto had been scarcely more explored than that to the south, although a survey was made in 1893 by the late Colonel Shunk for the Pan-American Railway Corp., over the entire Andean range, including the cities of Pasto and Popayan. Urged, no doubt, by excellent reasons, Colonel Shunk located most of this line on the slopes of the central cordillera, which, for our purposes it seemed undesirable to follow, so the splendid data collected by that organization were unavailable for our use. From a point in the valley of the Patia River, Colonel Shunk's line somewhat follows this new location, which will be discussed later.

To reach the frontier, the Pasto-Popayan line employs that portion of the location previously discussed, from Pasto to Tuquerres, and a further branch of 34 km. southward on the Tuquerres plateau that is without technical difficulty.

North from Pasto the first problem of the location was to reach the long basin of the Patia River, reconnaissance showing this route to be much less expensive and only slightly longer than the location in the slopes of the cordillera, made by Colonel Shunk. For the purpose of reaching the Patia River, however, this project was not so fortunate as the other, the only available basin, that of the Pasto River, turning out on reconnaissance to be disappointingly full of vertical canyons. The line leaves Pasto from the same point chosen on the Tumaco survey for yards and terminal, and follows the valley of the Pasto until its precipitous banks require the use of the slopes of the divide between the Pasto and Guaitara valleys. By these it attains the pass

of Motillon, whence the projection follows the right slope of a spur from the central cordillera to the pass of San Juan. There the route takes the left bank of the Patia River to the junction of the Guambuyaco River with the Patia. At this point the distance of 91 km. from Pasto proved to have been insufficient, at the rate of grade imposed, the line being at an elevation of 740 m., and the river more than 200 m. below. For this reason the line was run up the Guambuyaco canyon for a distance of 7 km. to catch the level of that stream, at 596 m. above sea level, and returns by the northern bank to the Patia River.

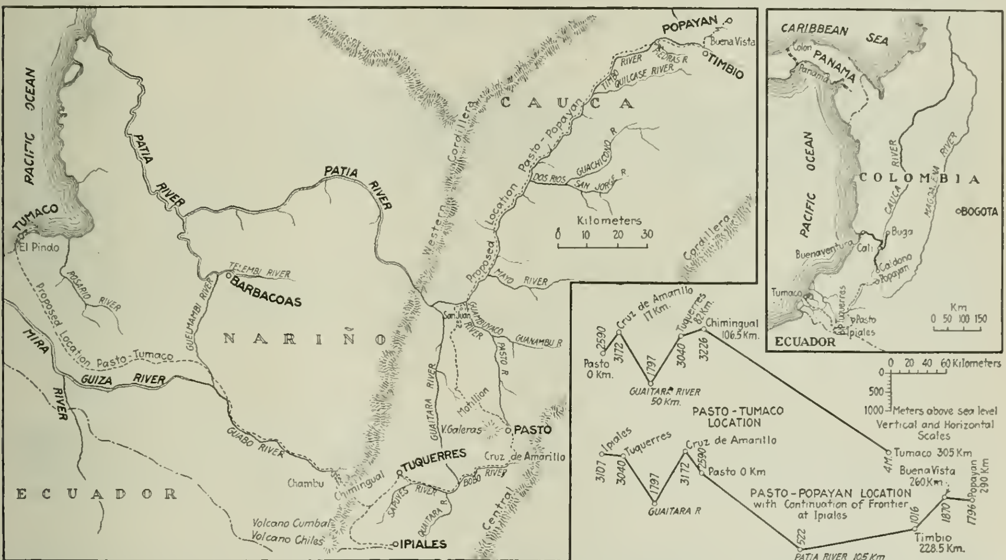
Here the second portion of this location is encountered, that of following the Patia valley as far as its grade might permit, the direction of that stream being conveniently northward with a slight eastward component. The right bank was chosen, to avoid the wide crossings of the rivers Mayo, San Jorge, Guachicono and Quilcase and for the advantage of better topography in other respects.

The crossing of the Patia was effected at Km. 105 from Pasto, at an elevation of 522 m. above sea level, the lowest point in both these projects, except for the termination of the Tumaco line at the coast. The valley of the Patia afforded an excellent route as far as the junction of the Quilcase and Timbio rivers, which form the Patia at that point. Here Colonel Shunk, who had maintained his location far to the east and above us, on the other side of the Patia, dropped to the banks of the stream, and rejecting the Quilcase valley, as we did, because of its more circuitous route and deep upper valley, assumed that the Timbio would carry his grades throughout. He took up his survey on the upper banks of the river above the town of Timbio, on the slopes of the central cordillera again. This assumption, however, is not justified, for although the upper valley of the Timbio near the town of the same name, is flat, and the lower portion carried our limiting grade of 3.5 per cent compensated for 40 km. upstream from the mouth, the river grade between these flatter stretches stiffens to 10 per cent. It was necessary therefore, to cross the Timbio at an elevation of 1,016 m., 228.5 km. from Pasto, and to employ the valley of the river Piedras, on the other side, for development, this being the only stream within reach that was not too steep.

At this point the next characteristic of this location became evident, that of leaving the friendly valleys of the Patia, Timbio and Piedras that had carried the line most satisfactorily for 150 km., to cross the continental divide to Popayan. Running up the Piedras for 4.5 km. and crossing at 1,120 m. above sea level, to continue rising on the northern side, with the maximum grade, found the line sufficiently high to ride out of the Timbio valley, cross that river again near the town of Timbio, and cross the continental divide at the pass of Buena Vista, with an elevation of 1,870 m., the highest point on this location since leaving the corresponding elevation in the first descent from Pasto.

From this pass the final requirement of this location was solved by running toward the city of Popayan in the most direct route, crossing three small rivers near their sources at right angles, to arrive at Popayan, 290 km. from Pasto, and 1,796 m. above sea level.

The entire 290 km. from Pasto was located with no greater grade than 3.5 per cent compensated, the contract requiring this limitation as well as that of 16 deg. metric curves for a minimum. These are equivalent to about 6 deg. .06 min. English, and have a radius of 71.85 m. The minimum tangent between curves of opposite flexure was 40 m., and the rugged nature of the topography traversed is demonstrated by the fact that the line was 49.3 per cent curve, employing 69,000 degrees of central angle, and leaving 147 km. of tangent. The line had 50 km. of level grade, 130 km. of plus grade toward Popayan, to rise 1,900 m., and 110 km. of negative grade, to fall 2,700 m.



MAP OF SOUTHERN COLOMBIA SHOWING THE LOCATION OF PROPOSED RAILWAYS

Fire Destroys Old Wooden Bridge

By Charles A. Mead

Chief Engineer, Bridges and Grade Crossings, New Jersey Public Utility Commission, Newark

FIRE started by lightning on the night of Sunday, July 22, destroyed a very old wooden bridge over the Delaware River at Stockton, N. J. Because of the great age of the structure as well as the nature of its destruction the following notes on it may be of interest.

Records show that the bridge was originally erected in 1812-13. This would make it 110 years old if it was not rebuilt at a later date; there is no record of such rebuilding. No information can be found as to the name of the builder or other pertinent facts.

Since 1911, when the writer first saw the bridge, only such repairs have been made as were necessary to keep it in service. In recent years it has been limited to loads of one ton. A year ago a Packard truck having a nominal capacity of 3½ tons, carrying a load of miscellaneous groceries, attempted to cross the bridge from the Pennsylvania end. It reached the second span from the New Jersey end, where it broke through the floor and fell into the river—a direct consequence of the driver's failure to heed the load-limiting signs. Many of the floorbeams over which the truck had passed were found broken. Repairs were made and the bridge was again opened to traffic under the one-ton limitation.

The drawings reproduced in Fig. 1 herewith show the principal features of the construction of the bridge, as plotted from a survey made in 1914. The spacing of the piers that supported the six river spans was quite irregular. Most of the old timber in the bridge was hemlock. The masonry was random. It is believed that the piers were probably founded on timber grillage and the abutments on rock. The truss intersections were held together with hand-shaved oak treenails 1⅝ in. in diameter.

The fire, which resulted from a lightning stroke on July 22, burned up five of the spans. The New Jersey end span was dragged from its abutment when the adjoining span collapsed; this was due to the continuous truss construction. A number of men who were fighting the fire fell with the span, some being injured. The stonework of the piers was spalled off by the heat 1 or 2 in. deep, and the tops were injured.

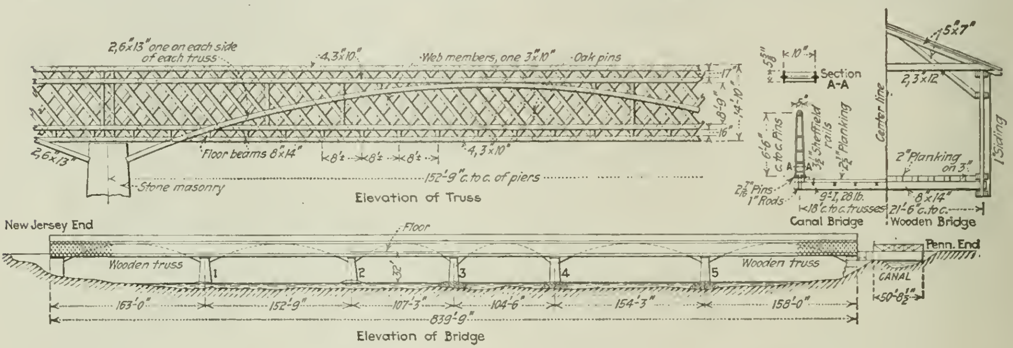


FIG. 1—CHARACTERISTICS OF TIMBER SPANS AND IRON APPROACH SPAN OVER PENNSYLVANIA CANAL

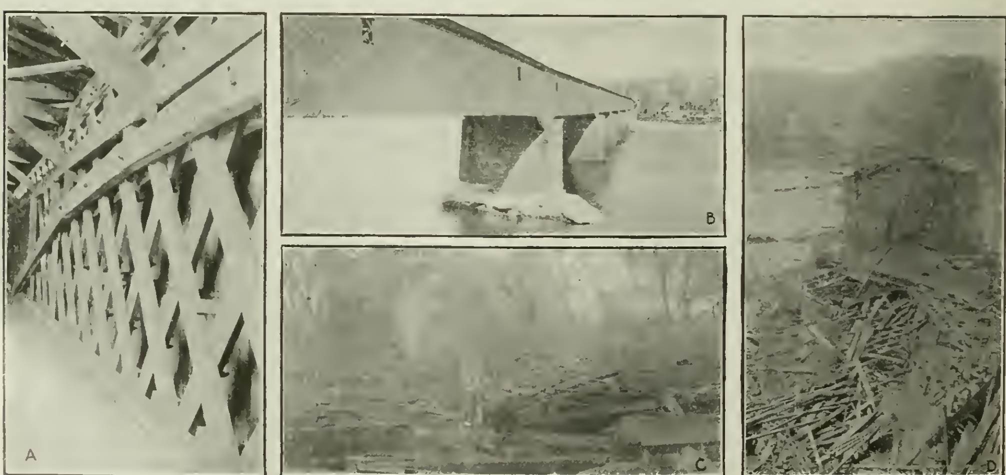


FIG. 2—STOCKTON BRIDGE, BEFORE AND AFTER THE FIRE

A—Interior view showing one of the trusses. B—General view of the bridge. C—Wreckage of the New Jersey Shore span. D—Ruins of the river piers.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Mechanics of the Human Body

REVIEWED BY GEORGE C. WHIPPLE
Professor of Sanitary Engineering, Harvard University, Cambridge, Mass.

LE MOTEUR HUMAIN et les Bases Scientifiques du Travail Professionel—Par Jules Amar, Directeur du Laboratoire de Recherches sur le Travail Professionel au Conservatoire National des Arts et Métlers, Docteur des Sciences, Membre Correspondant de L'Academie des Sciences de Lisbonne; avec une Preface de Henry Le Chatelier, Membre de L'Institut, Inspecteur General des Mines, Professeur a la Sorbonne. 2nd Edition. Paris: Donod. Cloth; 5x7 in.; pp. 690; 324 line cuts and halftones.

This is an interesting discussion of the human body from a mechanical standpoint. It treats of anatomy and human energy. It describes many sorts of experiments in the physiological laboratory and the application of mechanical principles to human labor. Compared with other motors, a laboring man is rated as having about one-seventh horse-power and an efficiency of 30 per cent. These figures mean little because they are apparently based on laboratory experiments of short duration, do not take into account cumulative fatigue, fatigue of particular muscles, mental fatigue, and other factors which are matters of importance.

Nevertheless, the book is an interesting one as showing the care with which the human mechanism is now being studied by physiologists.

River and Harbor Engineering

THE HYDRAULIC PRINCIPLES GOVERNING RIVER AND HARBOR CONSTRUCTION—By Curtis McD. Townsend, Colonel, United States Army (Retired), M. Am. Soc. C. E., Late President Mississippi River Commission. (Engineering Science Series.) New York: The Macmillan Co. Cloth; 6x9 in.; pp. 189; 5 line cuts. $2.60.

The literature in English of river and harbor hydraulics is limited to a very few books and to the proceedings of the technical societies, periodical literature and the report of the Corps of Engineers of the United States Army. Colonel Townsend has therefore done excellent service in setting down the results of his forty years of experience in this kind of engineering work. No one in the United States certainly is better qualified to write on the subject than he.

The book is devoted more largely to rivers than it is to harbors. It traces the geologic and hydrologic history of rivers, outlines the laws governing the flow of water in open channels, analyzes the question of sediment flow and describes methods of flood prediction. All this is the hydrologic side of the river and is not concerned with man's control of it. The next division is on the control. Here the methods of regulation are described in some detail under the heads of Bank Construction and Bank Protection, Improvement by Canalization and Dredging. Three chapters take up the question of flood and navigation control, particularly as relating to the Mississippi River, and repeat Colonel Townsend's well-known views regarding the proper method of control of the Mississippi. There is, moreover, an extended historical-descriptive chapter on flood protection in the various rivers of the world. A chapter on harbors, estuaries, and the mouths of rivers and harbors is followed by a final chapter on the economics of water transportation which is so definite and concise that it would be well if it were circulated to be read by all of the violent enthusiasts of waterways versus railroads. Colonel Townsend is by no means an antagonist of river transportation, but he sees and sets down clearly the conditions which govern such a development.

River regulation is a fascinating branch of engineering which few engineers outside of those in government service have occasion to practice. Moreover, it is a science in which experience counts more than theory. Any engineer, therefore, who has such work to do would do well to fortify himself with the record of experience here set down and thereby add to his own theory.

A.I.A. Promotes Appreciation of the Arts

THE SIGNIFICANCE OF THE FINE ARTS—Published Under the Direction of the Committee on Education of the American Institute of Architects. Boston: Marshall Jones Co. Cloth; 6x9 in.; pp. 481; 128 halftone plates. $3.50; or edition de luxe, $7.50.

To those engineers who ask themselves, What is art? and who wish for a concrete rather than an abstract answer this book should be welcome. It should be all the more welcome because architecture, with which the engineer has so much to do, takes up the larger part of the volume—the book was planned by a committee of the American Institute of Architects.

The specific object of the book is to arouse general "interest in the fine arts" and to create "a better understanding and appreciation of them." Particular attention is given to showing the relation of art to life, historically and today, and, more specifically, how the variations in the arts, and how the different styles of architecture, reflect, and were "developed from, the customs, habits and social and religious life of the several peoples."

By periods, architecture is distributed as follows: Introduction, George C. Nimmons, for the Committee on Education, A. I. A.; Classical, H. Howard Walker, Boston; Middle Ages, Ralph Adams Cram, Boston; Renaissance, H. Van Buren Magonigle, New York; Modern, Paul P. Cret, Philadelphia. A point of importance to engineers is the statement by Mr. Nimmons, that emphasis is placed on "those *vital principles of design and construction* [italics ours] which not only govern all good architecture, but should also influence the character of all other arts and every manufactured product and material thing that human hands can make." The chapter on Modern Architecture, Mr. Nimmons well says, "describes new methods of construction, the new problems of design, the revolutionizing of many old modes of life by the new era of mechanical development, and the interesting reflection of the very pronounced characteristics of the people of today in their buildings."

The Allied Arts are necessarily treated more briefly, but fully enough to give their main significance to the

engineer—and it is to be noted that a hope of more detailed treatment of these subjects later on is expressed. The six topics in Part II are: Sculpture, by Lorado Taft; Painting, Bryson Burroughs; Landscape Design, F. L. Olmsted; City Planning, Edward H. Bennett; Industrial Arts, Huger Elliott; Music, T. W. Surette. Messrs. Olmsted and Bennett are well known to many engineers as experienced practitioners in the two fields which they have reviewed, Mr. Bennett having been associated with the late D. H. Burnham, architect and city planner, and Mr. Olmsted having been long established in both landscape and city planning work.

Well chosen illustrations abound in the various sections of the book and each has a well selected bibliography which will enable the reader to pursue the subject as much farther as he may wish. Altogether the book is a commendable one and should do much to extend the knowledge and appreciation of architecture, the other fine arts and the industrial arts.

Two Notable Books on Town Planning

TOWNS AND TOWN PLANNING, ANCIENT AND MODERN—By T. Harold Hughes, Fellow of the Surveyor's Institution, Associate of the Royal Institute of British Architects, and E. A. G. Lamborn, Hon. M. A. Oxon. New York: Oxford University Press, American Branch. Boards, cloth back; 8x10 in.; pp. 156; colored frontispiece, folding map and 89 line cuts and halftones. $5.

SITE PLANNING IN PRACTICE: An Investigation of the Principles of Housing Estate Development — By F. Longstreth Thompson, B.Sc. (Eng., London), Assoc. M. Inst. C. E., Late Assistant Architect to the Housing Department, Ministry of Health; with a Foreword by Raymond Unwin, F.R.I.B.A., Chief Architect, Housing Department, Ministry of Health. London: Henry Frowde and Hodder & Stoughton. New York: Oxford University Press, American Branch. 16s.; $5.35.

Engineers, architects, and students who are taking up city planning for the first time, or who wish to enlarge or freshen their knowledge of the historic backgrounds of the art and the way it has been influenced by the habits, customs, and spirit of the different periods of history, will find "Towns and Town Planning, Ancient and Modern" useful, interesting, and suggestive. The book surveys town planning the world over from the earliest known examples of ancient times to the present day.

From the book one may learn, either by direct statement or deduction, how largely military considerations governed town planning to and through the Middle Ages; how the ending of the need for walled towns led to a change from vertical to horizontal expansion as populations increased; how a desire to increase land rents encouraged monks and kings to expand town areas by turning agriculture into urban areas, at the same time making villeins and serfs free citizens, through grants in many of the mediaeval borough and city charters; how the "industrial revolution" created city barracks and slums in the prevention or amelioration of which neither the industrial nor spiritual lords of the day took thought, except to oppose—the first having no interest except in factory profits, and the second feeling more concern for proprietors than for people, and for rents from overcrowded, insanitary dwellings than for reforms of any kind; and how in the long process of time it finally was realized that cities exist for the people rather than for emperors and kings, or military, industrial, or religious overlords.

Of all the kingly and military figures chronicled in this history of town planning, Edward I stands out most prominently through the towns he caused to be planned and built in his French, English, and Welsh domains. Louis XIV and Leñôtre at Versailles, Washington and L'Enfant at Washington, Napoleon III and Baron Haussman at Paris, Howard in his visions of the Garden City, and Cadbury and Lever and others in making the vision a reality, and Burnham in his Chicago plan are some of the notable figures since Edward I that appear in this inspiring survey of town planning. In the field of legislation, Sweden as early as 1734 and in more detail in 1874, stands out. Germany took a place of its own, both in theory and practice, soon after Sweden's example. Other high spots are the British Town Planning Act of 1909, due largely to John Burns and Lloyd George (although the former is given no credit in this book) and recent French legislation. Although the book mentions the recent sweep of town planning in America it takes no account of the large volume of state legislation which has given town planning and zoning a legal status here. Nor does it take into account vertical city expansion in America made possible by steel and steel-concrete construction and the high-speed elevator, with the serious problems in city planning thus created.

"Site Planning in Practice," by the London partner of Thomas Adams, is a book of quite a different sort from the one we have been considering, but in a sense it supplements the final chapter of "Towns and Town Planning," which is devoted to current and future town planning. Primarily, the second book is devoted to that part of housing which plans street, block and house-group layouts; but this also includes a consideration, mostly sketchy, of water supply, sewerage and sewage disposal, schools and other public buildings, parks, open places, and main highways. Transportation is even more lightly sketched, to which no serious objection can be made in view of the main topic of the book, but if water supply and sewerage are to be included, why not gas and electric lighting?

The greatest usefulness of the second book lies in its analysis, by text and diagram, and with halftone illustrations where feasible, of the economics, hygienics (light and air) and in less degree the esthetics, of placing houses upon land and providing access to and from them. The facts, figures and illustrations on this main topic will repay study by American town planners, even though some of the governing conditions in England are so different from those in America.

It should be understood that the volume has a still further limitation in that it is confined almost wholly to what may be termed liberal-housing developments under a two-story height limit. That is, the authors base their detailed studies on the new British housing limits of twelve families to the acre (or sixteen houses if 25 per cent is allowed for streets and open spaces). This is liberal compared either with previous two-story house practice in England or with American multi-story tenement and apartment houses.

The attention that the author seems compelled to give to utilizing almost every foot of frontage, even to the extent of almost or quite continuous front walls, is distressing unless one remembers that this twelve-family limit gives every family a fairly deep though narrow front or back yard (considered sufficient to produce an ample supply of vegetables) and until it is realized that the real cost of housing includes all the attendant outlay for: (1) Land, including (a) the house lot and (b) streets and open spaces, and (2) Pavements, curbs, sidewalks, house walks, water and

gas mains, sewers, wires for electric and telephone service. As to how these various elements affect cost, Mr. Thompson takes into account, in his view cost figures, only land, road and sewer construction. Presumably he leaves the cost-elements of the other utilities to be covered in the charges for water, gas, electricity and telephones; or even assumes that in most cases the householders will do without telephones and in many without electricity—neither of which would be expected in most American twelve-family-per-acre new housing developments.

The author gives no evidence of having consulted "Industrial Housing" by Morris Knowles (see these columns, Oct. 21, 1920, p. 807), in which the economics of housing developments, including land, street and utility cost elements, is worked out in detail and numerous examples of site planning are given.

Notwithstanding the usual limitations of a book written chiefly for use in a single country (which applies more particularly to Mr. Thompson's Site Planning) both these volumes deserve wide attention in this country; particularly should they be given immediate place in the libraries of town planning engineers, planning commissions, colleges and municipalities.

Ups and Downs of Business and Labor

BUSINESS CYCLES AND UNEMPLOYMENT Reports and Recommendations of a Committee of the President's Conference on Unemployment, Including an Investigation Made Under the Auspices of the National Bureau of Economic Research. With a Foreword by Herbert Hoover. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 405; diagrams. $4.

Growing out of the work of the President's conference on unemployment, which met in Washington in September, 1921, this report presents the results of an exhaustive investigation together with certain practical and constructive suggestions designed to stabilize business and industry so as to prevent the waste and suffering now brought about by the valleys in the so-called business cycle.

Although the immediate problem of the committee was to cope with the situation then existing, it was recognized that when business depression has come it is too late for any measures except those of relief for the unemployed, and that, if we are to follow a policy of prevention rather than of mitigation, it will be necessary to develop the exercise of foresight and to provide means to maintain greater business stability.

As a result of its studies the committee is confident that the destructive extremes of business cycles can in a large measure be controlled.

In undertaking its study, however, it found that little could be accomplished toward a definite constructive program until the fundamental facts upon which action must be based are made available in current and comparable form. A considerable part of its recommendation concerns means whereby data may be accumulated.

The general methods by which the business cycle may be controlled are outlined by the committee as (1) control of credit expansion by banks generally, (2) possible control of inflation by the Federal Reserve System, (3) control by individual business men of the expansion of their own industries, (4) control of public and private construction, including construction by public utilities at or near the peak of the business cycle, (5) construction of public works in the depression, (6) unemployment reserve fund, (7) federal and state employment bureaus.

Upon these general principles, that is, the need for facts and methods of control, the committee makes ten recommendations. It sets forth also six questions for discussion, addressed respectively to business men, to bankers, to managers of public utilities and public service commissions, to wage earners, to engineers and to citizens' organizations, designed to procure from each its contribution toward the solution of the problem.

Following the formal report of the committee, the greater part of the book is given up to a series of papers discussing the relation of business cycles to unemployment and proposed remedies for present conditions. These have been prepared by authorities in the several fields of economics and social science, and include the following:

Business Cycles, by Wesley C. Mitchell, National Bureau of Economic Research; Individual Industries and Enterprises in the Business Cycle, Frederick R. Macaulay, National Bureau of Economic Research; Economic Losses Caused by Business Cycles, Wesley C. Mitchell and Willford I. King, National Bureau of Economic Research; What the Present Statistics of Employment Show, William A. Berridge, Brown University; Under-Employment, Paul F. Brissenden, Columbia University; Changes in Employment in the Principal Industrial Fields, Jan. 1, 1920, to March 31, 1922, Willford I. King, National Bureau of Economic Research; Effect of Unemployment Upon the Worker and His Family, Stuart A. Rice, Columbia University;

The Various Kinds of Remedies Proposed, by Wesley C. Mitchell, National Bureau of Economic Research; Methods of Stabilizing Production and Distribution, Sanford E. Thompson, The Thompson & Lichtner Co., Engineers, Boston; Problem of "Cancellation," Gilbert H. Montague of the New York Bar; Methods of Stabilizing Work in the Building Industries, Ernest S. Bradford, vice-president of the American Statistical Association; Stability of Railway Operations, Julius H. Parmelee, Director of the Bureau of Railway Economics; Long-range Planning of Public Works, Otto T. Mallery, Member Pennsylvania State Industrial Board; Financial Devices for Controlling or Mitigating the Severity of Business Cycles, Thomas Sewall Adams, Yale University; Public Employment Offices and Unemployment, Shelby M. Harrison, Director of Department of Surveys and Exhibits, Russell Sage Foundation; Trade Union Out-of-work Benefits, John B. Andrews, Secretary of the American Association for Labor Legislation; Unemployment Insurance, Leo Wolman, New School for Social Research; Charting the Course of Employment, Mary Van Kleeck, Director of the Department of Industrial Studies, Russell Sage Foundation; Statistical Indexes of Business Conditions and Their Uses, Oswald W. Knauth, National Bureau of Economic Research; Various Devices used for Stabilizing Business, by a Committee of the Federated American Engineering Societies.

These papers are effectively supplemented by tabular and graphical matter and constitute a unique compendium of data concerning the many factors that enter into modern social and economical development.

United States Bureau of Public Roads

THE BUREAU OF PUBLIC ROADS, Its History, Activity and Organization—By W. Stull Holt. Service Monograph of the United States Government, No. 26. Baltimore, Md.: Johns Hopkins Press. Cloth; 6x9 in.; pp. 123. $1.

In the last few years the work of the Bureau of Public Roads has grown so much and its influence on highway development has become so great as to make it desirable for engineers and others to have a handy volume like this one to which they can turn for information. Between its covers answers may be found to most inquiries likely to be made concerning organization, practices, laws and finances. The Federal Aid Acts are reprinted.

PUBLICATIONS RECEIVED

THE ENGINEERING ASSOCIATION OF MALAY, organized in 1920, published creditable *Transactions* a few months ago and announces that a similar volume for 1922-23 is now ready. The 1920-21 volume contains five papers, with folding plates, on Malayan water-supply works, railways and wharves, and a paper on Deterioration of Structures in Sea Water. Four of the papers are by members and associate members of the Institution of Civil Engineers and one is by an Assoc. M. Inst. Mech. E. (Serembam, Federated Malay States: F. M. Corkill, honorary secretary).

THE MILWAUKEE ACTIVATED-SLUDGE PLANT is briefly described in a pamphlet issued by the Sewerage Commission of Milwaukee, Wis.

SIX PAPERS ON SEWAGE TREATMENT and one on sewerage maintenance are included in the *Proceedings* of the New Jersey Sewage Works Association for the two years 1922 and 1923. Work at the sewage experiment sub-station at New Brunswick, N. J., is the subject of two papers. John R. Downes, of the Plainfield joint sewage-works, discusses odors. A report of a talk on Superfluous Sewage Treatment Works, by M. N. Baker, associate editor *Engineering News-Record*, includes a summary of attempts to treat sewage by electrolysis and comments on the plans to treat the sewage of Trenton by the direct-oxidation process, with particular reference to the Hirst-Potts charges, which had been filed with Governor Silzer shortly before the 1923 meeting of the association. (Myron E. Fuller, secretary-treasurer, 36 Mt. Airy Ave., Philadelphia, Pa.; $1.)

SYSTEMATIC ANTI-MALARIA WORK through the control of mosquito breeding has now been carried on in South Carolina since 1919 under a tripartite agreement between the U. S. Public Health Service, the International Health Board and the South Carolina State Board of Health. An illustrated pamphlet reviewing the work, written by L. M. Fisher, associate sanitary engineer, U. S. P. H. S., may be obtained on request from the State Health Officer, Columbia, S. C.

NOVEL EXPERIMENTS designed to lead up to the design of an intensity rain gage, apparently for use where heavy rainfalls occur, are described in a paper on The Experimental Development of an Automatic Integrating "Intensity" Rain-Gage Without Clockwork, by John W. Meares, C. I. E., M. Inst. C. E. The principle utilized was that the horizontal trajectory of water discharged from a small jet connected with the funnel tube of a rain gage would vary with the head in the gage, which in turn would depend on the intensity of the rainfall. Having determined these trajectories for various intensities, receptacles are located accordingly and, presumably, the depths or volumes caught in each receptacle are measured and a record made in terms of intensities. The author retired from the British Indian Service before his studies had been completed to his satisfaction, but states that installation of the apparatus on a working scale in India is under way; also that he has refrained from taking out patents. (London: Institution of Civil Engineers; Selected Engineering Papers, 1923, No. 2.)

"COMMERCIAL PREPAREDNESS" and "Greater Prosperity Through Greater Foreign Trade" are slogans that appear on the cover and title page of the proceedings of the Tenth National Foreign Trade Convention, held at New Orleans in May of this year. (India House, Hanover Square, New York City.)

THE WATER-POWER SITUATION IN NORTH CAROLINA is outlined in circular No. 6 of the water resources division of the North Carolina Geological and Economic Survey. Besides supplementing and bringing to date similar information given in Circular No. 2 this one enumerates the factors which are tending toward drawing on sources for power supply outside the state.

ENGINEERS OF HIGHWAY DESIGN WILL find suggestive information in the pamphlet of 48 pp. on economics of highway grades, published by the Engineering Experiment Station of Iowa State College, Ames, Ia. From experiments made in 1919, Prof. T. R. Agg arrives at certain tentative conclusions respecting allowable expenditure for reducing highway grades.

THE MINISTER OF PUBLIC WORKS OF ITALY through the Council of Public Waters (Consiglio Superiore Delle Acque Publiche, Rome, Italy) issues in the form of "annali" excellent reviews of water-works practice in Italy. The latest one, Vol. 5 of 1923, second section, has some beautiful views of the Tirso Dam, the highest multiple-arch dam in the world, recently described in *Engineering News-Record;* articles on rock tunnels, design of multiple arches and hydro-electric developments in Italy. The work is under the charge of the eminent Italian engineer, Carlo Bonomi.

NO ONE VOLUME contains more valuable current data on concrete and reinforced concrete than the Proceedings of the American Concrete Institute. Volume 19 of that society, giving the *Proceedings* of the nineteenth annual convention, is now available through the secretary, Harvey Whipple, Friesma Building, Detroit, Mich. It contains in addition to the numerous committee reports of the society a number of well illustrated papers in all fields of concrete design and construction.

New Books and Revised Editions

LE CALCUL RATIONNEL DES ÉLÉMENTS D'UNE CONDUITE FORCÉE EN MÉTAL: Sur base de la Théorie de San Rendement Economique Maximum—Par Paul P.-Santo Rini, Ingénieur E.P.Z., Ingénieur en Chef de la "Societe Anonyme d'Etudes et d'Enterprises," Athens. Grenoble, France: J. Rey. Paper; 6x9 in.; pp. 39; line cuts.

A new printing of a study first published in 1921.

THE DEESIDE REGIONAL PLANNING SCHEME [Chester & Flintshire]: Report Prepared for the Joint Committee of Local Authorities by Patrick Abercrombie, Sydney Kelley and Theodore Fyfe. Liverpool: University Press. London: Hodder & Stoughton. Paper; 10x12 in.; pp. 67; halftone plates and folding maps, some of the latter large and in colors. 7½s. net.

Follows the same general line as the Doncaster report noted at length in these columns July 19, p. 110, but is of far more general interest because Chester and Flint afford remarkable examples of Roman and mediaeval town planning, while Chester has a notable cathedral and the ruins of Flint and Hawarden Castles, as well as other ruins, to add to the attractions of the region considered in the planning scheme. Flint, the report says, was "laid out by Edward I, in 1277, as an appendage to his mighty castle and has preserved its mediaeval plan almost intact." Edward I, it may be added, was one of the greatest town planners the world has known.

ESTIMATING BUILDING COSTS—By Charles F. Dingman, M. Am. Soc. C. E., M. Am. Soc. M. E., M. N. J. Soc. A. New York and London: McGraw-Hill Book Co. Flexible cloth; 4x7 in.; pp. 240. $2.50.

GERMANY'S CAPACITY TO PAY: A Study of the Reparation Problem—By Harold G. Moulton and Constantine E. McGuire, with the Aid of the Council and Staff of the Institute of Economics. New York and London: McGraw-Hill Book Co. Cloth; 5x8 in.; pp. 384; 7 line cuts. $2.

HÜTTE: DES INGENIEURS TASCHENBUCH—Herausgegeben vom Akademischen Verein Hütte, E. V. in Berlin. 24 auflage, II Band. Berlin: Wilhelm Ernst & Sohn. Flexible cloth; 6x8 in.; pp. 1288, illustrated. $2 in Germany.

This volume of the new (24th) edition of the well known Hütte deals, among other things, with steam boilers, steam turbines, metal working machines, ship design, propellors, etc., automobiles, and some phases of electrical engineering.

INDUSTRIAL AMERICA IN THE WORLD WAR: The Strategy Behind the Line, 1917-1918—By Grosvenor B. Clarkson, Late Director of the United States Council of National Defense, with an Introduction by Georges Clemenceau. Boston and New York: Houghton, Mifflin Co. Cloth; 6x9 in.; pp. XXIII +573; 25 halftone plates of individual and group portraits. $6.

INDUSTRIAL DEMOCRACY: A Plan for Its Achievement—By Glenn E. Plumb and William G. Roylance. New York: B. W. Huebsch, Inc. Cloth; 6x8 in.; pp. 359; frontispiece portrait of senior author. $2.

OIL FLOW-VISCOSITY AND HEAT TRANSFER: Including Crude and Fuel Oil Viscosity Temperature Charts, Pipe Line Temperature Drop Charts, Commercial Pipe Coefficient Chart, Pressure Loss in Fittings Chart, and Formula for Testing Oil Heaters, Coolers and Heat Interchangers—By R. S. Danforth, Assoc. Mem. Am. Soc. C. E. San Francisco, Calif.: The Author, 525 Market St. Thick paper, cloth back; 6x9 in.; pp. 16, besides plates; $2.

THE VENTILATION OF PUBLIC BUILDINGS—By Robert Boyle. London: Robert Boyle & Son. Boards; 6x8; pp. 50; line cuts. 6s.

Excerpts from (1) reports of Royal Commissions and Select Committees on Ventilation Appointed by the British Houses of Parliament and (2) from other sources, mostly British, favoring natural rather than mechanical ventilation. Most of the excerpts are undated. A one-sided publication, likely to mislead the uninformed.

TABELLEN UND DIAGRAMME FÜR WASSERDAMPF—Von Dr. Phil. Dr.-Ing. E. H. Osc. Knoblauch, Dipl.-Ing. E. Raisch, and Dipl.-Ing. H. Hausen. Munich and Berlin: R. Oldenbourgh. Paper; 8x10 in.; pp. 32; 3 folding diagrams. 50c.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Soil Tests Essential to Foundation Design

Sir—Having acted, in an advisory capacity, for the Westinghouse Co., in connection with the underpinning of the foundations for their new building in Philadelphia, the writer was glad to see the full description of this interesting work in your issue of August 2, 1923, p. 192.

The ingenious plan adopted by the contractors, and the thorough manner in which the work was carried out, reflect much credit on their engineering and business methods. It is perhaps worth while to add that the strength of the U-bars, by which the new needle beams are attached to the footing slabs, was fully tested by actual experiment in the field.

The principal lesson to be learned from this partial failure, is of course the need, in all cases, of making thorough soil tests, before deciding on the methods to be used in foundations. Very truly yours,

HENRY GOLDMARK,
Consulting Engineer.

New York City, Aug. 8, 1923.

Subways and Building Heights

Sir—In connection with the question of building heights mentioned in the editorial in your issue of July 12, what the cities are doing is described in the Chicago *Herald & Examiner* of July 16 as "Chasing Their Tails." I enclose copy of this editorial.

So far as light, ventilation, architecture and beauty are concerned, these considerations, important though they be, can be laid aside. The difficulty of transportation cannot be laid aside and I do not agree with you when you say that these difficulties have never been made argument in height limitation, but I do agree that they have not received the study which they should. It seems obvious and self-evident that there should be a proper relation between the width of streets serving buildings and the *intensity of occupation* of those buildings. A tall building to be served by a narrow street is as I see it a matter of plain stupidity.

Building subways is a tremendous burden, in one way or another, on a community and it does not solve the problem. It is, in fact, just one step in the process of chasing our own tails.

Chicago, Ill., July 17. B. F. AFFLECK,
President, Universal Portland Cement Co.

[The editorial from the *Herald & Examiner* is as follows:

"When a dog chases his tail we laugh at canine stupidity.

"But when a government announces, through its Navy Department, that an armor has been invented which no shell can pierce, and then follows it with a War Department proclamation of a shell no armor can stop, we call it progress.

"So it is economic progress when wages are raised because prices are high, and then high wages send prices higher, so the wages cannot catch up with it.

"The Kelker report on 'Unified Transportation' made to the Chicago city council recited the fact that in New York City recently a new subway line was built beneath a certain street. Within the year a single building in a single block was built so great in size that it immediately absorbed one-third of the capacity of the new subway.

"That is no reason we should not hasten the building of subways in Chicago. But it is possible that even through subways we shall not travel to the millennium."—EDITOR.]

Computing Motor-Vehicle Fees

Sir—With reference to Mr. Barnett's article on "A Logical Method of Computing Motor-Vehicle Fees," *Engineering News-Record*, May 3, 1923, p. 797, it is desirable at the outset to get the fundamental facts of the question clearly in mind. Mr. Barnett speaks of annual cost and first cost, giving annual cost as the sum of three items, Interest + Maintenance + Sinking Fund—which is correct, but includes first cost, it being assumed that interest and sinking fund is for retiring bonds issued for the improvement. Bonds should not, of course, be issued for maintenance. The writer also assumes that the motor-vehicle owner does not pay the complete first cost of the system. Naturally, the general public as a class, being an indirect beneficiary, should share to some extent in such cost, but not in costs of maintenance.

To start then, where Mr. Barnett does, and with the above in mind, annual cost is the sum of Interest + Maintenance + Sinking Fund Payment. Let us condense this into two items, (1) Maintenance + (2) Interest and Sinking Fund Charge. Now what is maintenance? It is that branch of highway service applied constantly to the system which makes good each defect and deterioration as it occurs, reconstructing where necessary, and in short keeping the improvement or system in the condition *equal* to that in which it was when constructed. Consequently improvements so maintained are permanent, and strictly speaking, wear-proof. The cost of maintenance is the cost of such service. The second item of cost relates to the cost of the original construction.

Now, then, the motor vehicle owner must be assessed for the service which renders the improvement wear-proof, after which he must also share in paying the cost of original construction. This being true, why, then, after the first mentioned service has been paid for, should he be further penalized for producing impact on a road which is already made immune to impact, and is wear-proof (because maintained)?

Where an improvement is provided for a community, its cost must be shared according to the capacity of each individual to utilize or enjoy such improvement, that is, provided it is equally free to their use and enjoyment. Damage to the improvement must be made good by the individual who actually commits the damage, and not by the community according to the capacity of each one to do such damage. Thus, we arrive at the conclusion: for interest and sinking fund payment, each vehicle must pay according to capacity to utilize the system; for maintenance, each vehicle must pay according to the damage it actually does. The sum of the payments makes up the total annual cost.

For all practical purposes the capacity of a vehicle to utilize the improvement varies as to load carried and the speed, for which the fee becomes,

$$\text{Fee} = C \times L \times S = \frac{C \times L \times HP}{W}$$

where C is a constant, L = load above springs, HP = horsepower, and W = total weight loaded. This gives as the fee of the three-ton truck a sum about 50 per cent in excess of the Ford touring car for its item.

So far as the damage done is concerned, Mr. Barnett's formula only gives capacity to produce impact and therefore damage, and hence is useless unless distance traveled is taken into account. There must also be considerable doubt as to the effect of resiliency of tires, and notwithstanding tests made by the Bureau of Public Roads resulting in a factor of 7 for the resiliency of a pneumatic tire relative to the solid tire, it certainly would seem more on the side of safety and conservatism to eliminate this factor for the present, until the actual facts have been demonstrated by more extended field test. Other factors such as applying of brakes, and shifting gears are items whose effect cannot well be calculated. Such uncertain factors are to a greater or less degree taken care of through such a tax as the gasoline tax. As all motorists know, the consumption of fuel is affected very appreciably by condition of tires, speed, shifting of gears, applying of brakes, etc.

While the writer does not believe that the total cost of

maintenance should be met by a gasoline tax, he does believe that between 50 and 75 per cent of it should be, and the balance should be met by a vehicle fee. For those using gasoline for purposes other than the propelling of motor vehicles on the roads, a system of rebates will, it is believed, be worked out.

With a gasoline tax, the items of cost to be met by a license fee become: (1) Maintenance-Gas Tax + (2) Interest and Sinking Fund. The first is met by Mr. Barnett's formula for fee, the second by the one above given, and the sum of the two is the license fee. The constant in the formula should in each case be worked out by assuming an arbitrary value as the fee for a particular car, and then adjusting to give the result desired for the total. The average, as taken by Mr. Barnett, might not be a point on the curve, unless average weight, horsepower, etc., were carefully worked out, which would be laborious and involve useless effort.

Taking Mr. Barnett's figures and assuming that, of the \$6,000,000 total, \$4,000,000 is required annually for maintenance, of which latter \$2,800,000 may be raised by a gasoline tax (given approximately by a 2c. tax on the basis of 350,000 cars) we then have, to be raised by Mr. Barnett's formula, \$4,000,000 — \$2,800,000 = \$1,200,000 and the balance, \$2,000,000, to be raised by the formula proposed by the writer, then assuming Mr. Barnett's figures for average values to be correct and neglecting resiliency,

C (in Barnett penalty formula) =

$$\frac{1{,}200{,}000 \times 3{,}000}{350{,}000 \times 1{,}600 \times 500 \times 30} = 0.000428 \text{ (approx.)}$$

C (in writer's formula) =

$$\frac{2{,}000{,}000 \times 3{,}000}{350{,}000 \times 1{,}600 \times 30} = 0.357 \text{ (approx.)}$$

For the Ford Touring Car:

$$\text{Penalty Fee} = \frac{0.000428 \times 1{,}450 \times 300 \times 25}{2{,}500} = \$1.87$$

$$\text{Utilization Fee} = \frac{0.357 \times 1{,}450 \times 25}{2{,}500} = \$5.17$$

Total License Fee = \$7.04, say \$7

For the 3-Ton Truck:

$$\text{Penalty Fee} = \frac{0.000428 \times 7{,}200 \times 1{,}200 \times 35}{12{,}000} = \$10.80$$

$$\text{Utilization Fee} = \frac{0.357 \times 7{,}200 \times 35}{12{,}000} = 7.50$$

Total \$18.30, say \$18.25

This compares with \$8.50 and \$49.30 respectively as given by the Barnett formula.

J. F. Seiler,
Engineer of Bridges, Wyoming State Highway Dept.
Cheyenne, Wyo.,
June 19, 1923.

[Copy of this letter was sent to Mr. Barnett for comment and his reply follows.—Editor.]

Sir—Mr. Seiler's comments on my article under the caption of "A Logical Method of Computing Motor-Vehicle Fees" are not without merit. It is admitted that no one form of tax will equitably meet all the requirements for a highway development program. It would be well, however, to confine our attention to one subject at a time and to leave for other and separate discussions such collateral issues as the distribution of construction costs between property owners and users of the road, or that of the gasoline tax sales, or whether maintenance should be defined so as to include replacement and reconstruction.

The underlying idea of my original article was that of distributing a given tax burden among motor vehicles in such a way that greater equity to the owners would be assured. The method there proposed applies equally well whether the fees are used solely for maintenance or for the entire annual cost of the road. Neither does this proposed method preclude the adoption of a gasoline sales tax in conjunction therewith.

The fact that motor traffic—through reduction of operating cost and in the saving of time—is the greatest beneficiary of, and is also the largest factor in, producing wear on roads, gives the best reason for collecting from such traffic, by means of license fees, the equivalent of a major portion of the annual costs. We start from the basis that a certain sum of money is to be raised by collecting motor license fees from motor vehicle owners. This sum may be sufficient to pay the entire annual costs or only some part thereof, such as maintenance. That is a matter of state policy and is beyond this discussion. The immediate problem is then so to distribute these fees among the motor vehicle owners that some fairness and equity may prevail.

If we take the use of the road as a basis for assessing fees on vehicles, we are confronted with the difficulty that we cannot determine in advance the amount of such usage. We should need to know not only the distance traveled, but also the load carried. Again if the mere use of the road were the test, then the vehicles that produce the same ton-mileage of transportation should be assessed equally. However, it is readily seen that if these vehicles are of different sizes and types some of them will produce more wear upon the roads than others and that it would then be necessary to devise some means of assessing against the more destructive vehicles a heavier penalty. The gasoline would, of course, afford some partial measure for the use of the road as such usage occurs. But a gasoline-sales tax is not a motor-vehicle tax and so must be left for separate discussion. We are here directly concerned with the proposition of assessing license fees against motor vehicles. The practicable basis, the basis that will give some approach to equity for such assessments, is the amount of wear or damage done the road by any vehicle.

The wear on the road is largely due to impact, which all vehicles produce to a greater or less extent. While it is not practicable to measure in advance the actual impact, or rather to measure the total of a series of such impacts as the vehicle moves over a stretch of the road, it is, however, entirely feasible to determine in advance the capacity of the vehicle for producing impact. It is thus seen that the practicable thing, the tangible thing that we can lay hold of, is the capacity of vehicles to produce impact. The license fees based upon such capacity will be a closer approximation to an equitable standard than anything we now have.

The determination of impact stresses must necessarily include the properties of the body absorbing the impact, as well as the amount of energy stored up in the motor vehicle springs which produces the impact. To leave out the factor of resiliency is to ignore the fundamental principles of mechanics underlying the phenomena of impact. Furthermore there is no reason at this time to discredit or minimize the results of the investigation carried on by the Bureau of Public Roads, for as yet we have no better information nor more reliable data upon which to base our conclusions.

Jefferson City, Mo., R. C. Barnett.
July 2, 1923.

Swiss Rack-Rail and Cable Mountain Lines

Steep-grade mountain railways operated by rack-rail or cable, in Switzerland, aggregate 64 in number and about 98 miles in length, according to a paper in the *Proceedings* of the International Tramway and Light Railway Association by Charles Rochat, general manager of the Geneva Electric Tramway Co., Switzerland. Of 15 rack-rail lines aggregating 67.58 miles, 9 are operated by electricity, with a total of 41.54 miles. The first was the Righi Ry., 4.24 miles, opened in 1877. The latest were the Jungfrau Ry., 5.71 miles and the Villars-Bretaye Ry., 2.29 miles, opened in 1912 and 1913 respectively. The longest is the Wengern Alp Ry., 11.78 miles, opened in 1893. Cable incline railways are 49 in number, aggregating 30.38 miles. Of these 37 lines with 24.8 miles are operated by electricity. The first was the Lausanne-Ouchy line, 1.11 miles, opened in 1877, and the lates. was the Trieb-Seelisberg line, only 0.7-mile, 1916. The longest of these cable inclines is the Sierra-Vermala line, 2.62 miles, opened in 1911.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

An Ordinance Zoning the city of Pittsburgh, Pa., was passed by the City Council on July 29 by a vote of 7 to 1, but at last reports awaited action by the mayor.

A Branch Line 30 Miles Long from near Forsyth, Montana south into the Rosebud County coal fields is being built by the Northern Pacific Ry. Co. to provide coal for its own use on the part of its system between Mandan, North Dakota and Missoula, Montana. A. T. Stevens is chief engineer.

Contracts for the Extension of the Toronto harbor works are in process of being awarded to Roger Miller and Co. of Toronto. The contract is for breakwater work, about 4,000 ft., in front of the exhibition grounds. The extended contract will involve a total outlay of slightly over $1,000,000.

Authorization Has Been Given the Oregon Short Line R.R. by the Interstate Commerce Commission to build a line from Rogerson, Idaho, to Wells, Nev., a distance of 97.7 miles, on the express condition that the construction will be commenced on or before Jan. 1, 1924, and completed on or before June 30, 1925. The cost is estimated at over $5,000,000.

Assurance That the Provincial Government would give its immediate attention to the question of the early completion of the Ottawa-Prescott highway was given by Premier G. Howard Ferguson of Ontario to a deputation which waited on him in Ottawa last week. The Prescott highway is important principally because it is an international highway giving access to the United States.

About $20,000,000 is Being Expended and about 2,000 men are employed on work designed to enlarge and improve the grain transhipping facilities of Fort William and Port Arthur, Ont., in time for the expected bumper crops this year. The storage capacity of the two ports will be increased nearly 10,000,000 bu. by new construction, and a proportionate increase will be made in the handling capacity of the port.

Application Has Been Made by the American Niagara Railroad Corp. to the Interstate Commerce Commission for authority to construct a road from Tonawanda Junction, on the New York Central, to connect with the Canadian Niagara Bridge Co.'s line at the international boundary over the Niagara River, a total of 10.4 miles of track. This new line will furnish connections to the T. H. & B., the C. P. R., and the M. C. R.R., as a new outlet for freight from this territory which has become greatly congested.

Trenton Has Until Aug. 1, 1925, To Build Sewage-Works

The New Jersey Court of Chancery has so modified its injunction requiring the City of Trenton to stop polluting the Delaware River with sewage as to give the city until July 31, 1924, to submit plans for sewage-works and until Aug. 1, 1925, to build the works. This is a sequel to the action of the State Board of Health, on July 31, rejecting for the second time and finally plans for the direct-oxidation process and giving the city a year to file plans for treating the sewage by sedimentation. (See *Engineering News-Record*, Aug. 2, p. 198).

Rock Fill Dam for Hydro-Electric Plant in Kentucky

A rock-fill dam 800 ft. long and 270 ft. high above river bottom will be the principal engineering feature of the plant for 30,000 hp. hydro-electric development now being built on the Dix River near Lexington, Ky., by the Kentucky Hydro Electric Co., which is backed by the Middle West Utilities Co., Chicago. The head will be 235 ft. from river bed to crest of spillway section. Concrete facing will be applied to the rock fill and this in turn will be faced with timber. The dam is about 2½ miles above the mouth of the Dix River, which discharges into the Kentucky River. At present the site is being cleared, railroad spur constructed and camp buildings erected, while construction equipment is being forwarded. L. F. Harza, Chicago, is designing engineer, and the L. E. Myers Co., Chicago, has the construction contract.

Work on Parkway Tunnel in Philadelphia to Resume

The Commissioners of Fairmount Park, Philadelphia, are making plans for resumption of work on the tunnel that will carry surface cars under the Parkway in front of the Philadelphia Art Museum, work on which was stopped several months ago when funds provided for the purpose were exhausted. Resumption is made possible by the transference of about $180,000 from the Department of Public Works to the Commissioners of Fairmount Park.

The tunnel on which work is to be started is at present simply an open cut extending across the Parkway. When completed this tunnel will carry surface cars from Spring Garden Street under the Parkway to the Spring Garden Street bridge over the Schuylkill River.

The sum set aside is not sufficient to complete the entire tunnel and put it in operation, but it will permit completion of the portion of tunnel directly crossing the Parkway, and the extension of the Parkway over this portion of the tunnel.

Irrigation District Votes $23,000,000 Bond Issue

Verde River Project Contemplates Storage of 1,200,000 Acre-Ft. and Developing 68,000 Hp.

Special Correspondence

With but a single adverse ballot voters of the Verde River Irrigation and Power District on Aug. 7 approved the issuance of $23,000,000 in bonds for constructing a dual irrigation and hydro-electric project, plans contemplating the storage of 1,200,000 acre-ft. of water in two reservoirs and the development of 68,000 hp. in seven power plants. The district, which will operate under the laws of Arizona, at present comprises dam sites, power sites, canal rights-of-way and 102,000 acres of irrigable land adjacent to and north of the Salt River Valley Water Users' Association—the Roosevelt project near Phoenix. The district has a right to the flood waters of the Verde River, and the amount of the normal flow not diverted by the Salt River Valley Water Users' Association. Pursuant to the action of the voters of the Verde River district bonds will be advertised for sale in the near future and construction work will be started as soon as the bonds are sold.

Power to Carry Financing

To pay off the bonds from straight irrigation assessments would create a comparatively heavy annual bond charge for a large part of the thirty-year bond issue. In order to make the project more feasible from a financial standpoint, it is necessary to develop hydro-electric power in connection with the irrigation plans, making a dual purpose project. The two reservoirs make it possible to develop about 200,000,000 kw.-hr. per year primary power, and there is also about 20,000 additional kw.-hr. per year secondary power that can be developed by the above plants. There is sufficient market within 100 miles for all of the power and the gross revenue is estimated at $1,900,000.

The irrigation works include the construction of either a rock-fill or a concrete constant-radius arch storage dam with a maximum height above stream bed of 265 ft. and a capacity of 950,000 acre-ft.; a multiple-arch dam with a maximum height of 160 ft. and a capacity of 240,000 acre-ft.; a concrete arch diversion dam with a height of 28 ft.; canals of a total length of 62 miles; a small earth-fill dam; a distribution system for 102,000 acres.

Power will be developed in seven plants, according to the following distribution: 24,000 hp. operating under maximum head of 265 ft.; 3,700 hp. with maximum head of 90 ft.; 12,000 hp. with head of 292 ft.; 8,000 hp. with head of 190 ft.; 6,800 hp. with head of 145 ft.; 8,700 hp. with head of 175 ft.; and 4,900 hp. with head of 95 ft.

The directors of the district are E. W. Michael, president, and J. D. Bowers and H. C. Ludden. John G. Bailhache is chief engineer for the district.

Bluff Plan for Arkansas River Control Approved

District Judge Park Finds Official Project for Flood Control at Pueblo Most Adequate

Formal approval has been given the bluff plan for controlling the flood waters of the Arkansas River at Pueblo, Colo., by District Judge Park, after hearings that lasted more than a week and after careful consideration of all controversial points and the examination of four other plans designed to avert repetition of the disastrous flood of 1921. In accordance with the court's decision construction work will start as soon as sale of the conservancy district bonds can be arranged. (For full description of the bluff plan see *Engineering News-Record*, July 12, p. 48.)

Three Objections Made

Three principal objections had been raised to the execution of the bluff plan; that it offered excessive protection; that it entailed expense out of proportion to the ability of the city and district to pay; and that it endangered the intake and distribution system of the South Side Water Board.

To the first of these objections Judge Park asserted that, though provision for the control of 115,000 sec.-ft. (25,000 sec.-ft. more than the peak flow during the 1921 flood) might be sufficient protection, he believed that the greatest reasonable protection, even though considered popularly excessive, should be provided. The bluff plan contemplates control of a flood of 180,000 sec.-ft., not an impossible flow as testified to at the hearing by flood-protection consultants.

On the proposition of expense Judge Park said that by far the greatest number of objections of increased taxation because of the improvement had been registered by property owners outside of the conservation district. An appraisal of cost given was that the bluff plan would increase taxes but $3.84 per $1,000 of valuation outside the district as against $2 per $1,000 valuation for the cheapest of the other four plans submitted. As $4,000,000 had been made as a high estimate and as a liberal sum was included therein for engineering, contingencies and the acquisition of property over which the new channel would flow, the actual construction could be done, it was estimated, at considerably under $3,000,000, a sum deemed not excessive by the court.

Water-Board Issue

Judge Park said that the objections of the South Side Water Board that its intake would be endangered could be raised against any of the plans and therefore was not to be taken as a too serious objection. That matter was something to be adjusted between the district commission and the water board, said Judge Park.

Opposition to the two other chief plans for controlling the Arkansas was registered by Judge Park principally on the ground that were greater floods to occur than 115,000 sec.-ft., Pueblo would have no protection.

Preliminary investigations and surveys for the project were begun in September, 1921, by the Dayton Morgan Engineering Co.

Moffat Tunnel Bid Opening Postponed Three Weeks

In order that contractors may have more time in which to study plans and specifications, bids for the construction of the Moffat Tunnel through the Colorado Rockies are not to be opened until Sept. 16 according to an announcement by W. P. Robinson, chairman of the commission. The original date was set for Aug. 25.

Southern Pacific to Build Natron Cutoff

Following the announcement that the United States Government will not appeal the recent decision against it in the suit for the dissolution of the merged Southern Pacific and the Union Pacific, the chairman of the executive committee of the Southern Pacific has announced that the railroad company will proceed at once to complete the Natron cutoff. Work on the cutoff was stopped in 1912 when the dissolution suit was started. There still remain 118 miles to be constructed, from Oak Ridge, Ore., over the Cascade Mountains to Kirk, Ore. Survey parties are now at work on this line, which will not only open up a fertile section of country but will also give the Southern Pacific a second line parallel to the coast with much better grades than there are on its present line. The total cost of the work will be between $10,000,000 and $12,000,000.

Illinois Society Acts in Case of A. P. Davis

After consideration of the recent dismissal of A. P. Davis as Director of the U. S. Reclamation Service, the Illinois Society of Engineers has passed the following resolutions:

"Resolved, That in regard to the recent summary dismissal of A. P. Davis, a highly competent and experienced engineer and executive, from the position of Director of the U. S. Reclamation Service, the Illinois Society of Engineers makes emphatic protest against this action of the Secretary of the Interior and against the unjust and sinister method in which this dismissal was effected, namely, by abolishing the position, thus leaving the Director without opportunity for redress.

"Furthermore, protest is made against the appointment of a local banker to practically the same position, but under another title created for the purpose.

"Resolved, That the position in question is one requiring both technical skill and administrative ability, both of which have been exercised by Mr. Davis for several years with marked benefit to the Reclamation Service, the public, and the development of the arid region. And such political interference with work of such importance is a serious detriment to the public welfare, to the work of the Reclamation Service and to the civil service principle, as well as to the engineering profession!"

California A. G. C. Protests Bidding Up Wages

At a special meeting of the Executive Board called for the purpose of dealing with the objectionable practice of contractors bidding up wages for building craftsmen during periods of apparent shortage of help, the Southern California Chapter of the Associated General Contractors of America adopted a resolution against this practice. This resolution, which has been sent to employers in the building construction industry, calls upon the builders and contractors of Southern California to put an immediate end to the practice of recruiting crews of skilled workers from other jobs by offering to pay more than the prevailing wages. The resolution calls attention to the hardship caused to the builders so deprived and the restriction of output of local workmen because of lost time in turnover and the removal of incentive for honest effort.

Break in 24-in. Water Main at Seattle, Wash.

PAVEMENT BROKEN BY BURST WATER MAIN AT SEATTLE

A break in a low-service water main at Seattle, Wash., July 20, broke up pavement, as shown in the accompanying view, flooded basements and damaged property to the estimated amount of $50,000. Gates only a block distant in either direction made the stoppage of the flooding easy.

Sacramento Municipal Utility District Created

By a popular vote of 6,378 to 978 out of a total registration of about 36,000 a municipal water and power development scheme for the benefit of Sacramento, Calif., and presumably some adjoining territory, was authorized on July 2. The proposal voted on was the creation of the Sacramento Municipal Utility District, and the election of five directors of the district. The project on which engineers have already made a preliminary report is for the development of a maximum of 150,000 hp. from the waters of Silver Creek, a tributary of the American River, together with the purchase of the distribution systems of the Great Western Power Co. and the Pacific Gas & Electric Co. within the newly created district. Condemnation proceedings for acquiring these distribution systems are proposed. The estimated cost of the entire project is $8,000,000, divided equally between the new power development project and the acquisition of the distribution system named. An election to vote on bonds for the project is proposed for this fall.

The storage system includes two main reservoirs with a total ultimate impounding capacity of 210,000 acre-ft. and a tributary drainage area of 191 sq.mi. One of the two main reservoirs would be at Union Valley on the main fork of Silver Creek and would be formed by a dam 302 ft. high. The other main reservoir would be at Ice House on the south fork of Silver Creek and would be formed by a dam 138 ft. high. H. C. Bottorff is city manager of Sacramento.

F. A. E. S. Active in Pushing Coal Storage Investigation

Pursuant to its investigation into storage of coal, in co-operation with that of the United States Coal Commission, the Federated American Engineering Societies has sent out a questionnaire to local storage of coal committees of the various engineering organizations, and to their sub-committees, to be by them distributed to the industries.

Printed outlines and sheets giving classifications of industries to be covered are being sent to the chairmen of local storage of coal committees. Upon receipt of these, the chairmen are requested to call meetings of their committees, select the most important consumers of coal in their city and its vicinity, then distribute the questionnaire to the official of each company who will be best able to supply the information desired. Request is made that the classification of industries be followed and that as many companies as possible under each classification be covered, but at least one under each group.

The local committees are at liberty to develop plans as extensively as possible, securing the co-operation of local civic organizations, trade associations or individuals. The Storage of Coal Committee of the F. A. E. S. will handle from the executive office in Washington the largest corporations which have affiliations and branches in many cities, especially the steam railways, steel mills, meat packing houses, sugar refineries, dock and pier storage companies and the navy and merchant marine.

Developing More Water Power in Minnesota

To meet the rapidly increasing power demands of the Mesabi and Vermillion coal ranges of Minnesota a number of electric developments are under way. The Phoenix Utility Co. is increasing its capacity by 40,000 hp. at an estimated expenditure of $7,000,000. The Kawishiwi hydro-electric development of the Minnesota Utilities at Ely, Minn., is nearing completion. It will have an output of 12,000 hp. which will be transmitted 52 miles to the iron mines at Virginia at a voltage of 110,000. The Great Northern Power Co. is also constructing a 110,000-v. line from its Thompson plant to the western end of the Mesabi range. In addition to these developments a 30,000-hp. hydro-electric plant has been started on the St. Louis River just above Fond-du-lac, Minn. This project involves the construction of a concrete dam 100 ft. high and 650 ft. long. Eighteen-foot penstocks will serve the two 15,000-hp. generators.

Cannot Zone Against Two-Family Houses in New Jersey

Direct prohibition of two-family houses is not permissible under the New Jersey statute authorizing municipalities to enact zoning ordinances, declares Chief Justice Gummere in a Supreme Court decision filed on July 31. The suit was brought by the owner of a three-story brick building in Westfield, who had been denied a certificate of occupancy for two families. The judge held that zoning ordinances in New Jersey are based on the promotion of the public health, safety and welfare, and that:

"The [Westfield] ordinance operates upon every residence within the prescribed district, without regard to its size, sanitary appliances or convenience. It permits occupancy and use of a residence by a single family, no matter how large, but prohibits occupancy by two families, although the total membership of the two may be much less than that of the one.

"In short, its only purpose, so far as can be discovered from the language used, is to place a restriction upon the use of residential properties within the designated area without any pretense that such restriction is reasonably necessary for the public health and safety."

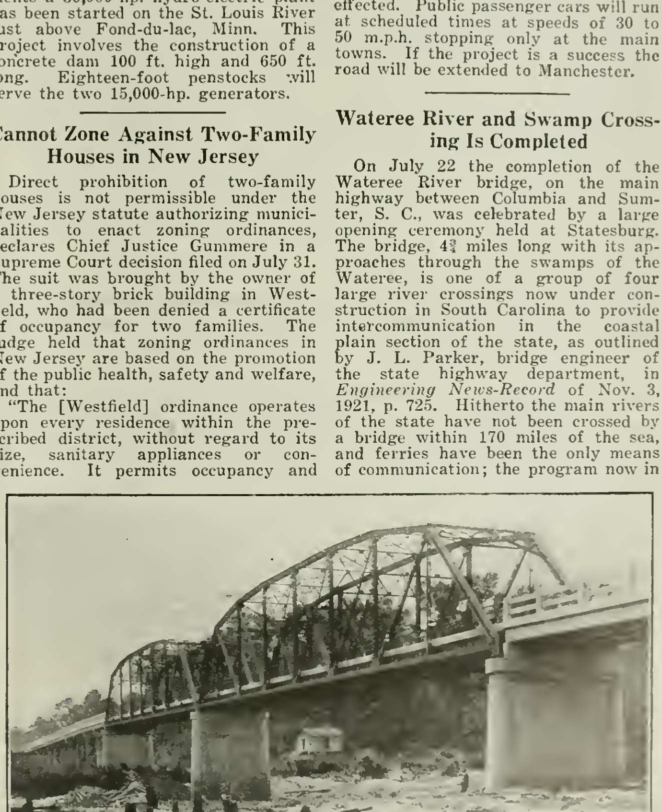
High Speed Motorway for Britain

An innovation in British highway improvement schemes is the proposal to construct a high-speed road from London to Birmingham, about 100 miles. This project will be taken in hand by private enterprise, with the approval of the Ministry of Transport. The route is through Aylesbury, Banbury, Leamington and Coventry. The road will be surfaced with concrete and will be 50 ft. wide and is estimated to cost about six-and-a-half millions sterling, including land, buildings and bridges.

Only mechanically-propelled vehicles will be permitted and pedestrians will be prohibited. Each vehicle will be subject to a toll on tonnage, from which the revenue will be derived. It is estimated that a saving of 20 to 35 per cent on transport charges will be effected. Public passenger cars will run at scheduled times at speeds of 30 to 50 m.p.h. stopping only at the main towns. If the project is a success the road will be extended to Manchester.

Wateree River and Swamp Crossing Is Completed

On July 22 the completion of the Wateree River bridge, on the main highway between Columbia and Sumter, S. C., was celebrated by a large opening ceremony held at Statesburg. The bridge, 4¾ miles long with its approaches through the swamps of the Wateree, is one of a group of four large river crossings now under construction in South Carolina to provide intercommunication in the coastal plain section of the state, as outlined by J. L. Parker, bridge engineer of the state highway department, in *Engineering News-Record* of Nov. 3, 1921, p. 725. Hitherto the main rivers of the state have not been crossed by a bridge within 170 miles of the sea, and ferries have been the only means of communication; the program now in course of execution is the beginning of the work of correcting this condition.



RIVER CROSSING AND CONCRETE TRESTLE OF WATEREE BRIDGE

The Wateree bridge with approaches cost about $300,000, of which half was expended on the main structure. This is slightly over 2,000 ft. long, and comprises two 168-ft. steel spans, 25 spans of concrete trestle of 36½ ft. each, and 49 spans of creosoted timber trestle of 16 ft. each. It was built by the Hardaway Construction Co., of Columbus, Ga., and the Austin Bros. Bridge Co., of Atlanta, Ga.

Random Lines

How To Become a Consulting Engineer

Sir:—You and your lynx-eyed correspondents have uncovered some decidedly rare specimens of specialized engineers. A much older member of this family is the self-styled "Consulting Engineer" of a certain type. How they "get that way" has long been a source of wonderment to the writer.

Perhaps the answer, in part, at least, may be found in the enclosed advertisement which was clipped from the Help Wanted columns of the Aug. 8 issue of the New York *Times*.

ELECTRICAL ENGINEER, who has had considerable experience in transformer design to tutor an engineer about to engage in consulting work in the fundamentals and practical design; evenings preferred; state experience, location and rate. C 400 Times.

The advertiser, an embryonic "Consulting Engineer," in this instance, at least, is apparently endeavoring to become prepared in the fundamentals of his chosen field before he essays to advise the rest of the profession. Let that much be recorded to his credit. For it is much more than can be said of quite a few of his brethren.

A. E. C.

* * *

Up in Buffalo, Karr Parker has been elected president of the local engineering society. Under the inspiration of such a name the Buffalo society should get something done about the automobile congestion in the downtown district.

* * *

In Explanation

A correspondent has submitted an advertisement of a "belting engineer" to be added to our *index ridiculosus* of adjectival engineers. This prompts a brief explanation. There are many adjectives quite properly applied to the word engineer to describe a specialty. The test of propriety would seem to be the qualification of the person so described to the term engineer, unmodified and alone, and the justification of the specialty to be a branch of engineering. Thus our much advertised friends the "exterminating engineers" are jokes, because the gentlemen who engage in this useful business are not, when so engaged, engineers, nor is the removal of bugs from kitchens a branch of engineering. So too our "hymn book engineers," and a newcomer, a "kitchen engineer" who helps a Buffalo supply house sell cook stoves and steam tables, are only stealing an honorable title. On the other hand when you come to "belting engineers" the case is not so clear. The proper solution of the problems of belt design and application may call for engineering skill and there may reasonably be engineers whose entire professional practice is confined to so narrow a field. There may be criticism for such close delimiting of professional activities, but it is all in the family. The jibes at "insurance engineers," who are merely insurance salesmen and "merchant engineers" who are heaven knows what, are expressions of group resentment. The more publicity that can be given to such resentment the sooner will the practice of title stealing be stopped.

Six Scalded to Death When Bus Rams Concrete Mixer

Six women died from burns and shock received last week when the autobus in which they were returning to New York City from an outing rammed a concrete mixer, near Nyack, ripping away the main steam supply line from the boiler to the mixer. The accident happened on Highland Avenue, where a state road is under reconstruction. The road is being rebuilt half width at a time. Two buses composed the party; and the first of these had succeeded in passing the mixer on the narrow strip, but the second sideswiped it, then became so entangled in the wreckage that the bus driver was unable to proceed. The broken steam line enveloped the occupants of the bus, who were all employees of the *Christian Herald*, New York City, with steam, with the fatal results noted.

Though the accident happened in the evening after the road gang had quit for the day, it is said that the mixer boiler showed a steam pressure of 150 lb. When the line was broken, the mixer tender could do nothing to shut the steam off. The road at the point of the accident is being reconstructed under state supervision.

An investigation is under way to determine the exact cause of accident and to fix responsibility for its fatal results.

New Hudson River Connecting R.R. Will Have No Grade Crossings

In anticipation of any future need of grade crossing separation, the Hudson River Connecting R.R. Co., which is building the Castleton cut-off on the New York Central System, will provide over or under crossing for all of the seventeen highways on its new line. For this purpose it has presented five petitions to the Public Service Commission at Albany. Physical conditions determine the type of crossing used at the various points. The plans filed call for an overhead bridge at Courtney crossing in Stuyvesant, an under pass at McCabe's in Stuyvesant, and under passes for the Requas highway and the county highway in Columbia County. The two latter highways are to be reconstructed by the railroad on a new alignment.

City-Manager Plan Voted Down at Plainfield, N. J.

The commission-manager plan of city government has been rejected by the voters of Plainfield, N. J., 2,225 to 346. The total vote was only 40 per cent of that at the last gubernatorial election and the vote for the plan was less than half the number of signers of the petition. The election was held under a law passed last winter—the first authorization of the manager plan in New Jersey. The plan was also defeated recently by the voters of Deal, the first municipality in New Jersey to vote on it. Plainfield is operating under the mayor-and-council plan, and is one of a few cities or towns of size in the state which has not adopted the commission as contrasted with a commission-manager plan.

Coolidge Withholds Policy on Anthracite Question

While officially there has been no move made by the federal government in the anthracite situation, it is known that the threatened cessation of work in the hard coal fields when the present agreement expires Aug. 31 has been given considerable thought by President Coolidge as well as by other officials. Despite many rumors and newspaper reports asserting as a fact that first one course then another will be pursued by the government, there has been no formal announcement of policy.

The activities of the Coal Commission have been restricted in the last week owing to the halting of governmental activities in Washington for three and a half days on account of the death of President Harding. Members of the commission have been watching for developments in the anthracite situation but formal meetings of the body practically were suspended for a week.

The Coal Commission made public last Wednesday a report submitted it by a special staff composed of Henry S. Dennison, Willard E. Hotchkiss and Joseph H. Willits, on "Labor Relations in the Anthracite Industry." This report was one of those upon which the commission based its recent report and recommendations regarding the anthracite industry.

The commission also made public a statement showing that it will be impossible for the commission to make the detailed investigation of the retail coal industry throughout the country as such a survey would cost $2,000,000 and in all probability would not be conclusive.

As the crisis in the anthracite industry through the apparent deadlock in negotiations between operators and miners is of immediate importance and is pressing for attention as the days of August pass, the situation has been called to the attention of President Coolidge by a number of visitors who were accorded audience with him in his first week as Chief Executive. It may be stated upon reliable authority that President Coolidge has not indicated a course of action definitely.

Newfoundland to Develop Power and Build Paper Plant

The Newfoundland legislature, on July 11, approved the agreement whereby the government will take over the Newfoundland Railway from the Reid-Newfoundland Co., along with land and port facilities belonging to that company. It also confirmed the agreement whereby the Newfoundland Power & Paper Co. is to develop hydro-electric power and establish a paper mill on the Humber River.

The company is to issue $20,000,000 worth of bonds, one-half of which is to be guaranteed by the British government, to be expended in Great Britain for machinery and other equipment; the other half is to be spent in acquisition of lands and buildings in Newfoundland.

The contract for the excavation of the canal on the Humber River, as the first step in this development, has been awarded to the Northern Construction Co. of Vancouver, B. C.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; Annual Conference, Chicago, Sept. 27-28, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga.; Nov. 12 to 16.

The North Carolina Society of Engineers held its annual convention August 10 and 11 at Asheville, N. C., and the North Carolina Branch of the American Association of Engineers held its sessions at the same time. John L. Becton is president and H. K. Witherspoon is secretary-treasurer of the first-named society.

The New York Chapter of the American Association of Engineers has elected the following officers: E. G. Haines, president; Dr. D. B. Steinman and Walter E. Brown, vice-presidents; Paul S. L. Bolger, treasurer, and Walter A. Craft, secretary.

The Duluth Engineers Club recently elected Frank Hutchinson president for the coming year. A. U. Shipman is the retiring president. Other officers elected are: Arthur M. Frazee, first vice-president; H. W. Richardson, secretary; Fred C. Baluss, treasurer; and F. E. House, J. L. Pickles, W. A. Clark and A. U. Shipman, directors.

Personal Notes

J. M. MARSHALL has been appointed district engineer of the Portland Cement Association office at Atlanta, Ga., succeeding WALTER B. ELCOCK, who has recently been promoted to assistant general manager in charge of the southeastern offices of the association. Mr. Marshall is a graduate of the Virginia Military Institute. To 1917 he was engaged in engineering work for the Seaboard Air Line and Pennsylvania R.R., and in rapid transit subway construction in New York City. He was a captain in the 11th Engineers and since the war has been connected with the New York office of the Portland Cement Association.

JAY T. WILLIAMS, civil engineer of Denver, Colo., and for the past seven years connected with the C. S. Lambie Construction Co., has been appointed building inspector for the city of Denver, succeeding FRANK M. LADD, retired by the newly elected mayor.

COMMANDER C. A. CARLSON, U. S. N., has been detached from duty as public works officer of the 14th Naval District at Pearl Harbor, Hawaii, and has been assigned to succeed CAPTAIN L. M. COX, U. S. N., the public works officer at Mare Island, Calif. Captain Cox has been on duty since 1919 and will be retired at his own request.

HARRY A. STORRS of San Francisco has been appointed chief engineer for the Modesto Irrigation District at Modesto, Calif., succeeding Percy F. Jones, resigned.

MYRON HENDEE, formerly connected with Thomas F. Bowe, consulting engineer, New York City, has taken up practice in surveying and municipal engineering in Bogota, N. J.

RUDOLPH P. MILLER, consulting engineer of New York City, the representative of American Engineering Council on the National Board for Jurisdictional Awards in the Building Industry, was elected chairman of that board at its recent meeting in Atlantic City, N. J.

STAFFORD X. COMBER announces resumption of private practice as consulting engineer in public works and general construction in the domestic and foreign fields. Mr. Comber, who is an American, educated at the University of London, was in 1918 retained by the British government to report on water resources in British Guiana, and also built reinforced-concrete drainage and irrigation works at Demerara. Later for a European contracting firm he visited the Mourne Mountains, Ireland, and reported on a large dam construction for the city of Belfast. Again for the British government he reported on a route for a mountain highway and hydro-electric railway to the interior of Venezuela and Brazil. Mr. Comber's earlier work was with contractors in New York City, on Pennsylvania R.R. tunnels, on work for the Ashokan Dam and the Catskill Aqueduct, on subway construction and underpinning of large city buildings. For a short time he was production superintendent of ten factories in France and Belgium breaking down surplus Allied and surrendered German ammunition and recovering metal and chemicals for commercial use; also he was for a time progress engineer for the Southern California Edison Co. His present address as consulting engineer is 32 West 40th St., New York City.

LOUIS E. AYRES, GEORGE E. LEWIS, ROBERT NORRIS AND DONALD C. MAY, Ann Arbor, Mich., announce the formation of a partnership for the practice of hydraulic and electrical engineering. All of these men have been with GARDNER S. WILLIAMS, consulting engineer; Mr. Ayres as principal assistant engineer, Mr. Lewis as electrical engineer, Mr. Norris as supervising engineer and Mr. May as designing engineer. Mr. Williams will continue his consulting practice at his old address.

W. EARL WELLER, city engineer of Binghamton, N. Y., has accepted a position in the Bureau of Municipal Research, Rochester, N. Y., to compile data on municipal projects in all sections of the country of interest to the city of Rochester. Mr. Weller designed the boulevard lighting systems of Binghamton, established a new accounting and tax assessment system for the city, and also designed the memorial bridge across the Chenango River. Mr. Weller has not definitely decided when he will leave Binghamton.

NORMAN L. STANN, chief engineer of the Department of Wharves, Docks and Ferries, Philadelphia, Pa., and for 27 years in municipal service in Philadelphia, having been made assistant engineer of the Bureau of Surveys in 1897, has retired, on the pension list.

JOSEPH A. ELLIOTT has been appointed superintendent for the Utah Construction Co. on the construction of a new line of the Southern Pacific in Mexico between Tepic and Guadalajara. Mr. Elliott has recently been in charge of the construction of an icing plant in Nevada for the Western Pacific Ry.

C. E. BLEE, formerly assistant engineer, California-Oregon Power Co., Medford, Ore., has accepted a position at Vaucouver, B. C., as chief assistant to E. E. Carpenter, consulting engineer in charge of new construction for the British Columbia Electric Co. Mr. Blee has been associated with Mr. Carpenter on three previous construction jobs, the Jordan River power development and the Sooke water project on Vancouver Island, and in the construction of buildings for the Panama-Pacific International Exposition.

IRVING R. FRAY has severed his connection with the Louisiana Highway Commission, engineering department, where he has served since the organization of the commission, and has been made special representative of the Southern Surety Co., of Des Moines, Ia., with headquarters at Baton Rouge, La.

Obituary

LEROY W. CUMMINGS, a highway engineer in the employ of the California Highway Commission, died near Clear Lake, Calif., recently at the age of 43 years. Mr. Cummings was a graduate of Harvard University. Prior to the World War he was a construction engineer for the California Highway Commission. He served during the war as a captain of the 23rd Engineers and then became senior highway engineer with the Bureau of Public Roads stationed at Chicago. Later he rejoined the military establishment as captain of engineers but resigned on account of poor health and in the spring of 1923 again entered the service of the California Highway Commission.

THEODORE RALL, chief engineer of the Strobel Steel Construction Co., died recently in Chicago. He was the inventor of the Rall type of bascule bridge.

HERMANN J. STROBEL, supervisor of appraisals, of Stone & Webster, Inc., Boston, died Aug. 3 following an operation. He was 41 years old and had been with the Stone & Webster organization for the past eleven years in electrical engineering and appraisal work. From 1905 to 1911 he was with the New York Central & Hudson River Railroad in New York as chief draftsman and assistant engineer on the electrical work of the Port Morris and Yonkers power stations and the Grand Central Terminal.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Steel Corporation Starts Abolition of 12-Hr. Day

Change to Eight Hours to Be Gradual—Workers to Get Higher Pay Rate But Will Earn Less

In accordance with a decision arrived at more than a week ago by the American Iron and Steel Institute, confirmation of which intent was given later by Judge Elbert H. Gary, abolition of the 12-hour day in the steel industry begins today, Aug. 16. This action is the culmination of a series of conferences which began late in June after President Harding had asked the Institute to guarantee ending the long steel day as soon as labor conditions in the industry would permit. Elimination of the 12-hour shift and the 24-hour shift once every two weeks will progress as rapidly as the supply of labor will permit. It will not, however, be simultaneous in all of the Corporation plants, changes depending upon labor conditions in the respective mills.

Judge Gary's Statement

According to Judge Gary's statement of ten days ago "where the hours of employees connected with continuous process are reduced from 12 to eight hours, their wage rates will be so adjusted as to afford earnings equivalent to a 25 per cent increase in hourly and base rates. All other workmen will be on 10 hours or less and their present hourly and base rates will be continued; but whenever it is practicable, by promotions or changes in position, the daily earnings will be accordingly adjusted."

It has been estimated that 60,000 more men will be needed in the steel mills to make possible the total elimination of the 12-hour day. It is understood that about 60 per cent of the quarter million employees of the Corporation are working on the two-shift basis of 12 hours each. The hourly rate of these workers is 40 cents. The daily wage would therefore be $4.80. Should the hour rate increase 25 per cent, that would mean a base pay of 50 cents, and on an eight-hour shift a daily rate of $4. In wages therefore 80 cents a day will be lost but four hours more leisure will be gained for the workers.

Effect on Prices

What effect the elimination of the 12-hour day will have on the price of steel products is problematical, but when a change to eight hours was first considered the Institute received a report from an investigating committee that prices would be raised about 15 per cent by the change. Installation of mechanical devices and removal of certain immigration restrictions to allow the absorption of a greater number of alien workers should, it was believed, offset this theoretical price advance.

Oil Equipment Manufacturers To Hold Exposition at Tulsa

With 125 manufacturers of oil equipment and appliances signed up as exhibitors at the International Petroleum Exposition and Congress, to be held in Tulsa, October 8-14, the directors of the "first world oil show" declare the display of machinery, scientific instruments, mechanical equipment and new devices, all of interest in some phase of the oil industry, will be one of the largest exhibitions held in that part of the country. Every phase of the oil business will have its technical display. Supply companies, belt and cordage makers, rig manufacturers, tank and pipe makers, will all present displays—for oil producers. Displays also will attract the refiner, the jobber, marketer and filling station man.

Tulsa's convention hall will be the center of activity during the exposition. Streets on all sides of this building will be closed and fair buildings are to be erected for housing the displays.

New July Record Set for Automobile Production

Production of motor vehicles in July was 318,000, according to the estimates based on shipping reports received by the National Automobile Chamber of Commerce. As expected, July showed a slight seasonal decline, compared with the extraordinarily large records of the previous months; but compared with the corresponding month in previous years July set a new record, gaining 29 per cent over July 1922. The weekly trend in production was upward during July, the last two weeks being larger than the first two weeks in the month. The output of cars and trucks during the first seven months of this year was 2,344,000, showing an increase of 68 per cent over the corresponding period last year.

Number of Locomotives Needing Heavy Repair Increases

According to a recent statement issued by the Car Service Division of the American Railway Association, Class One railroads of the United States had in need of repair on July 15, 11,855 locomotives, or 18.6 per cent of the total number on line. This was an increase of 405 over the total number on July 1, at which time there were 11,450. Of the total number on July 15 last 10,784, or 16.9 per cent, were in need of heavy repair. This was an increase of 458 over the number in need of such repair on July 1.

The railroads on July 15 had 2,437 locomotives in good repair and stored away to meet increased traffic demands later in the year. This was an increase of 256 over the number in storage on July 1.

During the first fifteen days in July 18,290 locomotives were repaired and turned out of the shops.

Preliminary Plans Made for 1924 Road Show

Record Convention and Greatest Number of Exhibitors Forecast — Questionnaire Circulated

From interest manifested by exhibitors and state highway officials, the 1924 convention of the American Road Builders' Association will be greater than any previous one, according to Charles Upham, convention manager and state highway engineer of North Carolina. Already preliminary plans for the convention and the Road Show have been made and certain blanket contracts entered into for moving machinery to the Coliseum in Chicago where the Show is to be held.

Mr. Upham, in a recent bulletin, asserts that the indications point to an early rush for space and that while every attempt will be made to locate satisfactorily all exhibitors, it is already apparent exhibitors will not be able to get as much space as they desire, nor will location in every instance be ideal. However, with the idea in mind to locate every exhibitor as agreeably as possible, a questionnaire has been circulated among manufacturers requesting information as to satisfaction of location and amount of space at the 1923 convention, value of registration of delegates to the convention, the comparative value from an exhibit standpoint of various exhibit locations.

Road Show Dates

The Road Show is to be held from January 14 to January 19. The Coliseum will be occupied until 12 o'clock on Jan. 12. However, exhibitors are to be allowed to store their equipment up to five days ahead of this time in the annex. Exhibits in the ballroom may be set up Jan. 7. The main floor of the Coliseum will not be available until Jan. 13 and the balcony until Monday, Jan. 14. This condition will exist because a show is to be held in the Coliseum during the week previous to the American Road Builders' Show. Negotiations are now under way with the Coliseum people to change the time of the show that is to be held previous to the Road Show, so that additional time may be secured. Definite arrangements on this score are to be concluded before Aug. 20. The Greer Building will be available to exhibitors five days previous to the opening of the Road Show.

The Congress Hotel has been selected as convention headquarters where the daily meetings and the annual banquet will be held. The organization for handling the Road Show in 1924 will be somewhat similar to that which functioned this last January.

Engines Exported

Exports of stationary internal combustion engines during May, according to figures from the Department of Commerce, were as follows: 359 Diesel and semi-Diesel engines valued at $130,976; 2,968 gas engines not over 8 hp. valued at $255,265; and 113 gas engines over 8 hp. valued at $72,251.

Argentina received the greatest number of the Diesel engines, 310, costing $117,800. Japan was the biggest user of the gas engines under 8 hp., taking 1,225, costing $100,220.

Government Figures on Industrial and Commercial Movements

The Department of Commerce announces the following figures representing industrial and commercial movements in june:

Contracts awarded for construction in 27 northeastern states amounted to $323,559,000 in June as against $374,400,000 in May and $343,440,000 in June a year ago. In point of floor space construction contracts awarded in June aggregated 46,344,000 sq.ft. as against 60,430,000 sq.ft. in May and 60,526,000 sq.ft. in June, 1922.

Production of Southern pine lumber amounted to 450,408,000 board feet as compared with 499,247,000 ft. in June a year ago. Stocks on hand at the end of June aggregated 1,054,133,000 ft. as compared with 1,095,580,000 ft. on June 30, 1922.

Production of oak flooring in June amounted to 34,342,000 board feet as against 34,636,000 ft. in May and 23,495,000 ft. in June a year ago. New orders booked called for 15,081,000 ft. as against 22,677,000 ft. in May and 24,472,000 ft. in June, 1922.

Production of clay fire brick in June amounted to 63,861,000 bricks as against 48,367,000 bricks a year ago. New orders amounted to 46,244,000 bricks as against 57,805,000 bricks ordered in June, 1922.

A total of 24,640,000 face brick was produced in June as compared with 26,057,000 in May and 28,673,000 in June a year ago. Unfilled orders at the end of June amounted to 54,128,000 bricks as against 57,363,000 bricks on May 31 and 43,283,000 on June 30, 1922.

Brick Paving Committee Conference Postponed

Due to the inability of two of its members to attend the meeting scheduled for Tuesday, Aug. 14, the session of the Advisory Committee of the National Paving Brick Manufacturers Association has been postponed until the following Tuesday, Aug. 21, at Cleveland. This meeting is primarily to consider and take action on the revised specifications and text book on Brick Pavements.

The invitation extended to the membership of the association to submit suggestions as well as to attend this meeting in person still holds good.

Steel Industries Plan Exposition

Over 100 manufacturers of steel mill apparatus have combined to hold an iron and steel exposition at the Buffalo, N. Y., auditorium, Sept. 24-28. Exposition managers plan to make the demonstration one of the greatest exhibitions of electrical, mechanical, power and combustion apparatus. One of the features of the exposition will be a modern electrified foundry which will be in actual operation under the supervision of E. T. Langworthy, a steel expert. The foundry will produce finished products and will start with hot metal, passing from machine to machine until its final form.

The purpose of the exposition is chiefly to bring to the attention of the steel mill world the latest improvements in devices which have to do with the conservation of fuel, production of steel, etc.

Gypsum Production for 1922 Nearly 4,000,000 Tons

According to a statement issued by the Department of the Interior, compiled from statistics collected by the U. S. Geological Survey, the demand for most of the gypsum products was greater in 1922 than in 1921. During the year 3,779,949 tons of gypsum were mined, an increase of 24 per cent over the output in 1921. The sales of agricultural gypsum decreased from 104,966 tons, valued at $490,902, in 1921, to 101,904 tons, valued at $387,203, in 1922. The sales of gypsum for use in Portland cement, paint, and other compounds amounted to 668,821 tons, valued at $2,056,143, an increase over the corresponding figure for 1921 of 24 per cent in quantity and of 16 per cent in value.

GYPSUM PRODUCED AND SOLD IN THE UNITED STATES IN 1922, BY USES

Calcined:	Short Tons	Value
Stucco	396,990	$2,813,561
Neat plaster	1,333,261	12,126,811
Sanded plaster	80,455	1,165,771
Mixed plaster	(a) 218,650	1,914,572
Plaster of Paris, molding, casting plaster, etc.	(b) 126,288	1,198,819
Keenes cement	21,991	324,316
Plaster board	42,088	945,171
Wall board	120,591	4,500,725
Partition tile	68,338	915,449
Roof tile	(c)	(c)
Special tile or blocks	44,834	368,068
Other purposes	37,779	644,542
	2,491,265	$26,917,805
Crude	770,725	2,443,346
	....	$29,361,151

(a) Includes small quantity of wood fiber plaster. (b) Includes dental plaster and plaster sold to plate-glass works. (c) Included under "Other purposes."

The accompanying table shows by uses the quantity and value of gypsum sold during 1922. Much of the difference between the 3,779,949 tons of gypsum mined and the 3,261,990 tons produced and sold in United States represents exports.

Compton to Study Lumber Conditions Abroad

Wilson Compton, secretary-manager of the National Lumber Manufacturers Association, is now in Europe and will represent the American lumber industry at the Swedish Tri-Centennial Exposition at Gothenberg. The Bureau of Foreign and Domestic Commerce of the U. S. Department of Commerce has requested A. X. Oxholm, chief of the lumber division, who is already in Europe, to accompany Mr. Compton on his special tour of the Swedish saw mills and forests. Mr. Compton's special purpose in the Swedish trip is to get a first hand impression of waste prevention and raw material utilization methods of Scandinavian mills.

The United States commercial attaches in different European cities will assist Mr. Compton in his study of the methods used in Europe for enforcing and guaranteeing lumber quality and dimension standards. Mr. Compton will also probably make a brief tour of German national and municipal forests, in company with a party of Oxford foresters under the guidance of Dr. C. A. Schenck, of Darmstadt, who was formerly in charge of the Biltmore Forest School in North Carolina.

West Coast Lumber Production 17 Per Cent Above Normal

One hundred and thirty mills reporting to the West Coast Lumbermen's Association for the week ending July 28, manufactured 103,264,839 ft. b.m. of lumber; sold 95,063,633 ft.; and shipped 97,842,724 ft. Production for reporting mills was 17 per cent above normal. New business was 8 per cent below production. Shipments were 3 per cent above new business.

Thirty-nine per cent of all new business taken during the week was for future water delivery. This amounted to 36,669,991 ft., of which 26,530,805 ft. was for domestic cargo delivery; and 10,139,186 ft. export. New business by rail amounted to 1,792 cars. Thirty-nine per cent of the week's lumber shipments moved by water.

In the first thirty weeks of the year, production reported to the West Coast Lumbermen's Association has been 2,941,715,476 ft.; new business 3,027,109,400 ft.; and shipments 3,210,996,676 ft.

Business Notes

RAYMOND CONCRETE PILE CO. announces the opening of a Pacific Coast office in the Washington Bldg., Los Angeles, Calif., with O. C. Struthers, formerly with Pratt & Thompson, Kansas City, in charge.

JOHNSON GAS APPLIANCE CO., Cedar Rapids, Iowa, manufacturers of gas torches and furnaces and other appliances, have taken over the manufacture and sale of the Moore self-cleaning rake, having acquired on July 1 all equipment, stock, patent rights, etc., of the Moore Self-Cleaning Rake Co. of Cedar Rapids.

SOUTHERN PINE ASSOCIATION at a recent meeting in Chicago elected H. C. Berckes, of New Orleans, secretary-manager to succeed the late J. E. Rhodes, who died recently. Mr. Berckes has been connected with the Southern Pine Association staff almost since its organization in 1915 and has been assistant secretary since 1919.

GILMORE OIL CO., Los Angeles, is the name of the new organization formed by the consolidation of the A. F. Gilmore and Gilmore Petroleum companies. L. Hoffman-Pinther has been named advertising manager.

FRANKLIN S. TERRY, co-manager of the National Lamp Works, Nela Park, Cleveland, was elected vice-president, and B. G. Tremaine, also co-manager of the National Lamp Works, was elected a director of the General Electric Co., Schnectady, N. Y., at a meeting of the board of directors held in New York City, June 22.

WHITING CORP., Harvey, Ill., has opened a district sales office in Birmingham, Ala., in charge of W. R. Hans as district manager. The Birmingham office will handle sales in Alabama, Georgia, Tennessee and northern Mississippi for the Whiting Corp, and its

subsidiaries, Grindle Fuel Equipment Co. and Swenson Evaporator Co. The Company also plans to open on July 1 a district sales office in Cleveland, Ohio, in charge of R. P. Dryer.

Equipment and Materials

Rugged Construction a Feature of 21-E Paving Mixer

Ruggedness resulting from the use of oversize shafting and other parts so as to prevent operating delays due to breakdowns is featured by the Ransome Concrete Machinery Co., Dunellen, N. J., in its latest model of 21-E paving mixer.

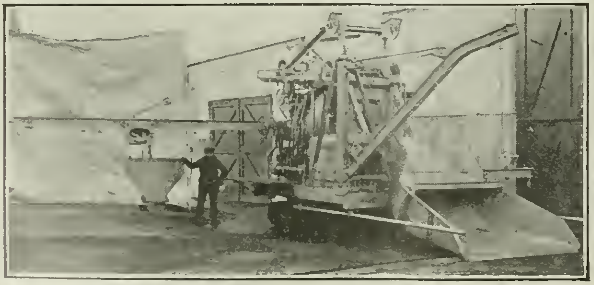
In this mixer all turned shafting is of 0.3-0.4 high carbon steel with diameters of 5⅜ in. for the traction shaft that drives the crawlers, 4⅜ in. for the traction speed change shaft, 4⅞ in. for the traction reverse shaft, 3⅜ in. for the mixer drum drive shaft, 4⅞ in. for the drive shaft for the crawler treads, and 3⅜ in. for both the power loader winding drum and the boom bucket winding drum shaft.

The power equipment consists of a 40-hp. four-cylinder Hercules gasoline engine, which, it is claimed, may be stalled without bending the shafts or breaking the sprockets and gears. Heretofore, the company points out, steam power of 15 to 20 hp. has been used extensively for driving paving mixers.

Many of the breakages as well as delays to paving mixers have been caused, it is said, by trying to transmit 40 hp. from a gasoline engine through shafts and gears designed for only 20-hp. steam engine operation.

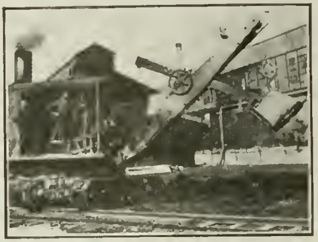
The main frame consists of longitudinal members and has a three-point suspension on the axles to avoid undue strains during traveling over rough roads. The mounting is of the crawler type.

The loading hopper is constructed of $\frac{5}{16}$-in. steel plate and is served by a power operated derrick with a reach of 14 ft. from the center of the paver to the center of the industrial tracks alongside for handling batch boxes. Delivery of the mixed concrete is by means of a 20-ft. boom and a bucket of 30 cu.ft. capacity of the bottom-dump spreading type. Overall dimensions of the mixer, including loader, are: Length, 20 ft. 9 in.; height, 3 ft. 11 in.; width, 10 ft. 1 in. The weight is 33,250 lb.



Crane Convertible to Shovel

A crawler-mounted locomotive crane, convertible to a ¾-yd. revolving shovel, is one of the new products of the McMyler-Interstate Co., Bedford, Ohio. The crane is steam operated and is fitted with the necessary mechanism for hoisting on either of the two main drums, operating a two-line bucket, lowering or raising the boom, rotating the crane and traveling. The machine



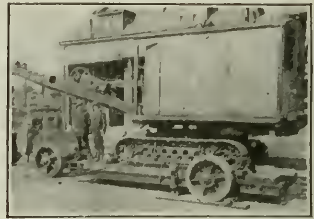
may be equipped with a boom 30, 35, or 40 ft. long, and its overall dimensions are length 16 ft. 7 in., width 8 ft. 10 in., and height 13 ft. 2 in. The operating weight of the crane is 55,000 lb. The crane has a capacity of 20,000 lb. at 12 ft. radius. A feature of the design is the accessibility of all parts for adjustment and repair.

The various operations of the crane are actuated by a 6 x 8-in. double-cylinder, non-reversing engine. Link motions and reversing valves are eliminated through the use of right- and left-hand clutches for raising and lowering the boom, for slewing, and for propelling. For operation of the steam shovel the equipment includes a 17 ft. 6-in. boom and a 12 ft. 6-in. dipper handle.

Rubber-Tired Trailer Built for Transport of Heavy Equipment

For the quick transportation from one job to another of heavy construction equipment such as steam shovels, cranes, road rollers and concrete mixers, the Douglas Transfer Co., hauling contractor of Pittsburgh, is using a four-wheeled truck trailer with solid rubber tires having a carrying capacity of 50 tons, made by Rogers Bros. Co., Albion, Pa. The overall length of the trailer, from the end of the drawbar to the rear of the deck, is 26½ ft., the overall width 13½ ft., and the height from pavement to the top of the platform 22 in. The frame is composed of 8-in. steel H-sections and heavy 8-in. ship channels. The solid rubber tires are 14x40 in.

The Douglas company cites the following two instances of the performance of its trailer: A ¾-yd. Erie steam shovel was moved a distance of 11 miles over hilly roads in 3½ hr. actual hauling time. It was necessary to load and unload the shovel three times dur-



ing this trip on account of overhead obstructions of bridges, steam pipes and wires. Another trip of 12 miles over steep grades and under unfavorable weather conditions delivered a 20-B Bucyrus shovel in 5 hr. and 30 min. actual hauling time.

Publications from the Construction Industry

Gasoline Engines—STOVER MANUFACTURING & ENGINE CO., Freeport, Ill., describes in a 24-p. illustrated catalog its line of gasoline and oil engines from 1 to 30 hp. Most of the models shown are stationary types. One of the units is a 1½-hp. engine direct connected to a Myers pump and several of the outfits from 1½ to 12 hp. are mounted on four-wheel trucks, including one portable wood-sawing rig.

Truck Motors—GEORGE HAISS MANUFACTURING CO., INC., New York, has issued a 27-p. catalog, illustrated, featuring its path-digging truck loader for handling crushed stone, sand, gravel, coal and other loose materials. The loader is of the continuous bucket type mounted on crawlers. One of the machines illustrated is equipped with a measuring hopper at the discharge end. Several pages are devoted to a presentation of figures on loading capacities and costs as compared with hand shoveling.

Paint—E. I. DU PONT DE NEMOURS & CO., INC., Philadelphia, has just published a 200-p. illustrated book entitled "Principles and Practice of Upkeep Painting," written to serve as a practical aid to plant superintendents or others responsible for the maintenance of industrial property and equipment and as a help to architects and engineers in the protection of new construction. It covers modern painting practice for all types of exterior and interior surfaces. The data are presented in 28 chapters, taking up such subjects as the preparation of the surface for painting, methods of application, treatment of both wood, metal and cement concrete surfaces, light reflecting finishes for walls and ceiling. There is an important discussion of spray painting and suggestions on how to operate a paint shop and provide for periodical paint inspection. For every kind of use a specific type of paint is recommended. The book contains a supplement in the form of a color chart.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Public Bond Sales in July Far Below June Aggregate

The reaction from the exceptional activity displayed during June in the issuance of state and municipal bonds coupled with the customary dullness which comes at this season and the weakness of the security markets on the Stock Exchange, according to the monthly review in the *Commercial and Financial Chronicle*, New York, kept the aggregate of new municipal issues during July down to $59,107,271. This is $100,578,816 less than the June aggregate. The falling off was not confined to states and municipalities in this country but extended to Canadian municipal and Provincial bonds.

The largest issue during the month, $3,500,000 5½s., was sold by the Everglades Drainage District at a price reported to be 95. There were two issues for $2,000,000; one by the state of Michigan for highway improvement bonds, the other put out by Cook County Forest Preserve District, Illinois.

The number of municipalities emitting long term bonds and the number of separate issues during July 1923 were 333 and 478 respectively. This contrasts with 425 and 594 for June, 1923; and 591 and 752 for July, 1922.

Of the forty representative bond issues included in the tabulation on this page, none was sold at par, three sold below par, the balance above par. The yields ranged from 4.16 to 5.37, and the rate of interest from 4 to 5½ per cent.

National Lumber Trade Steady

Although the national lumber trade, as reflected by reports from 398 of the larger commercial mills of the country to the National Lumber Manufacturers' Association here, fell off slightly last week, new business was up to the average of May and above that of June and the first part of July. While production declined from the high levels of May and June it is still in excess of shipments and orders. The general lumber movement is larger than at this time last year. Unfilled orders of the West Coast Lumbermen's Association's mills increased 5,000,000 ft. and those of the Southern Pine Association decreased 4¼ per cent, as compared with the preceding week.

For all the reporting mills shipments were 88 and new business 82 per cent of production last week; for the Southern Pine mills, the percentages were 95 and 82, respectively, and for the West Coast mills 93 and 91. Most of the reporting mills have a normal production figure for the week, and according to that their actual production was 105, shipments 96 and orders (new business) 90 per cent.

Car Service Division Reports Record Freight Loading

According to a report issued Aug. 13 by the Car Service Division of the American Railway Association, the railroads of the United States on July 31 had 76,453 surplus freight cars in good repair and immediately available for service if necessary despite the fact that during the week which ended on July 28, 1,041,044 cars were loaded with revenue freight, the largest number for any one week in the history of the country. When a record loading of 1,018,539 cars was established during the week of October 14, 1920, which record remained until this year, a car shortage of 69,517 cars was reported.

The total number of surplus freight cars on July 31 was a decrease of 3,257 compared with the number on July 22. Of the total number on July 31, 57,831 were box cars, a decrease of 3,388 in approximately a week; while there were 6,546 surplus coal cars in good repair, an increase of 1,379 within the same period. Surplus stock cars numbered 3,437, a decrease of 846 since July 22, while a decrease for the same period of 648 was reported in the number of surplus refrigerator cars which brought the total for that class of equipment to 7,615.

REPRESENTATIVE PUBLIC BOND SALES DURING JULY AND AUGUST, 1923

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Oregon	State Highway	1,000,000	4½	98.66	4 64	Aug. 1, 1923	1928-48	Stacy & Braun, Eldredge & Co. and others
Phillipine Islands	Irrigation and public works	2,000,000	4½	95.30	4.88	July 1, 1923	1952	Hallgarten & Co., White, Weld & Co., Blair & Co., Inc., and Chase Securities Corp.
County								
Broward, Fla.	School	60,900	5½	102.25	5.33	July 1, 1923	1938-53	Ft. Lauderdale State Bank, Lauderdale
Mahoning, Ohio	Sewer improvement	280,000	5	101.67	4 76	March 1, 1923	1925-38	Hayden, Milier & Co., Cleveland
Brown, Ohio	Public improvement	23,800	5½	101.19	5.23	July 1, 1923	1927-33	Breed, Elliott & Harrison, Cincinnati
Franklin, Ohio	Sewers	26,500	5	100.05	4.99	May 15, 1923	1925-33	Tucker, Robinson & Co., Toledo
Madison, Ind.	Orphans home	125,000	5	101.18	4.81	July 16, 1923	1924-36	Breed, Elliott & Harrison, Indianapolis
Montgomery, Ohio	Sewers	33,000	5½	103.40	5.03	July 1, 1923	1925-39	A. C. Allyn & Co., Chicago
Anderson, Texas	Roads	266,000	5	100.98	4.91	Apr. 10, 1923	1924-53	Taylor, Ewart & Co., Chicago and syndicate
Ashtabula, Ohio	Roads	139,000	5¼	101.06	5.24	Apr. 1, 1923	1924-32	Seasongood & Mayer, Cincinnati
Cass, Mich.	Roads	49,500	5½	100 84	5.32	July 1, 1923	1925-33	Cass County Bank, Cassapolis
Princess Anne, Va.	Road and bridge	250,000	5½	104 09	5.19	July 15, 1923	1928-57	C. W. McNear & Co., Chicago
Rush, Ind.	Road	29,160	5	100.23	4 95	May 15, 1923	1924-33	Breed, Elliott & Harrison, Indianapolis
Township								
Burlington, Ohio	School	55,000	5½	101 51	5 32	June 15, 1923	1924-45	Ryan, Bowman & Co., Toledo
Municipality								
Haverhill, Mass.	Streets and sewers	210,000	4¼	100.15	4 21	June 1, 1923	1924-33	Estabrook & Co., Boston
Lewiston, Me.	Armory	200,000	4½	101.32	4.34	July 15, 1923	1924-43	H. M. Payson & Co., Portland
Akron, Ohio	Street improvement	355,200	5	100.70	4.86	July 1, 1923	1924-47	Eldredge & Co., New York
Bellaire City, Ohio	Schools	80,000	5	100.25	4.98	July 23, 1923	1933-48	Breed, Elliott & Harrison, Toledo
Cohoes, New York	Local improvement	211,481	4½	100.53	4.42	May 1, 1923	1934-37	A. M. Lamport & Co., New York
Honea Path, S. C.	School building and repair	65,000	5	101.16	4.89	July 1, 1923	1928-43	Bank of Honea Path
North Hempstead, N. Y.	Schools	130,000	5	105.38	4.49	June 1, 1923	1938-47	Lehman Bros., New York
Pittsfield, Mass.	Water and sewers	61,000	4½	100.92	4.28	July 15, 1923	1924-36	Estabrook & Co., Boston
South River, N. J.	Electric light	65,000	5	100.94	4.86	July 1, 1923	1925-39	First National Bank, South River
Troy, N. Y.	Water works ext.	44,000	4¼	100.40	4.20	Aug. 1, 1923	1924-43	Manufacturers National Bank, Troy
Atlantic City, N. J.	General improvement	1,617,000	4¾	100.21	4.73	July 1, 1923	1925-58	Geo. B. Gibbons & Co., New York
Framingham, Mass.	Sewers	240,000	4½	100.85	4.17	July 1, 1923	1924-53	Harris, Forbes & Co., Boston
Garden City, N. Y.	Water and sewers	905,000	4½	100.59	4.45	July 1, 1923	1928-52	Stacy & Braun and Eldredge & Co. New York
Hightstown, N. J.	Water	88,500	4¾	100.10	4.74	June 1, 1923	1932-48	Hightstown Trust Co., Hightstown
Lynn, Mass.	Water, street and sewer	415,500	4-4¼	100.03	4.22	July 1, 1923	1924-33	Estabrook & Co., Boston
Mount Vernon, N. Y.	Roads and sewers	175,000	4½	101.09	4.34	June 1-July 1, 1923	1924-42	Sherwood & Merrifield, Inc., New York
Pittsfield, Mass.	Paving	80,000	4½	100.45	4.34	July 15, 1923	1924-28	R. L. Day & Co., Boston
San Bruno, Calif.	Water works improvement	100,000	5	100.01	4.99	July 1, 1923	1928-43	Blyth, Witter & Co. and the Bank of Italy
Waltham, Mass.	School and sewers	176,000	4¼	100 66	4.17	July 1, 1923	1924-53	Arthur Perry & Co., Boston
Dayton, Ohio	Street improvement	225,000	5¼	103.11	4.79	Aug. 1, 1923	1924-32	Austin, Grant & Ogilby
Denton, Texas	School	200,000	5	98.00	5.14	July 1, 1923	1924-63	Mercantile Trust Co., St. Louis
Easthampton, Mass.	School	120,000	4½	101.27	4 21	July 1, 1923	1924-33	Estabrook & Co., Boston
Lenoir, N. C.	Water	125,000	5½	101.77	5.37	July 1, 1923	1926-63	N. S. Hill & Co., Cincinnati
Malden, Mass.	School and paving	401,000	4¼	100.68	4 16	June 15-July 15, 1923	1924-43	Harris, Forbes & Co., Boston
Mayfield, Ohio	School building	226,000	5½	102.38	5.29	April 1, 1923	1927-47	Richard, Parish & Lamson
Nashua, N. H.	Road and sewer	125,000	4½	100.17	4 17	Aug. 1, 1923	1924-38	E. H. Rollins & Sons, Boston
Newcomerstown, Ohio	School	125,000	5	102.72	4.72	Jan. 1, 1923	1924-48	Richards, Parish & Lamson, Cleveland

To Reduce Industrial Accidents

In order to reduce industrial accidents in New York State, formation of an educational council to co-operate with the state labor department has been decided upon. Educational campaigns are to be carried to public schools, high schools, night schools and various vocational and continuation schools. Exhibits will indicate accident causes and how they may be avoided.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 89 to 97, are the following:

Store building, Los Angeles, Calif., to MacDonald & Kahn, $1,000,000.

Store, office and hall building, Chicago, Ill., to McKeown Bros., 112 West Adams St., $1,250,000.

Sewage treatment works, Chicago, Ill., to J. Griffiths & Sons Co., 112 West Adams St., $5,602,636.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 89 to 97, are the following:

Wharves, Houston, Tex., for Houston Port District, $4,000,000.

Apartment-Hotel, Chicago, Ill., for G. G. and E. C. Anders, $1,000,000.

Sewage-treatment works, Chicago, for Sanitary District of Chicago, $5,602,636.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the the issue of Aug. 2; the next, on Sept. 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4 00	$4 20	$3 40	$3.55	$4 20	$3.60	$4.10	$4.25
Structural rivets, 100 lb.	4.40	4 75	4 90	3 75	4 25	5 40	5 00	4.75	6.00
Reinforcing bars, $\frac{3}{4}$ in. up, 100 lb.	3.54	4.00	3.80	3.20	3 45	3 85	3 65	4.10	4.00
Steel pipe, black, $2\frac{1}{2}$ to 6 in. lap, discount	44%	52%	45%	47%	53–5%	36%	33.2@42.2%	40%	47.43
Cast-iron pipe, 6 in. and over, ton	62.30	56.00	63.00	60.20	60.50	69.00	62.00	70.00	60.00
Concreting Material:									
Cement without bags, bbl.	2 70@2.80	2.85	2.25	2.20	2.50	2.84	2.63	2.90	2.25
Gravel, $\frac{3}{4}$ in., cu.yd.	1.75	1.90	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	1.89	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, $\frac{3}{4}$ in., cu.yd.	1.75	2.00	2.83	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	—58 00@60.00	40 00	52.25	56.50	42.50@43.75	42.75	41.00	28.00	70.00
Lime, finishing, hydrated, ton	18.20	22.50	22.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	2.35	1.50	1 50	2.70	2.10	2.80	10.00
Common brick, delivered, 1,000	—20 00@22 00	12.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	.115	.0724	.0816	.065	.....	.11	.....
Hollow partition tile 4x12x12, per block	.1573	.102	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	1.05	—1.08	1.19	1.14	—1.08	1.25	—1.18	.86	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	—.50@.55	.35@.50	.50	.50@.62½	+.35@.40

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size $5\frac{1}{2}$ x 8 x $11\frac{1}{2}$. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.78). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in., $119.

A Little Review of the Situation

The very real likelihood of an industrial depression did not dissolve into a mere possibility until the middle of July, when *Engineering News-Record's* Construction Barometer said: "When a number of red flags are displayed for a considerable period of time it is likely that the danger indicated will be avoided." This danger in the construction industry was a large-scale buyers' strike caused by high cost.

There was a buyers' strike in the larger centers, but the construction thus curtailed was proportionately small, and the actual volume (not mere money value) of construction in 1923 is well ahead of 1922.

Interest centers chiefly in construction cost as the critical element of the situation. Since October, 1922, it has risen until at the beginning of June it reached a point 121 per cent above 1913. It has maintained that level to date, and is 28 per cent above a year ago.

Construction cost is high because the country is oversold on building materials and the demand for labor is such as to encourage high wages. Last year's construction amounted to $4,500,000,000. Contracts awarded in the first half of 1923 reached three billions.

The only practical relief is in producers of construction materials catching up on their orders. Contract-letting declined 14 per cent in July, with indication of a further falling off in August. This is, of courser seasonal and should furnish the breathing space needed to fill present orders. The unfilled steel tonnage curve (see The Construction Barometer, July 26) indicates this catching-up process on the part of the United States Steel Corporation. That general business remains active is shown by heavy freight car loadings. Total loadings for the week ended July 21 was 1,028,927 cars, which is the heaviest in the history of railroading.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

Engineering News-Record

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor
Frank C. Wight, Managing Editor

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Has the Public Control?

THE negotiations between the coal miners and operators now in progress at Atlantic City will demonstrate as never before whether public opinion is an effective force in the settlement of labor disputes. The people, generally speaking, have not taken sides in this controversy; few outside those directly concerned know anything about the issues involved. What the mass of the people do know is that anthracite coal, hitherto a necessity for a considerable and important part of the country, is controlled absolutely by half-a-dozen men sitting around a table at a beach hotel. On their ability to agree rests the comfort and health of many millions of American citizens. These citizens, we believe, are agreed that the questions in dispute are arbitrable and they expect them to be settled but, having in mind the hardships of last winter, they are willing that the government, through the President, go to any means, however extreme, to force the production of anthracite in the event that those in control cannot agree. Within a week we shall see whether Mr. Lewis and Mr. Warriner are willing to force the coal business into government control.

The Ruhr Deadlock

HOWEVER much one sympathizes with the French effort to extract proper reparation from the Germans the impression grows that the occupation of the Ruhr is a failure, unless it is a preliminary to annexation, though how any Frenchman can desire such annexation with the memory of Alsace-Lorraine and its fifty years of "revenge" in mind is more than the boundary-secure American can imagine. As an industrial move, however, the French policy is playing into German hands. For a certain length of time—no one knows how long—the Germans can continue to refuse to produce and can concentrate all their effort on permanent improvements, which will return increased revenues when, or if, they ever get back control of their own industry. The deadlock grows—but with it grows the feeling that the whole reparations question must be taken out of the hands of the statesmen, or politicians (which is a more exactly defining word), and turned over to an international group of business men to settle.

Speeding-up Through Motor Traffic

ONE WAY of solving the problem of traffic congestion in small cities and towns is suggested by M. O. Eldridge, executive chairman of the American Automobile Association, after an inspection trip in the New England States. Mr. Eldridge says: "Oftentimes through a careful study of the traffic situation a route through the town can be selected which will avoid the heavily congested streets. The route selected may not be the most direct and may require the use of a number of different streets. However, if the route is plainly marked, tourists will use it in preference to stopping at corners and inquiring their way. The situation I found in some of the cities and towns in the New England States can be duplicated all over the country. The impression which a well laid out and well marked route through town will make on the visiting motorist will amply repay any community for the study and effort required to bring it about. A tourist never fails to advertise a town where he found it easy to get in and out again." This recommendation is similar to that made in the editorial review of the traffic situation in *Engineering News-Record*, June 21, 1923, p. 1070. The success of the method in towns where it has been tried has been so general that most towns and cities will do well to make a special study of this feature and see if they can outline a route that will divert through traffic from their over-congested streets.

Federal Contract Provides Arbitration

A DECIDED advance in the equities of contractual relations is marked by the decision of the Interdepartmental Board of Contracts and Adjustments to provide an arbitration clause in federal government construction contracts. In these contracts in the past there has been no appeal from the decision of the contracting officer. Now the right of appeal to department heads is extended in matters of time and of the financial consideration involved. Coming from the stronghold of drastic contracts and exacting supervision this concession of arbitration privileges assumes almost an epochal significance. It should stimulate action, long delayed, by a number of engineering associations which now have arbitration clauses before them for consideration.

Too Much Standardization

EX-PRESIDENT Eliot of Harvard, in a recent letter to the New York *Times*, deplores the current craze for standardization as a deadening influence on social development. In particular, he is concerned with the evil effects on a proper individualism which will result, he thinks, from our growing standardization of the worker's operations. It is a fair question whether this phase of the standardization evil is not being overemphasized. Is it a fact that the worker is more deadened by eight hours of one operation than by twelve or more hours of varied tasks? The man in the story who said that his qualifications for a machinist's job were that he had spent three years tightening the right forward holding-down bolt on Ford engines doubtless did not get as much out of his work as did the mechanic who built Stephenson's locomotives, but certainly he sees more and enjoys more in his sixteen daily hours away from the shop than did his predecessor in the ten or twelve which he had for leisure and sleep. This world can never return to the individual artisan. The

best that can be done is to move toward an amelioration of working and living conditions and an increase of leisure and pay which will make up for the loss in the joy of the work itself. At the same time, Dr. Eliot does well to sound a warning that standardization is not the ultimate ideal in every phase of life, which is a too general tendency especially in technical circles. The distinction between simplification of style and pattern and complete standardization is too little appreciated. It is eminently desirable to have the sizes and shapes of steel I-beams reduced to a minimum. It would be a most restrictive binder on engineering initiative to insist on the establishment of a few standard types of bridges. And yet just this latter kind of thinking is apt to result from the glorification of the standardization idea.

State Supply of Road Materials

BOLD seizure of the road-building materials supply situation is apparently contemplated by the Missouri State Highway Commission. A month ago the announcement was made that the commission would receive bids for furnishing, for one or several years, all cement required, or, as an alternative, for providing the state with one or two cement manufacturing plants. On Sept. 5, it is now announced, the commission will receive bids for furnishing for one year or for a term of years, all sand, gravel and crushed stone required for road construction. Except that Missouri contemplates supplying all materials and not cement alone its plan is not different than that in force for some years in Illinois. Its threat to operate state cement mills is nothing different than is being threatened by half a score of states. The significance of the present action is that it indicates the hardening will of state highway administrations to rid themselves of the obstacles of alleged unfair prices, insufficient production and uncertain transportation of road-building materials. Virtually it is an attempt to stabilize for road construction the materials market. There is precedent for state purchase and supply of road-building materials. Apparently the practice has been satisfactory. The uncertain venture is state manufacture of cement. Opinion of some of its complexities was given in the issue of March 22, 1923, p. 519, and nothing has since occurred which materially modifies that opinion. The vision of state manufacture, as a certain means of relief from present difficulties of cement supply, will not, however, be dispelled by anything that anyone can say. The plan has to be tried out. Perhaps Missouri will be the state which will undertake the experiment. It is certain, if it does, that a number of other states will form an interested audience.

Amateur Engineering Again

FROM California there comes a story of amateur engineering which fortunately had no sequel of toll of life or injury, though it did involve sufficient loss of money to make it a good example of how not to do engineering work. A man who owned a large ranch in Humboldt County, near Eureka, not conveniently accessible to the rest of the county, succeeded in getting through a county appropriation for the construction of a 280-ft. span bridge under designs prepared by a local "engineer" in no wise qualified to undertake such work. The bridge was built and the ranch sold, after which the chief actor in the incident lost all interest in the structure. The superstructure of the bridge was of simple suspension design and seems to have been quite satisfactory, but the piers were founded on soft material and when the rainy season came they began to slip and slide. One of them moved down the channel and partly tipped over. The county had expended $25,000 on this bridge, and when it threatened to disappear in the river the county authorities called in a competent local construction company with emergency orders to salvage as much of the bridge as possible. This company went in and took down the entire superstructure and stored it for the winter or at least pending the reconstruction of proper piers. Possibly when they put back the bridge the county will think that a regular engineer will pay. Such an engineer can design a movable bridge; it takes one of his amateur imitators to design a removable one.

An Explanation Which Does Not Explain

DR. WORK'S explanation of the reasons for his removal of Arthur P. Davis from the Reclamation Service, as given in his letter to the American Society of Civil Engineers, is only a repetition, over his own signature, of the views that have been credited to him in interviews. To be completely understood, however, it should be read along with the "memorandum for the press," just issued by the Department of the Interior and reproduced along with the letter in the news section of this issue. The letter and the memorandum taken together make a fair prospectus of the campaign that Dr. Work purposes to follow in justifying his political reorganization of the Reclamation Service.

To the Secretary of the Interior government reclamation comprises two distinct, and apparently mutually exclusive, parts—the "building of dams and ditches" and the "problem of the water users." The former he considers the whole duty of the engineer, but for the latter he would secure a "practical business man." No more condescending definition of the function of the engineer was ever written than this letter, and the workings of the author's mind in depreciation of the engineer and the magnification of the business man are more fully revealed in the memorandum.

This memorandum is a gem. Intended obviously to impress the casual reader with the radically different type of mind that is now in charge of government reclamation, it proceeds to recite as the novel items of a new policy precisely the same details in irrigation design and operation that have always governed the practice of irrigation engineering. It is not necessary to repeat those details to an engineering audience, but for others it may be well to say that irrigation engineering involves the proper selection of site, not only to insure the water supply but also to insure the proper agricultural and marketing conditions, the safe and economical construction of the physical elements of the project, the careful adjustment of the water service to the needs of the crops, the study of the agricultural processes for the education of the farmers, and finally the nice balance of human relations which is necessary to insure the well being of the settlers and their proper repayment of the funds to the government. These elements make up irrigation engineering. It is only when they become dignified with the magic words "business administration" that they warrant a special "memorandum for the press."

Government irrigation has not been an unqualified success. In that statement Dr. Work is correct. Irrigation on such an extensive scale as practiced in the West is a new art which requires learning with its development. Engineers today know much better how they should build and operate irrigation works than they did twenty years ago and in that degree they are to blame for the failure of complete success. Quite as much of the blame, however, lies in the law itself and in its administration by those superior to the engineer. Such disabilities would in nowise be removed by an assumption that the engineer is merely the builder of dams and the digger of ditches and that the larger policies of reclamation can be determined by some overhead business management which works quite independent of those who conceive and execute the physical elements of the irrigation scheme. Design, construction and operation are inextricably woven in irrigation as they are in all other engineering work. In the design and in the construction one type of engineering activity is required. In the operation and in the control another type is required, but the two are equally engineering functions.

All of this has been sufficiently obvious to the engineers who are interested in or have been connected with irrigation work. The opposite contention—the one held by Dr. Work—that the administration of irrigation requires a business man, has a certain appeal to that very large body of people who are hypnotized by this demand for a business administration of everything. It is only when the advocates of this plan attempt to put down in words a program for administration that they find difficulty in expressing the distinction between what they advocate and what has been practice. The "memorandum for the press" is the best illustration of this difficulty of specifying what is a business administration that could be offered in defense of the engineer.

The Mystery of Fatigue

FROM the time of the earliest researches into the failure of materials through the effect of a very large number of load repetitions, carried out by Wöhler and Bauschinger, the subject of fatigue has remained enveloped in its cloak of mystery. The elaborate investigations of recent years have supplied more exact and more complete facts on fatigue, but they have not done much toward dispelling the mystery. Not the slightest approach has been made toward an understanding of what goes on in the metal that causes it to break after 5,000,000 but not after 5,000 repetitions of a particular load; and all the new facts developed, such as that the repetition of loading strengthens rather than weakens the material, merely add to the difficulty.

From the standpoint of the further exploration of fact, the two series of investigations summarized in this issue—those of McAdam at Annapolis and those of Moore at Illinois—are of great importance and interest. To the civil engineer in particular the research work now begins to have tangible value, because for the first time it touches upon the subject of endurance range under other conditions than full reversal of stress. In both the Annapolis and the Illinois work of the past year there may be found certain definite conclusions concerning the general endurance range, and while differing in form they are not far from agreement, to the effect that the total stress range of endurance is independent of the absolute values of maximum and minimum stress, up to the point where the upper limit reaches the elastic limit (or some other critical stress) of the material.

A further fact of decided importance may be concluded from the Annapolis work, namely, that stress attack of quite different kinds is subject to substantially the same laws as to endurance. Tests under repeated torsion, repeated impact and reversed bending showed no essential difference, except in the numerical measure of the critical value for the particular kind of stress concerned. This fact, which rests on a large amount of remarkably consistent and harmonious experimental material, will keep the subject clear of much confusion that otherwise would involve it.

Nothing has been uncovered in the past two years' experimentation to weaken the force of the conclusion previously arrived at in the Illinois work that the endurance limit is identical with a critical stress value which may be determined in a few minutes by its relation to the rate at which heat is developed in a specimen subjected to repeated loading. Below the critical stress, heat is developed at one rate, while above this limit it is developed at a greater rate. That this "heating limit" is identical with the endurance limit which requires many months of testing to determine it may now be considered to be fully established for steel, since all the Illinois data, without exception, agree with it.

This established fact almost inevitably leads to the conclusion that the more rapid heat developed corresponds to some destructive action in the interior of the testpiece, bringing about a gradual weakening of the piece until its final rupture. It is, therefore, disconcerting to be told that no test, microscopic examination or other method of study has been able to reveal the slightest change in the material in the course of the repeated application of stress just above the endurance limit. The destructive action evidently must be of such nature as to escape any means of discovery we yet are able to apply. But is there a destructive action in progress at all? McAdam's work shows that if a stress at or just below the endurance limit is applied as many as ten million times, the testpiece is strengthened, not weakened: it is able to endure without failure many additional millions of stress repetitions at a much higher stress, far above the original endurance limit. The nature of this strengthening effect is as much of a mystery as the weakening which is made manifest by this fatigue failure, but it seems likely that the two effects are in some way closely related.

For the present the results of research seem to sum up in the fact that we have learned certain things about endurance, but are quite unable to correlate these things with other scientific knowledge, so that the subject remains a deep mystery. Doubtless this mystery conceals within itself a great many additional facts about endurance, and it may be that we are not yet within even fair reaching distance of knowing the essential phenomena of this important mechanical action. Research is bound to continue, therefore, at the full present rate—or, better still, at a greatly accelerated rate, to engage many more workers and thinkers than are now active in the subject.

How Oklahoma City Water-Works Dam Withstood Floods

Twice the Designed Capacity Passed Safely—High Water Record Broken Three Times in Month—Repairs Planned, Spillway to be Made Open and Bank Protection to be Extended

By A. S. Holway
Chief Engineer, Water Department, Oklahoma City, Okla.

JUNE FLOODS on the North Canadian River broke previous records on three successive rises at Oklahoma City. They washed out practically all bridges over it in Oklahoma and seriously threatened the water-works storage reservoir at Oklahoma City. An amount equivalent to nearly twice the capacity of the spillway facilities passed the dam and the water rose to within 6 in. of the top of an extremely long earthen embankment. Driftwood and floating bridge timbers caused much anxiety. The water conduit to the city paralleling the river below the dam was nearly washed out. Sandbags by the thousands saved the day, being used extensively at the ends of the concrete section of the dam, on top of the various earth embankments and in protecting the city conduit. While the information of the rainfall over the watershed is meager, observations taken by the Weather Bureau indicate only moderately heavy storms in June but heavy ones in May which saturated the area.

WATCHING A PILE BENT OF THE INTERURBAN "GO OUT"
Bridge floor planks removed (1) to get at drifting logs and haul them out by tractor and wire cable operating along upstream side of approach, (2) to salvage and prevent their floating downstream two miles and lodging against the dam spillways.

The North Canadian River is formed by the junction of Beaver Creek and Wolf Creek, which rise in northeastern New Mexico and northern Texas respectively. The 10,000-sq.mi. drainage area is situated principally on its upper tributaries through the panhandle of Oklahoma and Texas where it varies from 30 to 75 miles in width. For 100 miles above Oklahoma City the watershed is extremely narrow, in some places not more than a mile in width. Except for Beaver and Wolf creeks the tributaries are short, usually not more than 10 miles long. The watershed is composed in most part of a porous sandy soil, approximately 35 per cent under cultivation. The topography is more or less rolling in character. The river channel is very crooked and the rainfall is light, producing a sluggish flow.

The average annual rainfall in Oklahoma City is 31 in. per year, but the principal tributary drainage area lies in a region of smaller rainfalls, ranging from 25 in. near the eastern end of the Oklahoma panhandle to 15 in. at the extreme west end of the State and in northeastern New Mexico. The average rainfall, total area considered, is probably not far from 20 in.

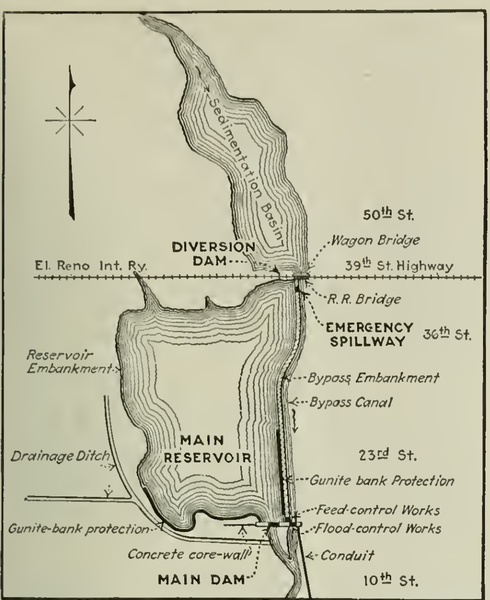
Excessive rains fell throughout the watershed May 21 to 23, with an average of 3.52 in. for thirteen stations. The heaviest rain, according to the U. S. Weather Bureau records, was 4.68 in. at Woodward. Newspaper reports indicate that there was more than 5 in. at many places at which there are no rain gages and from 8 to 10 in. at certain points.

Runoff from these storms was unusually heavy and rapid, raising the river gage at Oklahoma City to 13.9 ft. on May 22, the highest record since this gage was established. As the flood from the tributaries upstream passed down the river the gage at Oklahoma City showed 15.9 ft. on May 29, again the highest of record on this gage. The water from this flood covered the bottom lands and receded very slowly. Rain continued to fall over the watershed and on June 8 the river began rising rapidly at Woodward, reaching its crest at this station on June 10. The Weather Bureau records (see Table I) show general precipitation throughout the watershed, with 2.3 in. at Woodward and 3.25 in. at Canton, June 7 to 9. The records from other stations farther up the stream are incomplete for this period though the precipitation was doubtless heavy. The crest of the flood passed rapidly downstream reaching Canton at midnight on June 10, Reno Junction at 5 p.m. on June 12, the water supply reservoir at 10 p.m. on June 13 and Oklahoma City at noon June 14. At the latter place the gage reading was 16.3 ft., establishing a new record for the third time within thirty days.

The water supply reservoir was constructed in 1916-18 and the general layout is shown in the sketch. The structures consist of a hollow dam across the river valley approximately 1,100 ft. long, at the west end of which is an earthen dam with concrete core wall 1,200 ft. long.

Under ordinary conditions the river water flows through a shallow sedimentation reservoir, formed by an earthen diversion dam on which are the highway and interurban line. By this dam the water is diverted to the east side of the sedimentation reservoir, whence it flows through a bypass canal on the east side of the main reservoir to the flood control works which are located at the east end of the main dam. The 2-mile bypass canal is separated from the main reservoir by an earthen embankment originally built with an 18-ft. crown.

Flood control works at the lower end of the canal in the end of the dam consist of four electrically-operated sluice gates, 14 ft. high, and 9 ft. wide, having an estimated capacity of 8,000 cu.ft. per second. Four auxiliary spillways have an estimated capacity of 2,650 cu.ft. per second. These spillways are surmounted by a walkway across the dam. An emergency spillway of



OKLAHOMA WATER-WORKS STORAGE RESERVOIR AND SEDIMENTATION BASIN

7,850 sec.-ft. capacity at the north end of the bypass canal through the bypass embankment is so constructed that it will come into action at the time the flood control spillways start to overflow. Water flowing through this spillway passes through the reservoir to the spillway over the main dam. Feed control gates at the lower end of the bypass have a capacity of 1,220 cu.ft. per second, making a total capacity of all available gates and spillways of 19,720 cu.ft. per second.

In an engineer's report dated 1913 covering this project we read that the greatest recorded flow to that date was 3,640 sec.-ft. In the 1916 report covering the same project the engineer states: "We are undertaking to control the flood water of a stream capable of discharging in excess of 4,000 sec.-ft." This amount is equivalent to 0.4 sec.-ft. per square mile of drainage area. In October, 1920, after the dam was placed in operation a flood occurred carrying 8,750 sec.-ft. or 0.875 sec.-ft. per square mile. On May 28 of this year the flow was 10,000 sec.-ft. at the crest of the flood, or 1 sec-ft. per square mile. On June 13 the crest of the flood carried a total of 33,700 sec.-ft. or 3.37 sec.-ft. per square mile. The size of this flood takes on additional significance when we consider that during a period of three months of the summer of 1922 the flow of the river into the storage reservoir varied from 1 to 1½ sec.-ft.

In the afternoon of June 12 the water at the reservoir began rising very rapidly and by 9 o'clock the following morning the flood control gates and spillways were operating at their maximum capacity. Water began to run over the walkway across the entire length of the bypass dam. At the crest of the flood this walkway was finally overtopped by 1.8 ft.

Water began to run over the abutment on the east side of the dam and sand bags were called into use to prevent cutting away the earth to the east and below this abutment. The bags were carried up to a height of 3 ft. before the crest of the flood was reached. Soon after the walkway at the flood-control works was overtopped the water began to flow over low places in the embankment separating the bypass from the reservoir. Sand bags were again called into service and these low places were raised in such a way that the water flowing over this embankment was forced to flow 9 in. deep over the lower 5,000 ft. next to the dam, a section of the embankment recently improved by the construction of gunite revetment work, as described in *Engineering News-Record*, May 17, 1923, p. 880. The quantity of water carried over this embankment at the crest of the flood was estimated at 10,000 sec.-ft.

Throughout the day floating logs piled against the highway bridge at Thirty-ninth Street. This drift coupled with a severe scouring action at the bottom of the channel gradually weakened this structure until several 4-pile bents were undermined and finally went out, carrying with them the several 5-pile bents of the interurban bridge directly below. [Observations by a representative of *Engineering News-Record* in the afternoon and again about 8 p.m. disclosed that the first sign of weakness in the highway bridge was a slight curve, downstream, in the alignment. Shortly afterward the bridge started to sag at one of the undermined bents. Finally the bent passed out from below the bridge quite slowly and then floated against the interurban bridge. None of the structures went out with a rush. One of the interurban bents after floating from under the intact floor structure, turned end-for-end, the sharp ends of the piles giving a pinwheel effect in the rotation.—EDITOR.]

When it became evident that these bridges were going to fail the pipe handrails on the walkway across the bypass dam were cut to keep this drift from piling

TABLE I—DAILY PRECIPITATION FOR JUNE 1923 ON THE NORTH CANADIAN RIVER IN OKLAHOMA

Stations—Watersheds	Days of Month														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Beaver	1.36	0	0	0.06	0.07	0.02	0.19	0.57	*	0.05	0	0	0.02	0	0
Woodward	1.52	0	0.10	0	0.04	0	0.02	0.88	1.40	0	0.01	0	0	0	0
Canton	1.00	0	0.09	0	0	0	0.61	0.52	2.12	0.10	0	0	0	0	0
Reno Junction	*	0	0	T	0.32	0	0.60	0.60	0.70	0.05	0	0	0	0	0
Oklahoma City	1.60	0	T	T	T	0	0.63	0	0.96	0	T	0	T	0	0

* No report—No doubt heavy.

TABLE II—CANADIAN RIVER READINGS DURING JUNE FLOODS IN OKLAHOMA

Date	Woodward	Canton	Reno Junction	Oklahoma City
June 1	3.0	0.9		12.1
June 2	6.0	3.3	3.9	11.3
June 3	3.6	5.0	3.9	11.1
June 4	3.6	1.0	5.2	10.6
June 5	4.3	1.0	6.8	11.3
June 6	3.1	2.0	5.9	11.8
June 7	3.0	0.6	4.6	13.0
June 8	5.0	0.2	4.6	12.4
June 9	6.0	5.3	4.4	12.1
June 10	8.3*	5.3†	4.9	11.9
June 11	4.0	...	7.4	11.3
June 12	3.8	3.2	10.5**	12.1
June 13	3.7	2.0	12.0	13.5
June 14	3.7	2.0	7.4	16.0***
June 15	2.8	1.0	5.6	15.1

* Highest stage 8.3 at 12 a.m.
† Highest stage 8.6 midnight June 10-11.
** Highest stage 14.0 at 5 p.m.
*** Highest stage 16.3 at noon.
Note—Readings taken at 7 a.m.

WATER OVERTOPPED THE CONCRETE WALKWAY OVER THE HOLLOW DAM

Spillway sections both sides of gatehouse and at far end of concrete section flooded out. Railing near gate house cut to prevent driftwood lodging against it. Concrete apron below flood-control gates was washed out entirely.

against the dam and flooding the spillways. A large proportion of the wreckage from these bridges was hauled to shore with tractors. That which got away was carried by the side current and lodged on the bypass embankment. Some of it passed over the top of the walkway and a small amount lodged against the spillways at the flood contro' gates. Two large logs were lodged in the flood-control gates and could not be removed until the flood receded.

The water passing over the top of the bypass embankment and through the emergency spillway gradually filled up the main reservoir until the spillway and wasteways were carrying their full capacity. The walkway the entire length of the main dam was finally overtopped 6 in. Sand bags were used to raise the walkway at the west end to prevent the water from dropping down close to the west end of the main dam, where it would have gradually washed away the earth and exposed the core wall, eventually emptying the reservoir around the west end of the concrete dam.

A large portion of the west side and south side of the main reservoir is lined by an earthen embankment to prevent the water from flooding the lowlands. A drainage ditch parallels this bank for several thousand feet. The top of this embankment is 1 ft. above the top of the walkway on the main dam. The highest point reached by the water in the main reservoir was therefore only 6 in. below the top of the embankment

OVERFLOW FROM THE MAIN RESERVOIR INTO THE BYPASS CANAL

The pole line indicates the inside edge of the embankment.

for a distance of approximately 20,000 ft. At some points this embankment is very narrow and a high wind the succeeding day threatened to destroy certain parts of it. Sand bags were again called into use.

One of the particular points of danger from the water supply standpoint was the fact that the conduit line to the city is laid close to the east bank of the river for ½ mile south of the dam. Part of the riprap bank protection 150 ft. below the dam was destroyed by the floods in May. Hundreds of sand bags were used at this point to protect the shore from further erosion and to prevent the destruction of the water-supply conduit line.

In view of the fact that the flood was practicallv twice as great as the total capacity of all gates and spillways it is remarkable that so little actual damage occurred.

It will be necessary to replace the highway and interurban bridges at Thirty-ninth Street and the riprap bank protection below the spillway on the east side of the river. The concrete apron below the flood control gates was entirely destroyed. Some little wash occurred in spots over the bypass embankment but the gunite protection work remained intact. Plans were immediately started for making these repairs and certain changes to care for future floods which may equal or exceed this flood in severity. In some way the walkway across the flood-control dam must be eliminated to give a free spillway opening that cannot become clogged with drift. The capacity of the emergency spillway and of the spillway discharging from the main reservoir both need increasing. It is further planned to extend the bank protection work to all the earth sections which were so nearly overtopped. A row of piles will be driven across the sedimentation reservoir north of the highway bridge, at a point where the velocity will be extremely low, to catch whatever drift comes down the river. With the low velocity trees and floating debris can be easily removed to shore.

The Engineer in the Cabinet

"What Washington occasionally calls the important big three of the Cabinet are Hughes, Hoover and Mellon. Hughes and Mellon are in this group apart because of the importance of their particular offices, as well as because of their ability. Hoover is in it in spite of the relatively less importance of his Commerce Department, because of his extraordinary personal ability and because, as a matter of fact, he is so well grounded and so indispensable in many big matters that come up outside the limits of his particular official field. As to Secretary Hoover, in addition to his own department, he is everything that is embraced in the dignity and efficiency of the phrase, "a competent workman." He contributes able and faithful trustworthiness for such frequently arising emergencies as coal strikes, unemployment, conservation and a dozen other matters calling for hard work, concentration of mind and immensely varied knowledge. It was one of the comparatively few easing comforts that Mr. Harding had in his difficult Presidency to know that at any hour, day or night, Mr. Hoover was at the end of the telephone wire, subject to call for any emergency. It was a reliance of which Mr. Harding made frequent use."—Mark Sullivan, in the *New York Tribune*, Aug. 6, 1923.

Sledged-Stone Base Developed For Missouri Roads

One-Man Stone Sledged Down, Filled With Spalls and Rolled Gives Cheap and Durable Base From Soft Native Rocks

SLEDGED-STONE base, with penetration macadam or asphaltic-concrete surface, has been adopted as a standard construction on Missouri highways. On the porous, easily-drained soils of large sections of the state these bases are standing up excellently and are being placed at an appreciable saving as compared with crushed stone or hand-placed Telford. Quarry rocks too soft to provide a crushed stone that will wear can be used as one-man stone for sledged base. Limestone has been used commonly but now sandstone is being tried where it is the native rock.

Rock is plentiful in most parts of Missouri, but there is little which has the coefficient of hardness required of crushed stone suitable for modern macadam. In large sizes—one-man stone—the softness is less objectionable than when the rock is crushed. Used as a base and filled with spalls, crushed stone and screenings, the large stone apparently break down very slowly due to internal movement of the fragments, but crushed bases of this rock grind up quickly. Hence the sledged-stone base has developed as a means of utilizing local rocks. Briefly it consists of large stone bound together and interlocked by sledging after which spalls, crushed stone and screenings are filled into the interstices and rolled firm and smooth.

FIG. 3—SLEDGED-STONE BASE READY FOR SURFACING

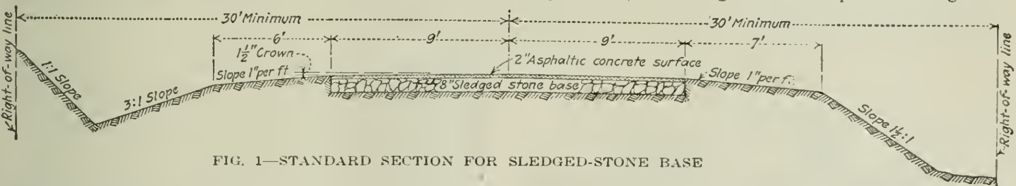


FIG. 1—STANDARD SECTION FOR SLEDGED-STONE BASE

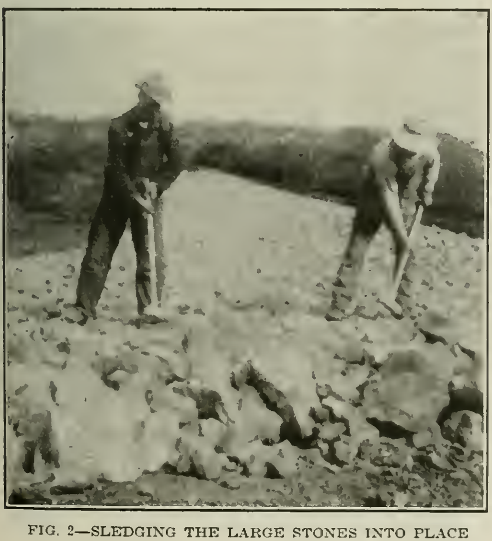


FIG. 2—SLEDGING THE LARGE STONES INTO PLACE

The sizes of stone used run about as follows: (1) As large as one man can readily handle, (2) spalls of any size up to 6 in., (3) crushed stone passing a 3-in. ring and (4) screenings which comprise all fragments passing a ¾-in. ring. The large stone are uniformly spread on a prepared subgrade as of the section shown by Fig. 1. Then men with 10 or 12-lb. sledges, as indicated by Fig. 2, pound down the projecting tops and hammer the stone into contact and interlock. In sledging, the men work to secure as nearly uniform depth and as even a surface as possible. The surface is then rolled with a 10-ton roller to set and interlock the stone still further than did the sledging. Spalls and crushed stone are next spread to level the surface and then the base is rerolled. The screenings are used to fill in remaining hollows and the base is again rolled. Fig. 3 shows the appearance of a finished sledged-stone base. On this any type of surfacing can be laid.

In contracting for sledged-stone base the practice is to pay a unit price per cubic yard for ½-mile haul and an additional price for each additional ½-mile haul. Measurement is made at the point of delivery and the price includes loading, unloading, sledging, rolling, etc. —complete base ready for surfacing.

Finish Alaska Topographic and Mining Survey

In the recent extensive work in Alaska by the Geological Survey of the Department of the Interior, 250,000 square miles, or about 34 per cent of the entire Territory, have been topographically surveyed and 200,000 square miles, or 30 per cent, have been geologically surveyed. In addition, detailed geological surveys have been made of sixteen of the largest mining districts totaling 5,000 square miles, including all of the important coal fields and several of the important copper and gold mining districts. Investigations of the water resources have also been made.

Improved Gantry Cranes for the Port of Hamburg, Germany

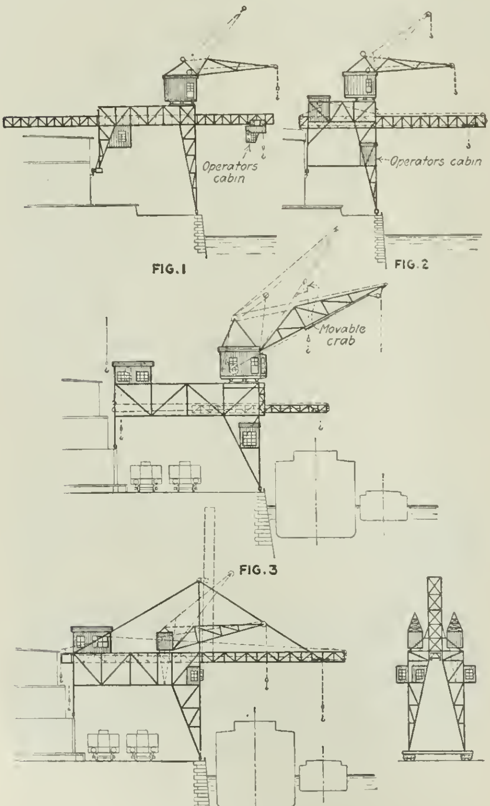
Unusual Combination of Swinging and Traveling Cranes Increases the Cargo Handling Facilities of the Port

By E. Krahnen
Duisburg, Germany

DOUBLE cranes of novel design have recently been installed at the port of Hamburg, Germany. They are a combination of a traveling revolving crane on a high superstructure and a straight line crane or transporter. To meet local conditions four combinations have been evolved.

Originally the crab of the straight line crane accompanied the load and carried the winding gear as well as the cabin with the man manipulating the winch (Fig. 1). In later designs a fixed winch located on the gantry is preferred, the operator having his stand on one of the gantry legs from where he can overlook the hold as well as the movements of the load on its way into the shed (Fig. 2). The runway of this type of cranes can be less substantial, a valuable feature if the reach has to be considerable. In a third design the jib of the revolving crane forms a runway for a second crab. It can be lowered so far that the load may be transported horizontally, thus forming a second straight line crane that can be turned in a convenient angle to the pier (Fig. 3). In some cases a combination of two revolving cranes and one straight line crane is desired. The revolving cranes are placed on each side of the runway girder in such a way that three cranes can work over one hatch. The runway girder is designed so that it can be drawn in behind the edge of the pier. If the reach is large the runway can also be built as a cantilever, capable of being lowered and raised out of the way on a hinge (Fig. 4). These four types of crane show the adaptability of double cranes.

FIG. 5—OLD AND NEW CRANES AT PORT OF HAMBURG
New double cranes are the first four in the foreground; behind them are the radius cranes of 1900 type.



FIGS. 1 TO 4—DIAGRAMS OF THE DOUBLE CRANES

The straight line crane is employed for general cargo that easily passes between the legs of the gantry. It reaches well into the pier and can operate without danger of conflict with the ship's rigging. The load is moved in the shortest way possible and only needs to be lifted to the height required without having to be lifted over deck superstructures as is necessary with revolving cranes while swinging the load. The runway can be designed to reach over two ships allowing direct transfers from the ship to a lighter beyond. Such movements constitute a large part of the traffic of many ports. A revolving crane is not well adapted to this kind of transfer as the ship's masts and yards constitute a serious obstruction to radial movements of any considerable extent. The crab of the straight line crane is usually built for a capacity of 1½ tons, which is sufficient for general cargo. It works with the high speed of 400 ft. per minute and as no superfluous work has to be done upon the load 40 cycles per minute can be easily attained. Under the same conditions a revolving crane could accomplish only 25 cycles and would require more current for the same amount of work. The winch is of a very simple design and well adapted to the rapidity with which the load is moved. The hoisting and crab traveling ropes are taken up by two drums which can be worked separately or simultaneously.

The revolving crane is usually built for a capacity

of 3 tons, a larger load than ships' gear can handle. Loads of nearly double the capacity of the single draft can be handled by two cranes working together.

In order to work a hatch at full capacity two cranes can be so placed together that four hooks are available for one hatch, the two straight line cranes working in the center while the revolving cranes are handling freight at the corners of the hold. By spotting the booms no time is lost in finding the opening of the hold with each successive draft. The revolving cranes can also be working the corners of the hatch while the straight line cranes are handling deck loads.

The longitudinal travel of the whole crane is effected by means of a hand traveling gear where the cranes are placed close together. For cranes that have to travel a considerable distance along the quai an electrically operated gear is provided.

The cranes at Hamburg were furnished by the Demag Company, Duisburg, Germany.

State Aid for Bridges on State Highways

A STUDY of systems of payment for bridges on state highways, made by the legislative reference library in New York State, shows that twenty-seven out of the forty-eight states of the Union have laws under which the state pays or may pay the entire cost of construction of such bridges, while in sixteen the state bears part of the cost. Five pay no part of the cost of state highway bridges. The sixteen which pay part of the cost includes three in which the state share of payment is limited to "state-aid" road bridges. In addition, five of the states which pay or may pay all the cost on bridges and state highways also have provision for the state paying part of the cost on "state-aid" roads. The lists follow:

STATE PAYS TOTAL COST OF BRIDGES ON STATE HIGHWAYS

Alabama	
Arizona	
California	The law is not clear but it would appear that state bears total cost.
Colorado	The law is not clear but it would appear that state bears total cost.
Delaware	
Florida	
Georgia	
Idaho	State may construct at its own cost.
Illinois	
Indiana	
Iowa	The law is not clear but it would appear that state bears total cost.
Kentucky	State is to bear total cost, but counties and municipalities may contribute if they wish.
Maine	
Maryland	
Michigan	State constructs and pays cost of all bridges greater than 30-ft. span.
Minnesota	
Missouri	
Montana	The law is not clear but it would appear that state bears total cost.
New Hampshire	
New Jersey	
North Carolina	
Pennsylvania	
Rhode Island	
South Dakota	
Washington	
West Virginia	
Wyoming	

STATE PAYS PART OF COST OF BRIDGES ON STATE HIGHWAYS

Arkansas	Not to exceed fifty per cent of cost.
Connecticut	From one-third to seven-eighths of cost.
Louisiana	Fifty per cent of cost.
Massachusetts	Three-fourths of cost.
Mississippi	State may pay part of the cost.
New Mexico	Not to exceed fifty per cent of cost.
North Dakota	Fifty per cent of the cost.
Ohio	Cost to be apportioned equally between state and county or township unless the county and township have agreed to pay more.
Tennessee	Contributes a certain share of cost and may require any county to contribute not to exceed fifty per cent of cost.
Utah	Contributes from one-fourth, one-half to full amount of same sum raised by counties.
Vermont	Not to exceed one-third of cost; town pays the balance.
Virginia	Fifty per cent of the cost.
Wisconsin	Fifty per cent of the cost.

(In addition to the above list, *Alabama* has a provision that the state may pay part of the cost instead of all, while in *Idaho* the state may pay one-third and the county two-thirds, instead of the state paying all.)

STATE PAYS PART OF COST OF BRIDGES ON "STATE-AID" ROADS

Kansas	Not to exceed twenty-five per cent of cost.
Nevada	State and county jointly bear cost of construction.
Texas	Twenty-five to fifty per cent of cost; in unorganized counties state may bear all of cost.

(In addition *Delaware, Florida, Maine, Michigan* and *Minnesota*, all included in the first table above, pay or may pay part of the cost of bridges on "state-aid" roads.)

STATE PAYS NO PART OF COST OF BRIDGES ON STATE HIGHWAYS

Nebraska	County maintains whole of state highway system within its borders.
New York	State constructs only culverts 5 ft. or less in length as a part of highway system. New York State, however, while its highway law specifically provides that no bridges over 5 ft. shall be built or maintained as a part of the highway system, has on a number of occasions provided by special appropriation for the construction of certain bridges and has made them a part of the highway system of the state, most recently the Poughkeepsie bridge across the Hudson River.
Oklahoma	County bears entire cost of construction.
Oregon	State loans funds to counties which counties repay in full.
South Carolina	

Scientist Heads New Italian Department

The four Italian government Departments of Industry, Commerce, Agriculture and Labor have been combined in a Department of National Economy, with four bureaus corresponding to the old departments, each headed by a director. Prof. Orso Mario Corbino has been made minister of National Economy and Prof. Arrigo Serpieri has been made undersecretary. Secretary Corbino was nominated professor of physics at the University of Rome in 1918. He became senator in 1920 and minister of Public Instruction in 1921. He has devoted himself largely to water-power development. Prof. Serpieri has specialized in agriculture. Each is an author of technical papers and books.

Endurance of Steel in Tension, Torsion and Impact

Results Show Endurance Under Three Kinds of Stressing Is of Same General Kind, Though Numerical Values Differ

Abstract of a paper by D. J. McAdam, Naval Engineering Experiment Station, Annapolis, presented at the Annual Meeting of the American Society for Testing Materials.

DATA and conclusions which add to prior knowledge of the endurance or fatigue-resisting power of steels were given by D. J. McAdam, of the Naval Engineering Experiment Station at Annapolis. His tests included not only the conventional rotating-beam tests for endurance in reversed bending, but also endurance tests in reversed torsion and tests under repeated impact of a hammer falling with definite amount of energy per blow. The results obtained are remarkably consistent, forming smooth curves and leading to mutually confirmatory deductions. It is shown that (1) the endurance under the three kinds of stressing is of the same general kind, though the numerical values differ; and (2) repeated stressing at a stress which does not produce fracture tends to strengthen the piece, giving it a higher endurance than possessed by a similar piece without such preliminary stressing. The effect of the heat treatment of the material and of its internal structure are also illuminated by the test results.

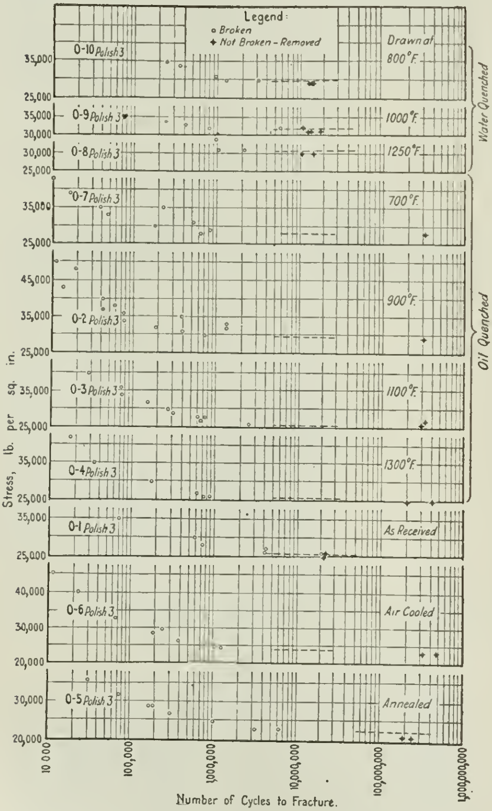


FIG. 1—REVERSED-BENDING ENDURANCE CURVES
For steel of 0.24 carbon and 0.45 manganese. Horizontal dash lines represent the point where the curve of the results intersects the 10,000,000-cycle vertical, which is taken as the endurance limit.

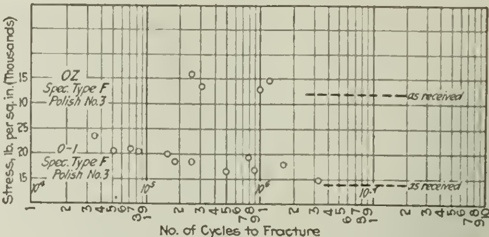


FIG. 2—ENDURANCE OF STEEL IN REVERSED TORSION

Rotating-beam tests were made on cantilever specimens at speeds of 1,200 to 800 r.p.m. Reversed-torsion tests were made in machines of two different forms, and in most of the sets were run at a speed of 2,140 r.p.m., although check tests covering a large range of speeds and of flywheel inertia showed these factors to be without material influence on the endurance limit. In the impact endurance tests a beam specimen supported at both ends was rotated intermittently, coming to rest after each 90-deg. rotation, and during this rest was struck by a hammer previously lifted by a cam. The frequency ranged from 90 to 600 blows per minute. The weight of hammer and height of fall were adjusted to the desired energy per blow, and this was so controlled as to require from 500 to many million blows for fracture. By a special arrangement still greater energy per blow was provided for, and tests were carried down to the point where a single blow fractured the specimen. Very uniform results were obtained, plotting in smooth curves. In this test, as in the torsion and tension tests, the curves approached a horizontal line in the neighborhood of 10,000,000 repetitions, and in all cases the value at 10,000,000 cycles was taken as the endurance limit.

Material—A large number of different steels was experimented with, ranging from ingot iron with 0.023 per cent carbon to high-carbon steel, nickel steel, nickel-chrome, and other alloy steels. Each was tested with various heat treatments: as received, annealed, water-quenched and drawn at different temperatures, oil-quenched and drawn at different temperatures. The critical part of the specimen in each case was polished after turning to size, and different kinds of polish were tried out, without showing any significant differences whatever.

The differences in composition of the steels and their differences of treatment produced a total range of 47,000 to 201,000 in tensile strength, 30,000 to 165,000 in yield point, and 40,000 to 124,000 in ultimate torsional strength.

Reversed-Bending Endurance—Plotted on paper with logarithmic abscissas and arithmetic ordinates the results of the reversed-bending tests yielded fairly regular curves; Fig. 1 is a typical set of diagrams, in which, however, the curves have not been drawn. All the plots became practically horizontal beyond 10,000,000 cycles, so that only the horizontal portion was drawn. The series of diagrams in Fig. 1 indicates that the endurance limit is raised by quenching, and is raised more by water quenching than by oil quenching; that it is decreased by drawing about in proportion to the temperature; and that it is lowest for the annealed material. In this respect all the endurance tests gave the same indication.

In a number of experiments a specimen was first subjected to 10,000,000 or more cycles at a stress below its expected endurance limit, then another 10,000,000 cycles at a stress slightly higher, and so on in 1,000 or 2,000-lb. steps until the specimen broke. Each time the stress was raised, counting of cycles started at zero for the purpose of entering the result in the diagram. It was found that a marked increase in endurance resulted from the low-stress repetitions.

Tests made on material from crank shafts of battleships, submarines and airplanes showed lower endurance limits

TABLE—ENDURANCE LIMITS FOR BAR MATERIAL

Material Designation	Cooled in	Drawn at— Deg. Fahr.	Average Tensile Strength, Lb. per Sq.In.	Average Torsional Strength, Lb. per Sq.In.	Endurance Limit For 10,000,000 Cycles, Lb. per Sq.In. Rotating Cantilever	Alternating Torsion	Ratio of Values Col. 5 to Column 4	Col. 7 to Column 6	Column 6 to Column 4	Column 7 to Column 4	Column 7 to Column 5
1	2	3	4	5	6	7	8	9	10	11	12
N-8	Water	.....	46,700	40,700	25,000	......	0.872	.....	0.535	.....	.....
O-10	Water	800	78,820	60,200	29,500	......	0.764	.....	0.374	.....	.....
O-9	Water	1,000	79,160	59,300	31,500	......	0.749	.....	0.398	.....	.....
O-8	Water	1,250	67,100	54,300	30,500	......	0.809	.....	0.455	.....	.....
O-7	Oil	700	68,500	56,600	27,500	......	0.826	.....	0.401	.....	.....
O-2	Oil	900	67,500	60,500	29,500	......	0.896	.....	0.437	.....	.....
O-3	Oil	1,100	66,000	53,440	25,500	......	0.810	.....	0.386	.....	.....
O-4	Oil	1,300	60,300	52,300	25,500	......	0.867	.....	0.423	.....	.....
O-1	As Received		60,400	53,430	25,500	14,000	0.885	0.549	0.422	0.232	0.262
O-6	Air	.....	60,750	48,730	24,500	......	0.802	.....	0.403	.....	.....
O-5	Furnace	.....	55,120	46,640	22,500	......	0.846	.....	8.408	.....	.....
Average of O Material						......	0.775	0.549	0.411	0.232	0.262
T-8$_2$	Water	800	96,620	67,480	38,500	......	0.698	.....	0.398	.....	.....
T-8	Water	800	85,250	63,390	34,500	......	0.744	.....	0.405	.....	.....
T-10	Water	1,000	97,370	60,450	41,500	......	0.621	.....	0.426	.....	.....
T-11	Water	1,100	86,250	64,300	39,500	......	0.746	.....	0.458	.....	.....
T-9	Water	1,250	82,000	62,490	35,500	......	0.767	.....	0.433	.....	.....
T-6	Oil	800	91,500	57,730	33,500	20,500	0.631	0.612	0.366	0.224	0.355
T-5	Oil	1,000	85,250	65,210	33,500	16,500	0.765	0.493	0.393	0.194	0.253
T-4	Oil	1,250	84,010	56,150	33,500	21,500	0.668	0.642	0.423	0.256	0.383
T-2	Air	.....	77,490	67,020	32,000	17,500	0.865	0.547	0.413	0.226	0.261
T-1	Furnace	.....	70,000	60,000	30,500	18,000	0.857	0.590	0.436	0.257	0.300
T-1$_2$	Furnace	.....	69,370	54,300	28,500	......	0.783	.....	0.411	...	...
T-3	Furnace	.....	72,000	54,790	29,500	16,000	0.761	0.545	0.410	0.222	0.292
T-7	Furnace	.....	70,000	52,980	29,500	......	0.757	.....	0.421	.....	....
Average of T Material						......	0.743	0.571	0.415	0.230	0.307
S-2$_2$	Air	.....	119,300	74,270	40,500	......	0.623	.....	0.339	.....	....
S-2	Air	.....	110,000	72,000	38,500	......	0.655	.....	0.350	.....	...
S-1	Furnace	.....	89,750	70,645	31,500	19,000	0.787	0.603	0.351	0.212	0.269
R-1$_2$	Furnace	.....	91,890	......	34,500	......	...	.....	0.375	.....	.....
R-1	Furnace	.....	87,500	69,900	32,500	......	0.799	.....	0.371	.....	....
Average of S and R Material						......	0.732	0.603	0.355	0.212	0.269
P-8	Water	900	154,200	91,370	74,000	47,000	0.593	0.635	0.480	0.305	0.514
P-7	Water	1,000	149,250	93,300	74,500	....	0.625	...	0.499	.....	...
P-6	Water	1,100	132,250	86,940	72,000	46,500	0.657	0.648	0.544	0.351	0.534
P-5$_2$	Oil	900	118,000	77,000	66,500	38,000	0.653	0.571	0.564	0.322	0.494
P-3	Oil	1,150	123,000	81,060	59,500	......	0.659	....	0.484	.....	.....
P-2$_2$	Furnace	.....	113,630	77,890	51,000	22,500	0.685	0.441	0.449	0.198	0.298
Average of P Material						......	0.645	0.574	0.503	0.294	0.460
Q-17	Water	900	145,750	99,000	......	44,000	0.679	.....	.....	0.302	0.444
Q-15$_2$	Water	900	145,880	......	69,500	......	....	.....	0.476	.....	...
Q-17$_2$	Water	900	138,750	88,000	......	42,000	0.634	.....	...	0.303	0.477
Q-15	Water	900	142,900	88,750	64,500	......	0.621	.....	0.451	.....	.....
Q-14	Water	1,100	115,900	77,890	59,000	......	0.672	.....	0.509	.....	.....
Q-16$_3$	Water	1,200	112,000	.....	63,000	......	.....	.....	0.563	.....	.....
Q-16	Water	1,200	99,100	69,700	55,000	......	0.703	.....	0.555	.....	.....
Q-16$_2$	Water	1,200	107,500		57,000	......	.....	.....	0.530	.....	.....
Q-12	Oil	900	117,500	77,000	54,500	35,000	0.655	0.642	0.464	0.298	0.455
Q-8	Oil	950	154,000	96,000	63,500	45,000	0.623	0.709	0.412	0.292	0.469
Q-7	Oil	1,050	155,500	111,400	59,500	48,000	0.703	0.807	0.375	0.303	0.421
Q-13	Oil	1,100	97,600	71,400	48,000	......	0.732	.....	0.492	.....	.....
Q-6	Oil	1,150	115,500	77,890	54,000	37,500	0.674	0.694	0.468	0.325	0.481
Q-3	Oil	1,200	97,500	67,920	47,500	......	0.697	.....	0.487	.....	.....
Q-10	Air	.....	91,050	67,300	42,500	......	0.739	.....	0.467	.....	.....
Q-11	Furnace	.....	85,500	60,000	41,500	......	0.702	.....	0.485	.....	.....
Q-5$_3$	Furnace	.....	90,800	......	50,000	......	.....	.....	0.551	.....	.....
Q-5$_2$	Furnace	.....	80,600	61,500	42,000	......	0.763	.....	0.521	.....	...
Q-5$_1$	Furnace	.....	86,450	62,000	43,000	......	0.717	.....	0.497	.....	...
Q-5	Furnace	.....	103,900	......	49,500	28,000	.....	0.566	0.476	0.269	.....
Average of Q Material						......	0.688	0.684	0.488	0.285	0.458
Xa-2	Water	900	121,570	......	68,000	......	.....	.....	0.559	.....	.....
Xa-3	Water	1,100	136,630	73,050	68,500	......	0.535	.....	0.501	.....	.....
Xa-1	Furnace	.....	85,750	......	38,500	......	.....	.....	0.449	.....	.....
Average of Xa Material						......	0.535	.....	0.503	.....	.....
Xb-2	Water	900	164,750	104,150	72,500	......	0.632	.....	0.440	.....	.....
Xb-3	Water	1,100	139,880	86,040	63,500	......	0.615	.....	0.454	.....	.....
Xb-1	Furnace	.....	82,430	62,950	36,500	......	0.764	.....	0.443	.....	.....
Average of Xb Material						......	0.670	.....	0.446	.....	.....
Xc-2	Water	900	172,000	125,510	88,000	......	0.730	.....	0.511	.....	.....
Xc-3	Water	1,100	157,000	103,370	77,000	......	0.658	.....	0.490	.....	.....
Xc-1	Furnace	.....	111,350	76,700	49,500	......	0.689	.....	0.445	.....	.....
Average of Xc Material						......	0.692	.....	0.482	.....	.....
Y-2	Water	900	201,000	124,080	94,500	......	0.617	.....	0.470	.....	.....
Y-2$_2$	Water	900	147,740		78,500	......	.....	.....	0.531	.....	.....
Y-3	Water	1,100	164,400	110,490	92,000	......	0.672	.....	0.560	.....	.....
Y-1	Furnace	.....	101,750	76,980	44,500	......	0.757	.....	0.437	.....	.....
Average of Y Material						......	0.682	.....	0.500	.....	.....
Z-2	Water	900	164,500	95,290	84,500	......	0.579	.....	0.514	.....	.....
Z-3	Water	1,100	144,250	82,420	72,000	......	0.571	.....	0.499	.....	.....
Z-1	Furnace	.....	117,750	78,500	50,000	......	0.667	.....	0.425	.....	.....
Average of Z Material						.....	0.606	..	0.47[illegible]	...	

for specimens taken in the transverse direction or from the block cut out between the crank webs, where the material had not been forged as thoroughly as elsewhere.

Reversed-Torsion Endurance—In torsion the results were closely parallel to those in tension, both as to the effect of heat treatment and as to the merging of the failure curve into a horizontal line at about 10,000,000 cycles. The effects of "fiber" as indicated by the results on transverse specimens from shafts also corresponded to those obtained in bending.

Impact Endurance—For the principal impact endurance tests, a specimen of ½-in. diameter was used, with a parallel-sided notch at mid-length of 0.4-in. bottom diameter and bottom radius 1/16 in. Other tests, made with a V-notch

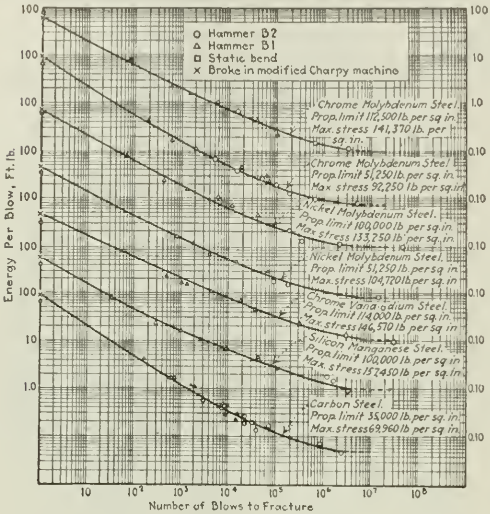


FIG. 3—REPEATED-IMPACT ENDURANCE CURVES

The left-hand ordinate of each curve is the energy required to break the specimen in one blow. The tests with smaller amounts of energy per blow extend to values requiring more than 20,000,000 blows for fracture and include one test with more than 40,000,000 blows in which fracture did not result.

specimen of much sharper curvature at the bottom of the notch, confirmed the results.

A typical series of curves is shown in Fig. 3. The curves are remarkably smooth. The ordinates at the left ends of the curves, representing single-blow impact fracture, are roughly proportional to the Charpy impact values, though differing from the latter because of the difference in form of specimen. The endurance limits (ordinates of the horizontal portion at the right) have no relation to the Charpy values, however, but are proportional to the reversed-bending endurance limit. For the seven materials represented in Fig. 3 the ratio of the reversed-bending endurance (lb. per sq.in.) to the impact endurance (energy per blow) ranges from 550,000 to 670,000, and four of the ratios lie between 610,000 and 630,000. The Charpy values for these materials, on the other hand, range from 3.7 to 29.1. Thus, impact endurance does not depend on the Charpy value but depends directly on the reversed-bending endurance limit.

If an attempt is made to measure impact endurance by a relatively small number of blows, so that the value found would lie in the sloping part of the curve in Fig. 3, the result would be influenced jointly by the Charpy value (which controls the position of the curve at the extreme left) and the bending endurance (which controls the limit at the right), and therefore would not measure any single property of the material nor indicate the true impact endurance.

Endurance Ratios—A tabulation of endurance limits and their ratios to each other and to static strength properties is given in the table. The endurance ratio, or the ratio of reversed-bending endurance limit to tensile strength, is given in column 10. For the different steels the average ratio varies from 0.355 to 0.503. The chemical composition appears to affect the endurance ratio. For high-carbon steel the average ratio is about 0.35, while for low and medium-carbon steels it is about 0.41 and for 3½ per cent nickel steel it is about 0.50.

Fuller study of the endurance ratio is represented by the diagrams Fig. 4, where endurance limit is plotted as ordinate and tensile strength as abscissa, separately for different kinds of steel. The straight lines are drawn so as to pass through the origin of co-ordinates, and their tangents represent the endurance ratios. In the lower diagram the lines from left to right represent respectively ingot iron, mild steel, and high-carbon steel; the endurance ratio is least for the latter. In (b) of Fig. 4 the two lines represent nickel steels and medium-carbon steels, the former having the higher ratio. Diagram (c) represents annealed carbon and alloy steels. Ingot iron is at the left of the mean line drawn, high-carbon steels are at the right or below, and nickel steels form a group of seven points well above the line. The diagram is taken to indicate that in the annealed condition the endurance ratio of 3½ per cent nickel steel is higher than that of chrome-molybdenum, chrome-vanadium, low nickel-chrome steel, and all carbon steels except ingot iron. The endurance ratio for annealed high nickel-chrome steel has not yet been determined.

Fig. 5 gives the torsional endurance ratio, referred to tensile strength and torsional strength respectively. In both cases the plotted points fairly well fit straight lines passing through the origin, just as in the case of the reversed-bending ratio. Fig. 5 also indicates that the endurance ratio of nickel steels is higher than that of carbon steels (0.28 as compared with 0.22). The crank-shaft diagram in Fig. 5 represents a ratio of 0.22, as for carbon steel bar material.

It appears that the endurance ratio decreases as the percentage of pearlite in the steel increases. Even the endurance limit itself is lowered by the first addition of cementite to ferrite; with greater increase of carbon and therefore of cementite the endurance limit is increased, but the ratio drops. Addition of nickel apparently strengthens the ferrite, with the result that the endurance ratio is raised.

Studies of the ratios of endurance limits to proportional limits do not show as regular relationship as the ratios to ultimate strength. The plotted lines generally start from the origin with a slope of about 45 deg., and then gradually curve to the right, concave downward. Thus for low

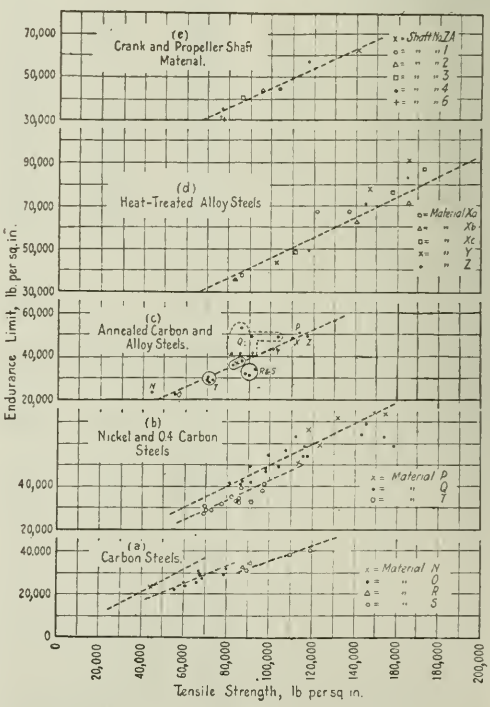


FIG. 4—ENDURANCE RATIOS FOR VARIOUS STEELS

Relation between tension-compression endurance limit and tensile strength. The plotted points show a fair straight-line relationship. Lines drawn to pass through the origin.

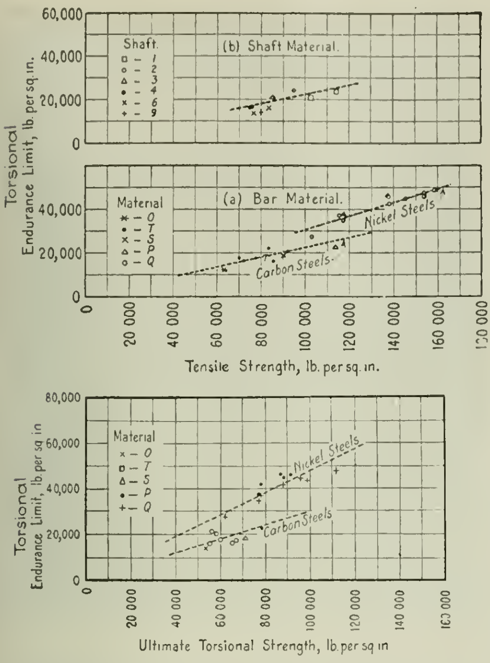


FIG. 5—TORSION ENDURANCE RATIOS

Upper diagrams show relation between torsion endurance limit and tensile strength. Lower diagram shows relation to torsional strength. The crank-shaft diagram represents a ratio of 0.22, as for carbon steel bar material.

or moderate proportional limit, the endurance limit is about equal to the proportional limit, while for high proportional limit the endurance limit is only about half. The ratio of endurance limit to proportional limit is conspicuously lower in low and medium carbon steels than in nickel steels of the same strength.

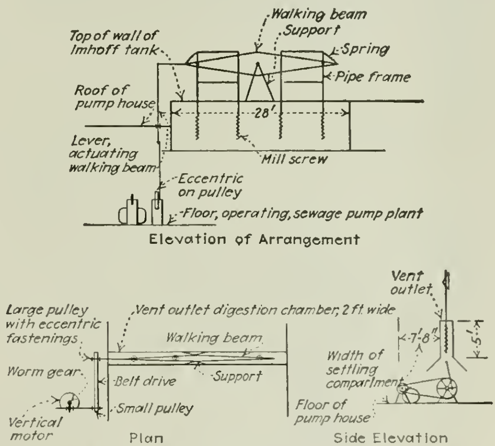
That endurance is not related to brittleness, or in other words to the property which causes failure of a notched specimen under impact, is shown by comparison of the reversed-bending and torsion endurance limits with the Charpy values, and also by the fact that the impact endurance limits depend only on the former. The impact endurance tests were made on notched bars, and here high-carbon steel having a Charpy value of only 2.9 proved superior in endurance to similar bars of low-carbon steel having a Charpy value of 23.6. It is concluded that, whether or not a machinery part contains abrupt change of section, its fatigue-resisting quality is independent of the impact value of the metal, provided the energy of impact is not so great as to cause fracture after less than about 1,000,000 blows.

Endurance Range—Some special experiments to supplement those already referred to were made to investigate the magnitude of the endurance range in various positions within the elastic range. With steels heat-treated so as to have proportional limit nearly twice their endurance limit, it was possible to vary considerably the position of the endurance range within the elastic range. From the results it is concluded that the variation of the endurance range within the elastic range is slight. Even when the stress oscillates between zero and a positive value, the endurance range is apparently not more than about 10 per cent less than when the stress oscillates between equal positive and negative values. It is further concluded that *within the elastic range the endurance range may be assumed to be practically twice the endurance limit.*

Mechanical Agitation of Scum in Vent Chamber of Imhoff Tanks

CONTINUOUS agitation of the scum forming in the vent chambers of the Imhoff tanks treating the sewage at Newton, Kan., prevents "boiling over," the bugaboo of so many operators of sewage plants. W. C. Conrad, mayor of Newton (not an engineer) and Mr. Bachus, a local machinist, have devised a motor-driven walking-beam arrangement carrying four mill-conveyor screws upright in the vent chamber. A. P. Learned, of Black & Veatch, consulting engineers, who designed the plant (see *Engineering News-Record*, Feb. 10, 1921, p. 249) states that such satisfactory operation was secured that a similar arrangement has been installed in the plant at Enid, Oklahoma.

The Newton plant consists of a pumping station, Imhoff tank, sprinkling filters, final settling tank and sludge drying beds. Because of the strong sewage, with the consequent large amount of gas generated in its digestion, and the fact that the walls of the vent chamber



WALKING BEAM DEVICE FOR AGITATING SCUM IN GAS VENT OF IMHOFF TANK

The pipe frames supporting the four screws are counterweighted and fastened to the walking beam at one point so that each screw has the same travel. Operation was unsatisfactory when the travel was unequal.

are only 1 ft. above the level of the outlet weir, the tank often boiled over. The mayor's idea in agitating the scum was to give a free passage of gas and to prevent its hardening, which entrained the gas.

The walking beam, of 1-in. angles, well laced and braced, is mounted over the center of the vent chamber parallel to the long dimension. Fastened to each end of the beam is a frame of 2-in. pipes mounted at one point and held by a spring so that each frame rides at the same angle as the walking beam is raised and lowered. To the bottom of each frame are attached mill screws 8 in. in diameter and 4 ft. long. To one end of the walking beam is attached a lever actuated by a large pulley belted to a smaller pulley run in turn by a shaft driven by a worm gearing mounting on a motor driving one of the sewage pumps. The gear and pulley arrangement reduces the speed of the motor so that the walking beam operates at four to five cycles per minute and the travel of the screws up and down is 12 to 18 in.

Why Steel Forms Were Successful on One Concrete Job

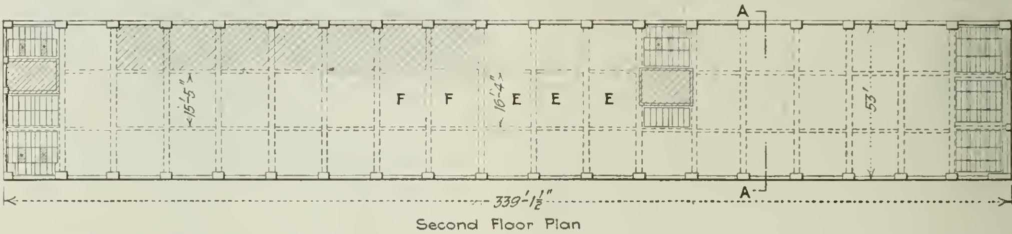
Construction Typical of Many Others Showed That Use of Steel Forms for Concrete Floors and Columns Made for Speed, Economy and Neat Appearance

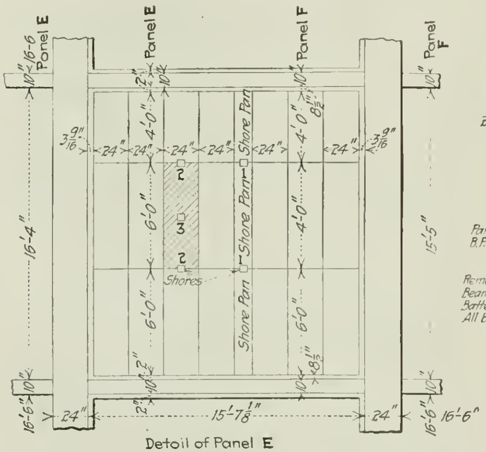
By Raymond C. Reese
Chief Engineer, Building Products Co., Toledo, Ohio

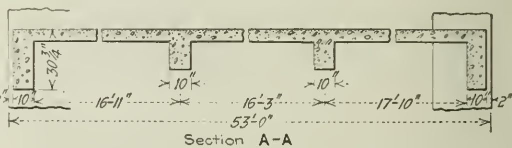
In the construction of a new group of reinforced-concrete buildings for the Hupp Motor Co., at Detroit, Mich., steel forms were used so successfully for the floors and columns that the experience there seems to be of especial value to those who wish more light on the availability of this type of formwork.

The group consists of two four-story parallel buildings of the flat-slab type, each 73 ft. 6½ in. wide by 396 ft. 9 in. long, numbered 9 and 10, respectively, and a third building, No. 11, in which beam-and-girder construction was considered preferable to flat slab because of the machine loads and spacing. This latter building is 53 ft. wide by 339 ft. 1½ in. long, four stories high. The first story is 24 ft. 6 in. high plus a 4-ft. track depression, which necessitated very long shores. Even with beam-and-girder construction it was found both feasible and economical to use the same forms for the solid slabs between the beams—a rather unusual arrangement but since repeated on other work.

The decision of the general contractors to sublet the formwork to steel form erectors was made on a competitive price basis, as compared with wood centering. There was a saving of about 10 per cent in favor of the steel forms. One of the first steps was to make complete working details showing the arrangement of steel panels, location of shores, run of stringers, detail of forms for drop heads, etc., which means that all preparations were made in advance to insure an average daily progress that would complete the work in the scheduled time. The layout required for Building 11 is shown in Fig. 1.







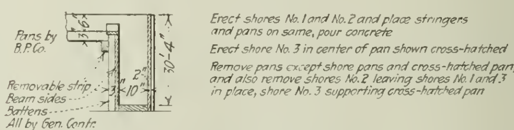


FIG. 1—LAYOUT OF STEEL FORMS ON BEAM-AND-GIRDER BUILDINGS

Fig. 2 shows a typical panel. Shores of 4x4's were set up at proper intervals (averaging one to every 30 sq.ft. of floor) with 2x8-in. stringers resting upon shoulder blocks, fastened to the shores. Wedges were interposed to allow for leveling up. The arrangement of buttons is particularly worthy of note. These can be turned up on the outside of the stringers to hold them in place or can be rotated about the bolt out of the way, to permit easy stripping of the stringers.

All steel panels were made from heavy gage sheet steel to prevent distortion. They were provided in widths of 1, 1½ and 2 ft., and in lengths of 4 and 6 ft., thus making only a few sizes to stock and handle, and likewise proving very feasible and adaptable in actual practice. These panels conformed to the floor layout within a few inches, and variations were filled in with a strip of wood. The 1-ft. steel panel had open ends so that shores could extend up into the panels and remain there for permanent shoring as shown in Fig. 3. The other steel panels were made with solid ends and all of the steel panels or forms were manufactured with stiffening ribs arranged at short intervals. Two or three days of good weather allowed the stringers and intermediate steel panels to be stripped and used on the next set-up leaving shores and permanent shore panels to support the floor until the deck above was poured.

FIG. 2—CLOSE-UP OF UNDERSIDE OF STEEL FLOOR FORMS ASSEMBLED

Progress of Work—The storage site where the material was to be stored was not particularly convenient being some little distance from the site of the buildings and separated by a railroad track over which a large amount of switching took place with consequent delay to the trucks. This was an unavoidable handicap but did not interfere with the completion of the work within a specified time.

The contractor first placed the concrete floor on the ground, thereby affording a firm foundation upon which to start shoring. The first operation was to build drop panels of wood to form plinths above the column caps. The columns were circular, spirally hooped, with a flaring cap and were formed with steel column molds. Experience has proved that the only way to obtain proper alignment and to reduce erection cost is to put up the drop panels in the form of strongly braced towers which are aligned in both directions and wedged up to grade. After these are firmly braced in position they establish reference points between which the steel panels are placed. Fig. 5 shows very clearly the arrangement of these towers.

On Sept. 11, 1922, the first steel forms or panels were placed for Building 9, shown by Fig. 4, and the erection schedule calling for completion of the concrete work by Nov. 11 necessitated strict adherence to the established routine. The steel form area shown in Fig. 4 is the result of part of the first day of form placing. Fig 5, taken two weeks later, gives a good conception of the entire layout and shows the tower for the second floor of Building 9 practically completed. It also shows towers being started on the second floor and part of the first floor on Building 10, while on Building 11 the first floor is entirely completed. This represents only two weeks progress after the first forms were placed. Two weeks later the third floors of Buildings 9 and 10 were started and the second floor of Building 11 was about finished. This progress schedule was carried forward steadily throughout the entire job.

On Nov. 11 the last concrete was placed. The chart which was prepared by the contractors for their progress schedule on Sept. 11 called for approximately 240 yd. per pouring day and made no allowance for mishaps or other contingencies. The usual difficulties were encountered, such as delay in the delivery of cement (the railroads being fearfully tangled up at that time), loss and replacements of labor, delay in pouring owing to trouble with cement plant and delays in trucking the material from the storage site; notwithstanding these handicaps the work was completed on the exact date predicted.

This job typifies co-operation between the contractor and the subcontractor as it involved a fairly good sized area of buildings and was carried through by all parties to their mutual satisfaction, and it will serve better as a typical illustration of steel formwork than one on which unusually favorable conditions enabled extremely low costs and unusually rapid programs to be attained.

The subcontractor's form-setting crew for both steel pans and column work, including handling of all slab shoring, fabrication and handling of drops, consisted of 20 men and a superintendent. This crew carried the job through to completion and formed 300,000 sq.ft. of floor in 60 calendar days. The attainment of such speed as shown in this particular instance is not an extraordinary accomplishment in the writer's experience. The explanation of maintenance of the speed schedule is based upon the fact that steel forms make possible the use of considerably less shores than are used with most forms; and the most important fact, that the steel form crew was trained man by man to perform certain special operations, each with the utmost speed. Because one man or set of men have just one thing to do they become expert and attain the highest possible speed in the performance of their special function. By this it is possible to obtain the highest speed from labor employed over the job and to use less men on a job of this character than would be necessary with other systems of forming.

FIG. 3—PERMANENT SHORING AND SHORE PANELS IN PLACE

One of the points encountered on all industrial buildings is the placing of inserts for fastening shaft hangers, sprinkler pipes, etc. When wood forms are used, these are screwed or nailed down. Metal forms have made possible the use of mastic cement which fastens the insert firmly to the metal forms. A large number of inserts were used on the Hupp job and by the use of this cement it was possible to place inserts at a cost of 1½c. each.

Construction Precautions—Great care was taken to see that materials were delivered to proper points and neatly piled ready for use. As soon as forms were stripped they were moved to the side wall of the building ready to be carried to the next point, loaded on buggies which were elevated by a boom on the tower. If this movement of forms had been only from floor to floor it would have simplified movement considerably and greatly reduced the handling charges, but as it was, the forms were moved in turn from building to building as progress required.

Emphasis has been made of the point of centering towers to line and grade and having them securely braced. A first glance would see a possible economy in the formation of less substantial towers, but experience has proved that the care and attention given to the construction of well braced towers, accurately lined, is a worth-while ultimate economy. Another point of economy consists in running long lines of shores at one time. It is expensive to spot a few shores here and there, but when a reasonable run can be pushed through at one time, the unit costs are cut considerably. The making of shores can be studied and systematized just as carefully as production work in a large factory. This is especially important when it is considered that a nominal amount of shores run well into the thousands in quantity. Adequate ribbon bracing of all shores is also important in the obtaining of a neatly finished job. It takes but little longer to do this and in the end it pays for itself.

One of the big economies of the steel form system as a whole lies in the small amount of lumber required. It is generally accepted that forms for a flat-slab job made up entirely of lumber require from 3 to 3½ ft.-b.m. per square foot of contact area, while with the system of steel forms used on this job, the requirements averaged ½ ft.-bm. On small jobs, where the number of re-uses is limited, a little more will be required, while on very large jobs it is possible to use a little less.

Furthermore, none of the lumber used in the steel form system comes into contact with the concrete and is consequently in good condition and has a very high salvage value. In fact it can be used indefinitely from job to job merely at the expense of freight and handling. On the Hupp Motor Group, the lumber was furnished by the general contractor who had already placed partial orders for material required, but was fabricated by the subcontractor.

The partial layouts, Fig. 1, show how nearly the forms covered the area to be formed and how little filling in was required. They give a good idea of the adaptability of the system. It has proved much more successful in actual practice than one would expect from a cursory examination. The chief matter of adjustment is obtained by using "pads" or fillers on the drop heads to take up the play between the actual drop as designed and the opening left by the panels. At these points practically all the slack is taken up. At spandrel beams it is well to follow the details indicated, leaving a few inches of filling in between the actual beam side and the first panel, both to facilitate the stripping of the forms and to give another point at which to take up play. This detail has practically become standardized.

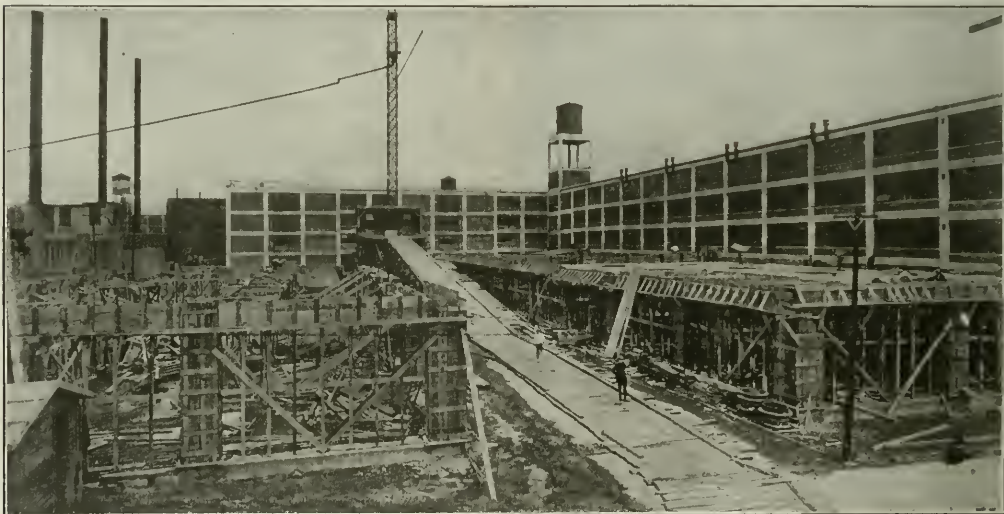


FIG. 4—SET-UP OF PANS ON STRUTS AT BEGINNING OF CONSTRUCTION

Conclusions—The following conclusions are the result of the writer's experience with the system:

(1) On buildings of such size that a sufficient area for one set-up is obtained with an area of forms that will permit of four or more re-uses, steel forms can be used more economically than wood forms, and as the number of re-uses increases, the economy increases.

(2) But little filling in between forms and spandrel beams or drop panels is required.

(3) No difficulty has been experienced due to the combination of steel forms with wood beam and drop panel forms. A little forethought in the design of the wood forms is all that is required.

(4) Inserts are readily and securely held by mastic cement and can be placed at a minimum expense.

(5) Steel forms produce a ceiling that is much smoother than can be obtained with the use of ordinary wood forms.

Whether or not steel forms are applicable to the particular construction is a question involving the calculation of forming cost on the particular job, considering especially the following headings:

(1) Number of Re-Uses to Which Forms Can Be Put on a Particular Job. This involves, among other items, the area of forms required in one set-up. Usually not less than 5,000 to 10,000 sq.ft. is desired at a time, and sometimes even more, depending upon the capacity of the concreting plant.

(2) Cost of Lumber. This is a highly influential factor in determining whether a job is one for steel forms or not, as steel forms require from 50 to 60 per cent less lumber than other methods of forming. Where lumber is high, the ultimate economy in the use of steel forms is easy to perceive. Steel forms can be used economically on a much smaller floor area where lumber is high than is possible where lumber is appreciably cheaper.

(3) Scarcity of Labor. The fact that we have been able to form large jobs and keep up with a definite progress schedule, with the use of very few men, has enabled us to disregard the labor situation to some extent, as we carry a regular force which can be kept busy at all times.

(4) Quality and Finish of Work Required. This particular item is one which is the subject of a great deal of discussion. On this particular job we were obliged to furnish a high class of finish on the concrete, which in our opinion would have been impossible with other methods of forming.

The general contract for the Hupp Motor Group was let to the Everett Winters Co., of Detroit, Mich. The subcontractor for formwork was the Building Products Co., of Toledo, Ohio. The Blaw-Knox slab forms were used.

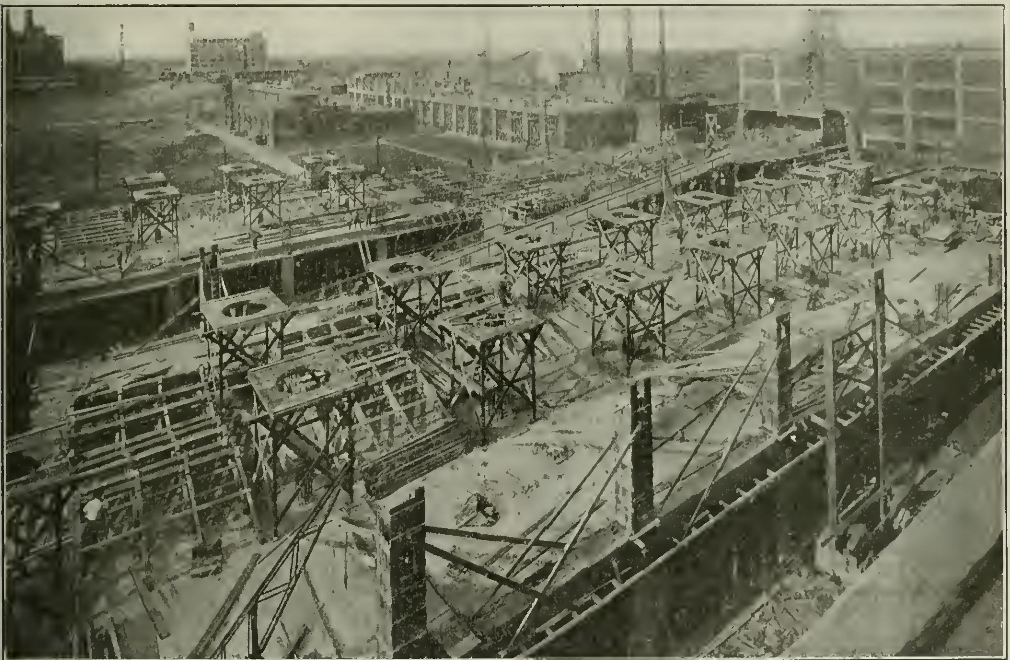


FIG. 5—PROGRESS ON HUPP GROUP AFTER TWO WEEKS OF FORM LAYING
Note towers supporting the column head panels

Mississippi Bridge at St. Paul

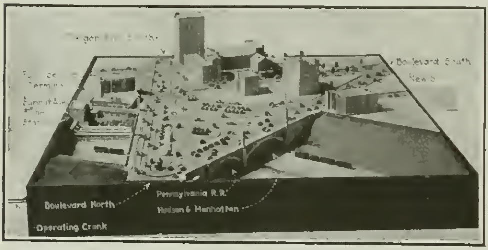
An engineering report is soon to be made on the proposed bridge over the Mississippi River at the new Ford plant, connecting the cities of St. Paul and Minneapolis. A commission to consist of at least five members was authorized by the last legislature, and the commissioner of highways was appointed chairman. The other members of the commission include the president of the council of each city and the city engineer of each city. This commission delegated the work of preliminary surveys and report to the two city engineers, N. W. Elsberg (Minneapolis) and George M. Shepard (St. Paul). Surveys have been made and a report will soon be made to the commission. The law provides for the issuance of $800,000 in bonds by each city to defray the cost of the bridge.

Bridge Plaza Plans Successfully Presented by Aid of Model

Complicated Layout Made Clear by Use of a Model—Mechanical Arrangement to Show Traffic Movements

THE USEFULNESS of a model in presenting proposed development schemes to the public is well demonstrated in the case of the proposed Hudson County Bridge Plaza at Summit Ave. in Jersey City, N. J. The Hudson County Boulevard is the one north and south thoroughfare on the west shore of the Hudson River opposite New York City. It is one of the most important thoroughfares of the Metropolitan District, used as the Lincoln Highway carrying all the traffic south and west from New York City. Its importance will be greatly increased when the vehicular tunnel now under construction under the North River between Jersey City and New York is opened.

The alignment of the boulevard is fairly straight until it reaches the point, in the vicinity of Summit Ave., where it is carried over a depression, in which the tracks of the Pennsylvania and Hudson & Manhattan railroads are located, on a three-span structural steel deck bridge 342 ft. long and 60 ft. wide carrying a 40-ft. roadway and two 10-ft. sidewalks. The height



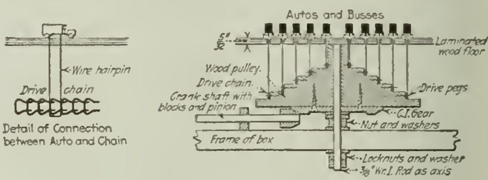
MODEL OF THE HUDSON COUNTY BRIDGE PLAZA

of the roadway over the tracks is 50 ft. The improved roadway beyond the bridge is 60 ft. in width. The existing bridge was built in 1894 when the boulevard was no more than a bridle path. Due to heavy traffic there is an excessive vibration throughout the entire structure, making necessary an immediate reconstruction.

In a northerly direction from the bridge the roadway curves to the left from the abutment through 51 deg. Likewise, going south, it begins to curve to the right immediately as it leaves the south abutment through 77 deg., then follows one full city block of tangent and another turn left through 46 deg., thus forming in all a very tortuous alignment. In this elbow curve is the center of great traffic activity which is due, in large measure, to the movement of passengers to and from the Summit Ave. station of the Hudson & Manhattan "Tubes," which is located just east of the south end of the bridge. In 1922 this station handled 24,000,000 passengers. This figure gives a fair indication of the magnitude of traffic in this section.

The great bulk of this passenger traffic is handled to and from the station by buses, private cars and taxicabs along the boulevard. The surface car traffic from Bergen Ave. does not directly affect the situation as the cars do not come out onto the boulevard. All the bus lines with the exception of the Central Ave. line terminate near the south abutment of the bridge discharging and loading passengers on the bridge and around the curve immediately adjacent thereto. This is for the convenience of passengers in reaching the 15-ft. passageway which is the only avenue of access from the boulevard to the station. The buses from the north discharge passengers on the bridge and turn around in the two narrow streets forming Journal Square. The Bergen Ave. line uses these streets also but turns at the street intersection north of the bridge which is also the turn-around for buses from the south on the boulevard.

The two principal bus lines north and south on the boulevard carry monthly approximately 1,600,000 pas-



METHOD OF MOUNTING THE MOVING PARTS

sengers. To complicate the situation there is the through and local travel on the boulevard. The maximum eight-hour count of vehicles over the bridge including the buses is 15,000. These factors, the tortuous alignment of the boulevard, the narrowness of the bridge roadway, the inaccessibility of the station and the enormous growth of travel have caused a traffic congestion comparable in importance and magnitude to the larger traffic problems of the Metropolitan District.

The Proposed Rearrangement—In correcting the alignment of the boulevard by projecting a new street forming the hypotenuse of a triangle to divert part of the traffic from the principal turn of the boulevard where the traffic jam occurs, all the traffic difficulties of the section are corrected and essential facilities are readily evolved. The new street continues across the railroad cut and intersects the present roadway just beyond the northerly abutment. The two roadways over the tracks form the sides of an A-shaped bridge plaza 200 ft. in width at the northerly abutment or apex, 525 ft. in width at the base, the length or altitude being 465 ft.

Traffic Movements—This "A" shape made possible a one-way movement in traffic control. Within this space three large platforms are placed to separate the traffic south-bound on the westerly leg and north-bound on the easterly leg or roadway of the bridge. The two platforms parallel with the roadways form a center plaza wherein the north-bound vehicles or buses can be drawn away from the through traffic. Passengers are to be unloaded on the one platform and loaded from the other, the vehicles turning within the area. The large platform forming the cross-bar of the "A" is used as a receiving and unloading platform for south-bound passengers. The buses are operated along the lower or curved side of the platform. The upper or straight edge of the platform will be used for private vehicles from the north turning with the general traffic movement. The sides of this big platform can be used for unloading passengers from vehicles continuing north

and south beyond the plaza. There is parking space in the center between platforms and along the side of the platforms for taxicabs and momentary stops of private vehicles. Private vehicles can also park along the roadway sides of the platforms.

Stairways lead from the three island platforms to two longitudinal and one main or transverse passageway built directly underneath the bridge floor. The transverse passageway is in line with the existing passageway to the station and will be built underneath it to the width of 20 ft. Other stairways from the various corners of the plaza connect with these passageways to make it possible to reach the station or the three island platforms from any point on the surface without crossing the roadways. Hudson County and Jersey City authorities jointly will remove the buildings in Journal Square, thus giving Bergen Ave. proper access to the boulevard.

Plaza Model—After the preliminary plan had been approved by the Board of Chosen Freeholders it was found that there was considerable misinterpretation and misunderstanding of the workability of the plan. To correct these false impressions a mechanical model was made so that the entire project would be visualized. The model was made to scale of 1 in. equal to 20 ft., the scale of the plan of the general layout. From this plan the buildings, roadways, piers, etc., were readily superimposed on a large piece of heavy cardboard on which were drawn also the lanes of all lines of traffic and the plan of the mechanical effects. The roadway of the model is made of laminated wood about $\frac{3}{16}$ in. in thickness. Slots were cut in the roadway in the center along the principal lines of traffic movement making loops of each separate route. Under the ends of the roadways were stepped sprocket wheels or cone pulleys so set that the face of each step came directly under the turn in the corresponding slot in the street. At the minor changes in direction stepped fixed guides were used instead of sprocket wheels. The main sprocket was geared to a crankshaft extending outside the frame of the model. When the wheels and guides were in place chains were fitted to them, one chain under each slot in the street surface. When the chains were adjusted hairpins were secured to each chain at intervals along its length by sticking the ends of the hairpins through the links of the chain. These pins were cut off about $\frac{1}{2}$ in. above the street surface and a tiny pressed pewter automobile was secured to the ends of each pin by sticking them in hot sealing wax poured into the body of the car. The automobiles on each line were colored differently to distinguish the separate traffic routes. Other automobiles were secured directly to the street surface showing position of parked cars.

When the whole model was assembled it was possible, by turning a propelling crank, to cause all the lines of automobiles, buses etc., to move around the plaza along their proper routes showing continuous movement without interference.

The buildings were made of cardboard with the architectural features drawn in elevation. Only the most important buildings of the section and those buildings necessary to show the relative position of the new street and the bridge plaza were made a part of the model.

The improvement is being carried on by the Board of Chosen Freeholders through the office of County Engineer Frank J. Radigan. The plans were prepared and the model was made in the office of A. Burton Cohen, consulting engineer, New York City, assistant engineers, Robert L'H. Tate and Harry K. Wilson.

Why Sacramento Garbage Collection Bills Are Presented by Agents

IN COLLECTING from the householders of Sacramento, Calif., the monthly charge which the city makes for removing garbage, the bills are presented at the door by employees of the city. Three collectors have been found adequate, with occasional aid from the head of the department, to collect the monthly bills for the entire 15,000 premises which subscribe for the garbage removal service. Owing to multiple payments at real estate offices, etc., only about 12,000 addresses have to be visited each month by collectors. Solicitation in person is made rather than mailing the bills because the additional cost is more than offset by the lower percentage of bad bills. Another advantage of personal solicitation is that the collector can report attempts to evade proper classification, failure to observe sanitary regulations, etc.

With a minimum charge of 50c. per month for weekly removal from one 20-gal. garbage can, the average collection per address is slightly over $1 and the total collection $12,500 per month from the 12,000 addresses.

Collectors carry a carbon copy attached to each bill. At addresses where no one is found at home the collector uses a rubber stamp to mark the bill "Pease remit by check with bill attached, or bring to City Hall be fore the first of the month." After repeated failures to make colletcions the collector leaves a bill marked "If this bill is not paid within three days service will be discontinued." Under this system only a fraction of 1 per cent of the bills go unpaid

Forests Prevent Silting of Reservoirs

Abstract of paper on Soil Erosion and Forest Cover in Relation to Utilization of Water Power, with Special Reference to the Southeast, presented by W. W. Ashe, Assistant District Forester, U. S. Forest Service, before the Southern Appalachian Water Power Conference.

IF THE ENORMOUS resources of our rivers are to be adequately developed it must be through a series of storage reservoirs such as have been tentatively located on the upper regions of some streams. As the value of such reservoirs depends largely upon their life and the maintenance of their storage capacity, erosion of soil is the all-important factor in determining the number of years which will elapse before the fertile soil and earth removed by heavy rains from the land in their catchment areas will fill them, gradually in most cases, but surely if any erosion takes place. Erosion is not a natural condition for such streams as lie above 1,500 ft. altitude, and in many cases it is entirely due to the removal of the protective cover of the forest with its litter and humus.

Hydrographers claim that forests have little effect on stream flow, but this is to be questioned except in the regions of sandy soil where the forest influences are usually at a minimum. These influences rise to a maximum in the Sierras of California, in the southern Appalachians, and in the southern Piedmont, where erosion is an important factor. Nor does grass cover take the place of forest cover, because grass cannot be adequately maintained without periods of cultivation and consequent erosion, and moreover a grass cover lacks the permeability of forest cover with its deep root zones and channels resulting from the decay of roots.

Endurance of Steel—Second Illinois Report

Correlation of Endurance and Heating—Tests on Combined Tension and Bending—Goodman's Law Not Verified

A DEFINITE endurance limit for wrought steels was established in the early series of tests carried on at the University of Illinois as a co-operative research between the Engineering Experiment Station of the University, the National Research Council, Engineering Foundation, and the General Electric Co., as reported in the Illinois Bulletin 124, published two years ago. Extensive additional tests have just been reported on in Bulletin 136 of the station, by H. F. Moore and T. M. Jasper. These additional tests confirm all the results indicated in the prior report, and in addition deal at considerable length with repeated stresses of combined tension and bending, in which case the stress in the outer fiber of the metal varies from a high tension to a low compression or from a high tension to a low tension, instead of varying between equal tension and compression values as in the previous reversed-bending tests. The results indicate that the so-called dynamic law of Goodman does not hold, but that higher endurance values are obtained than would follow from this hypothesis.

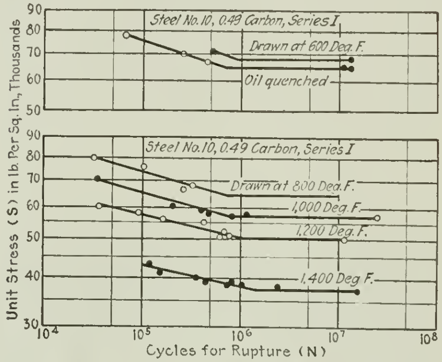


FIG. 1—TYPICAL REVERSED-BENDING CURVES
Endurance limit decreases with increase of drawing temperature from 600 to 1,400 deg. F.

In the recent work carbon steels ranging from 0.02 to 1.20 carbon, and two chrome nickel steels with about 3½ per cent nickel, were tested. Reversed-bending tests were carried out on a specimen supported at both ends and loaded in the middle, while rotated at a speed ordinarily 1,500 r.p.m. Substantially no effect on the results was found by changing the speed to as low as 200 r.p.m. or as high as 5,000 r.p.m. The torsion tests were made in machines of two different types. In all cases the specimens were cut from the material longitudinally (in the direction of rolling).

Endurance Limit Confirmed—The conclusion from the earlier tests that wrought ferrous metals have a definite endurance limit—a stress below which the material will stand an indefinitely large number of reversals—is confirmed by the more recent tests. All the plots such as those of Fig. 1 (reversed bending)

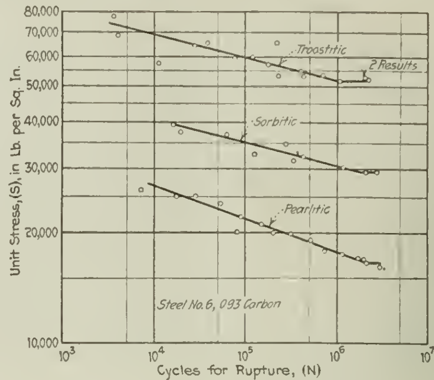


FIG. 2—REVERSED-TORSION CURVES

and Fig. 2 (reversed torsion) show a sloping part changing sharply to a horizontal part (in plottings on double logarithmic paper). Special search was made to discover whether the horizontal part of the curve shows a tendency to drop at very high values of reversals, and a number of tests were run to about one billion reversals at values just below the endurance limit deduced from a smaller number of reversals. No evidence of a lowered endurance limit at this very high number of reversals was found.

Heating Limit Identical With Endurance Limit—Complete confirmation was obtained of the previously

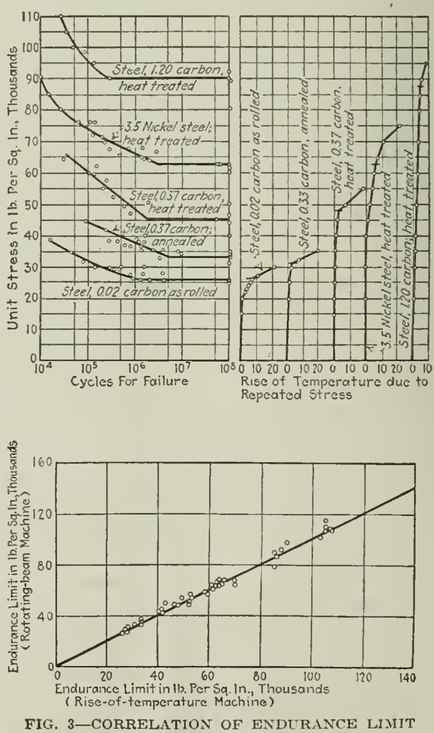


FIG. 3—CORRELATION OF ENDURANCE LIMIT AND HEATING LIMIT

developed fact that the endurance limit may be determined by noting the break in the rise-of-temperature curve in a series of stress reversals extending over only a few minutes. The upper diagram in Fig. 3 shows side by side the endurance curves (in this case plotted on simple logarithmic paper) and the corresponding heating curves, which show a break at the endurance limit. Fuller proof of the identity of the two points is given by the lower diagram, which represents a composite plot of all the tests so far made, each point being plotted with endurance limit as ordinate and heating limit as abscissa. None of the points departs materially from the straight line of equal values.

Strengthening Effect of Overstress—Some specimens which had stood 100,000,000 cycles without fracture, under stress just below the endurance limit, were retested under higher loads, and many of them ran up to 50,000,000 cycles or more although the stress in certain

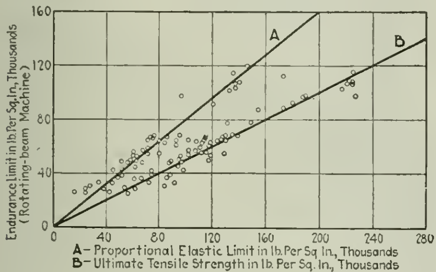


FIG. 4—CORRELATION OF ENDURANCE LIMIT WITH ULTIMATE STRENGTH

Left-hand curve shows the imperfect correlation with elastic limit.

cases was as much as 20 per cent above the endurance limit of the material in its original condition. This strengthening effect was especially noticeable in 0.37 carbon steel, normalized.

Relation of Endurance Limit to Ultimate Strength—From the two curves in Fig. 4 it may be seen that the endurance limit is very closely correlated to the ultimate strength of the steel, and only quite imperfectly to the elastic limit. This also agrees with the indications of the earlier tests. In this connection, however, the second report gives the following necessary caution: "The materials engineer should beware of regarding any single property of a metal—elastic limit, tensile strength, endurance limit, hardness, ductility, notched-bar value, etc.—as a complete indication of the usefulness of a steel. Static strength, resistance to impact, ductility under overstress, and resistance to repeated working loads are all important."

Effect of Overstress—In a number of tests the endurance specimen was first subjected to a few applications of direct tensile stress. As exhibited by the curves in Fig. 5, this preliminary stressing had no effect on the endurance test so long as it was well below the proportional limit, but above that limit it reduced the endurance 20 per cent.

Effect of Heat Treatment—When the temper of a hardened steel specimen is drawn, its endurance limit is not much affected until the drawing temperature exceeds 600 deg. Higher drawing temperatures pro-

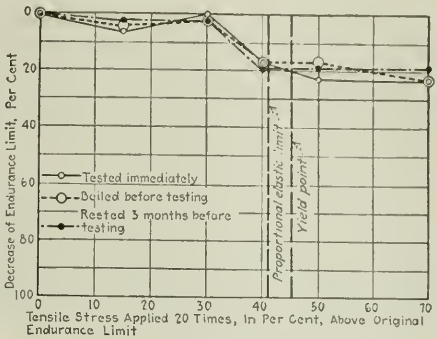


FIG. 5—REDUCTION OF ENDURANCE LIMIT BY PRELIMINARY OVERSTRESSING

duce a progressive decrease in endurance limit, as illustrated in Fig. 1. For nickel steel, both ultimate strength and endurance limit fall off slightly even with low temperatures of draw.

Combined Bending and Tension—An extended investigation of endurance under a range of stress other than complete reversal was begun during the past two years. The tests were made upon a rotating cantilever specimen loaded at its outer end, and stretched longitudinally by a heavy spiral spring bearing against a collar on the specimen. The endurance curves obtained proved to be exactly like those for reversed bending, but the endurance limit had a different value. The steels tested were a 0.53 carbon steel and a 3½ per cent nickel steel.

The results for the nickel steel, annealed, are reproduced in Fig. 6, where they are plotted in connection with a Goodman diagram. Professor Goodman, of Leeds, developed a hypothesis on the assumption that the varying component of stress has twice the effect of a steady stress, and that fracture cannot develop unless the sum of steady stress and twice the varying stress reaches the ultimate strength of the material. The shaded diagram in Fig. 6 represents the Goodman hypothesis. The plotted circles and the curved line passed through them represent the Illinois test results on this particular material. In all the tests it was found that the curve of maximum stress approached the horizontal in the neighborhood of the proportional

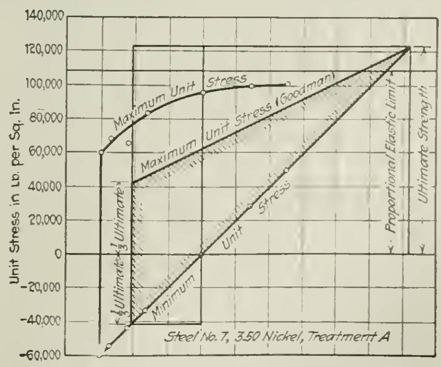


FIG. 6—GOODMAN DIAGRAM AND ACTUAL TEST RESULTS FOR 3½ PER CENT NICKEL STEEL

limit, while below the point of sharp bending the maximum-stress curve was not far from parallel to the minimum-stress line, in most instances.

A formula is proposed in the bulletin, to express the endurance limit (maximum stress) for any given ratio r of minimum to maximum, in terms of the endurance limit for completely reversed stress, S_{-1}:

$$S_r = \tfrac{1}{2}(r + 3)S_{-1}$$

The formula can be used only up to the limit at which the maximum unit stress reaches the proportional limit of the material; for most steels this eliminates ratios of minimum to maximum stress greater than zero. "Beyond the proportional elastic limit the static properties of the steel are the governing factors, rather than the fatigue properties."

Laying Large Cast-Iron Gas Main in Chicago

Work Expedited by Breaking Bell-Hole Material into Excavator Buckets and Calking with Air-Driven Tools

RAPID laying in Chicago last fall of 4½ miles of one of the largest gas mains in the country involved 7½-ft. trenches which were excavated at one cut with bell-holes predetermined and the material broken down into the excavator. Other features of the work were rapid calking by pneumatic hammers, cumulative testing of the line, reduction of the speed of the pipe-lowering lines by a double set of blocks and placing the pipe on the original, undisturbed bottom of the trench. The line was laid by the Peoples Gas, Light and Coke Co., on Crawford Ave. from Thirty-ninth St. to Forty-fourth St., on Forty-fourth St. from Crawford Ave. to Hamlin Ave., and south on Hamlin Ave. from Forty-fourth St. to Seventy-first St., as a new connection to the distribution system on the south side of the river from the newly completed plant at Thirty-fifth St. and the Main Drainage Canal of the Sanitary District of Chicago. The new pipe serves three purposes: (1) It takes care of the maximum capacity of the new plant, (2) it acts as a storage holder and (3) it will supply the south and southwest sides of Chicago for many years.

With a 3-lb. drop in pressure on the 48-in. main between the pumping station at the holder at Thirty-fifth and Crawford Ave., and with the different lines feeding east out of the 48-in. main, the new main will pass a maximum of 3,000,000 cu.ft. per hour. The pressure maintained at the pumping station is from 6 to 6½ lb. With a 1-lb. drop in pressure between the pumping station and Seventy-first St., a distance of nearly 5 miles, the 48-in. main will pass approximately 1,500,000 cu.ft. per hour.

The grade of the southwest side of Chicago drops gently to the north and all drainage flows to the Drainage Canal. It was decided that an easy grade should be given the 48-in. main to the north and that it should follow the natural contours of the ground. Two feet of cover was considered sufficient and by grading the line to the north, no drips would be necessary as the line would drain into the tunnel shaft at Thirty-ninth St.

All underground work was taken care of in advance, arrangements being made with the city water-works department to lower the mains deep enough to allow the 48-in. main to pass over them. A 30-in. main was cut and lowered 8 ft. by the insertion of 45-deg. bends. Telephone conduits and high voltage wires were moved out of the path.

An accurate survey was made of Hamlin Ave. along the route of the main and a profile map was made showing obstructions. The proposed line was laid out on this profile map and the grade established. Test holes were dug at each street intersection so that an accurate knowledge of the obstructions would be available and on record.

Because the south end of the job was on the highest elevation, and the territory at the north end near the Drainage Canal was open country, having a gumbo soil, very soggy in the spring of the year, it was decided to start at the south end.

Nash Brothers, the contractor for all work but the calking, sublet the excavation of the trench to W. C. Thorne, Oshkosh, Wis.

FIG. 1—THREE COMPRESSORS FEED AIR UNDER 100-LB. PRESSURE INTO HEADER LAID ALONG TRENCH
As high as fourteen sets of calkers and twenty-six hammers worked from the header line. The compressors supplied a maximum of 210 cu.ft. of air per minute.

An excavator with auxiliary cutters and buckets for the wide trench averaged about 200 ft. per day, while the average of 186 ft. of pipe laid, the speed maintained up to Aug. 1, is believed to be a record for 48-in. gas or water main. After this time the progress was slower as the line paralleled the trench of another underground utility making it necessary to substitute a dragline for the excavator.

Including the expansion of the earth from the trench the excavation runs about 2 cu.yd. per lineal foot. The position of bell-holes was determined ahead of the excavation and men with bars and shovels cut out the recess, throwing the material into the buckets of the excavator, thus saving the labor of throwing the material out of the trench. Due to a 43-day period of dry weather in Chicago only single pipe-trench braces were required, the clay gumbo standing up well.

To lower the pipe slowly into the ditch and to assist in lining it straight, the single line on the hoist drum was reduced by means of a double set of blocks so that 1 ft. on the drum was reduced to a 2½-in. drop at the pipe. A 10-ton caterpillar crane followed closely behind the excavator. It took 6 min. to lift the 48-in. pipe from the bank, place it in the trench and drive it

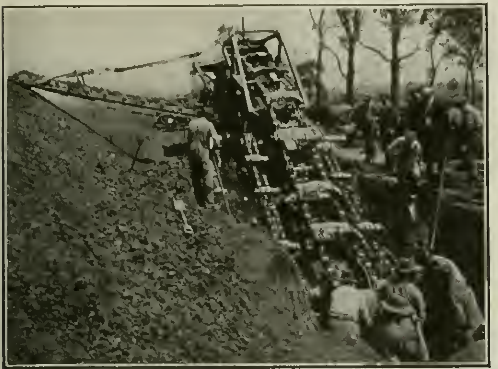


FIG. 2—BREAKING BELL-HOLE MATERIAL INTO EXCAVATOR
Position of bell holes was predetermined. With the auxiliary cutters the excavator dug a trench 7 ft. wide.

home. Extreme care was taken in laying the pipe, each length of which weighs 4 tons. The trench was dug to grade, and the 4-in. blocking so laid that the top was on grade, making the whole pipe, with the exception of the bell, rest on the original, undisturbed bottom of the trench. Constant engineering supervision was needed to carry out this plan. Levels were taken on the ditch as the excavator worked, on the blocking before the pipe was laid and on the pipe line after laying for a permanent record.

The company maintains its own machinery and crew for calking. Immediately after the pipe was placed in the trench, the bell-holes were trimmed in preparation for the calkers. At no time during the progress of the work were the calkers more than twenty-five joints behind the last pipe laid. Joints were 5 in. deep and calked with 3 in. of wool yarn and 2 in. of lead wool. Calking was done by pneumatic hammers, two men to each joint. It required 8 lb. of wool yarn and 126 lb. of lead wool per joint. Two men averaged two joints per day.

Compressed air was furnished by three portable compressors capable of supplying a maximum of 210 cu.ft. per minute each at 100-lb. pressure. A header line laid along the trench was fed by two compressors. At times as high as twelve sets of calkers and twenty-six hammers worked from this header line. The header line was run about 600 ft. ahead of the point where the calkers worked, and, by aid of an extra compressor, two compressors were always connected to the line while one was being moved ahead. By this arrangement the calkers were never held up waiting for air while the compressors or the header line was being moved ahead.

FIG. 3—EXCAVATION WITH DRAGLINE AND PIPE-LAYING WITH TRACTOR-MOUNTED CRANE

As precautionary measures against ground or surface water it was decided to have on the job three pumps having a capacity of 50 gal. per minute each. A header line was laid along the top of the trench and 12-ft. lengths of hose were connected by unions to this header line and lowered into each bell-hole where there was water. The method proved satisfactory in keeping the bell-holes dry.

The progress of the work for a week was so arranged that the digging and laying of the pipe ended Saturday noon. All uncompleted joints were then finished Saturday afternoon, or on Sunday if necessary.

To test the line a 48-in. plug was put in the last pipe by means of the traction crane. When the last joint had been calked, the three compressors were hooked up to the line and it was possible to secure 15-lb. pressure in the line inside of 8 hours. The tests were cumulative, the air being placed on each week's work in addition to the line already finished.

The contractor backfilled the trench with a power backfiller and puddled the dirt by means of a fire-hose connection to hydrants at street intersections. Excess dirt, which amounted to $\frac{3}{4}$ cu.yd. per lineal foot of ditch, was loaded by a clamshell crane on traction wheels, into auto-dump trucks and hauled away from the job to be wasted on vacant property.

The line was completed early in October and on Oct. 15 gas under 1-lb. pressure was turned in to blow out the air. Three hours later analysis indicated all of the air had been displaced and the full 5-lb. pressure was then admitted.

The new main was laid under the direction of John H. Eustace, chief operating engineer, with W. G. Rudd, assistant operating engineer in charge of the engineering details. Supervision and construction were carried on by the department of streets, of which C. L. Day is general superintendent, John Ginley, assistant general superintendent, and F. S. Carnes, superintendent of the south division.

Automatic Train Control Needed

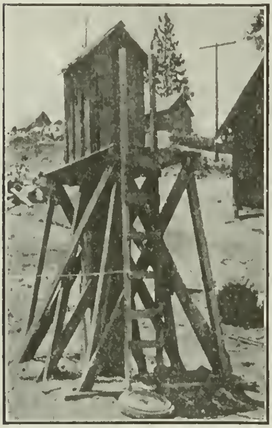
A rear end collision between two freight trains on the Illinois Central R.R. at Hammond, La., was caused by the failure of the engineer of the following train properly to observe and obey automatic block-signal indications. The director of the bureau of safety of the State Commerce Commission comments as follows: "This accident again directs attention to the necessity for an automatic train-control system which will operate and control a train whenever for any cause an engineer fails to see or heed danger signal indications. In accidents of this character involving automatic-block signals, such failure of the human element can not be fully checked and provided against except by the use of an automatic train-control system to supplement existing signal systems for the purpose of compelling obedience to such indications."

From Job and Office

Hints That Cut Cost and Time *For the Contractor and the Engineer*

Fire Hose Towers Protect Camps Despite Heavy Snowfalls

SEVERAL construction camps on the Big Creek project of the Southern California Edison Co. are located at elevations above 7,000 ft. where snow accumulates to great depths every winter. In the highest camp, at elevation about 9,000 ft. a 20-ft. depth of snow is not unusual. With several hundred men in such camps and important work at stake, adequate fire protection in winter time has been given careful study with the result that instead of being put on the ground in the usual way, fire plugs, together with the necessary hose, have been located in wooden towers whose height varies with the average depth of the winter's snow.



CAMP FIRE PLUG DESIGNED FOR WINTER SERVICE

These towers are located at strategic points throughout the camp and are arranged as shown in the accompanying illustration with the water main leading to the plug incased in earth or sawdust to prevent freezing and a small house on top of the platform in which lengths of hose can be stored.

Macadam Road Smoothed by Combining Dragging With Surface Treatment

By A. H. Hinkle

Superintendent of Maintenance, Indiana Highway Commission

A NEW method of making smooth a rough macadam surface by the use of surface treatments combined with dragging, has been used with success on one of our state roads. The work in this particular instance consisted in combining the surface treating of an old macadam road with a process of dragging, which resulted in transforming a rough and irregular surface into one much smoother.

About two years ago a waterbound macadam road was built under traffic, a condition which prevents the surface from being smooth when completed. This surface had been treated with tar in 1922 but the irregularities were still prominent. This year it was decided to retreat the surface. The surface was first swept and about .18 gal. per square yard of tar was applied with a bituminous distributor; and a light coat of stone ¾ in. to ½ in. in size spread thereon.

This part of the work was done by the ordinary method for any good surface treatment. The surface was then dragged with a road maintainer which scraped the screenings coated with tar into the depressions in the surface, leaving the road quite smooth. The surface was then given another treatment of tar of about the same amount as used in the first treatment, and another light application of clean screenings was applied. By this double treatment process and the dragging operations a smooth surface was left which ironed out under traffic. The grade of tar used was a medium heavy surface treatment tar with a viscosity of 25 to 40 at 40 deg. C. Dragging should be done not too soon after the first treatment is applied but before the tar has become set. Also, it is desirable to permit little traffic over the road after the dragging and before the second treatment of tar is applied.

While this method has not yet been attempted with asphalt, there is no reason why the same process would not be satisfactory if the right grade of asphalt is used.

Methods for Carrying Precise Levels Over Wide Bodies of Water

QUITE often surveying presents problems upon which there is little published data explaining the "best method" of solution. In river crossings, for instance, it will often be necessary to carry a line of precise levels over an arm of water too wide for ordinary sighting and not spanned by a structure of sufficient stability to carry a line of levels. In his recently-published Department of Commerce bulletin on "Use of Geodetic Control for City Surveys" Hugh C. Mitchell, mathematician of the U. S. Coast and Geodetic Survey, explains two precise methods of carrying levels across such wide bodies of water. Ten such crossings, varying in length from 790 to 4,400 ft., were met with in a survey of New York City.

The first of these is the fixed-target method and the second the movable-target method, and both will produce an accuracy comparable to what is attained in leveling over land. These methods are described by Mr. Mitchell as follows:

Movable-Target Method—On the New York City survey special targets were constructed for each river crossing. These targets had the same general design but differed in absolute dimensions and in some details of design, depending on the width of the crossing. They were clamped onto the regular level rods. The observations were made simultaneously from both sides of the river and required, therefore, two levels which were as nearly alike as possible. The instruments were very carefully adjusted and were set up on opposite sides of the river with the rods held on bench marks or turning points about 20 ft. distant from each. After each observer had read the near rod he then sighted across the river and by prearranged signal waved the target into position at the same time that the observer on the other side of the river was performing the corresponding operation.

In order to permit a change in atmospheric conditions to take place, five minutes were allowed to elapse before the targets were again waved into position for a new set. After

10 such sets had been obtained the observers changed stations, each observer taking his instrument with him, and 10 more sets were observed, followed by readings on the near rods. Such a series of observations will ordinarily give a satisfactory determination of the difference of elevation of the two rod stations. If the result should not have the accuracy desired, the atmospheric conditions should be carefully studied and more sets should be taken at such a time that the observations will be least likely to be subject to any abnormal refraction.

Particular attention should be paid to seeing that the line is not too close to the water, and that observations are not made when the sun is shining brightly in patches on the water through breaks in the clouds. There should be no change in the focus nor any disturbance of the line of collimation of the instruments in exchanging stations.

It is readily seen that the mean of simultaneous observations will be free from the effects of curvature and ordinarily from those of refraction. In practice it is best to combine the 10 readings on each rod in each set by taking a straight mean before subtracting to obtain an approximate difference of elevation. This also enables one to study the actual observations with the view of determining if any of them are beyond the limit of rejection.

A safe rule to follow in rejecting observations is given in "The Adjustment of Observations," by Wright and Hayford, who advise the rejection of each observation for which the residual exceeds five times the probable error of a single observation. Each observation for which the residual exceeds three and one-half times the probable error of a single observation should be examined, and if any of the conditions under which the observation was made were such as to produce any doubt it should be rejected.

The probable error of a single observation is computed from the formula

$$r = 0.6745\sqrt{\frac{\Sigma v^2}{n-1}}$$

in which r is the probable error of a single observation, Σv^2 is the sum of the squares of the residuals from the arithmetic mean, and n is the number of observations. Where an observation is rejected, it should, if possible, be replaced by another observation, in order that the computation may be kept as simple as possible by avoiding the introduction of unequal weights.

After correcting the approximate difference of elevation from the separate sets for index error of rod, rod length, and temperature, the results may be combined into one mean, giving the final difference of elevation of the rod stations. The computations may be made by combining either the means corresponding to simultaneous observations or the means representing a given instrument in its two positions. If the sets of observations are perfectly symmetrical, the final result will be independent of how the combination is made.

Fixed-Target Method—In this method the micrometer screw of the instrument is used to make readings on the rod above and below the level line of the instrument. It is essentially a method of vertical angles into which the absolute values of the vertical angles do not enter. The stations are selected with due regard to water line and height above water surface, and the rods are held in place by guys. Two targets are clamped on each rod in such position that one is above and the other below the point on the rod intersected by the middle wire of the diaphragm when the instrument is level. A single observation consists of three readings of the micrometer, one when the middle wire bisects the upper target, another when the instrument is made level, and the third when middle wire bisects the lower target. The positions of the targets on the rod may be closely measured, using dividers and scale. The point at which the middle wire cuts the rod when the instrument is level may then be easily computed, the intercepts on the rod being in direct proportion to the differences of the micrometer readings.

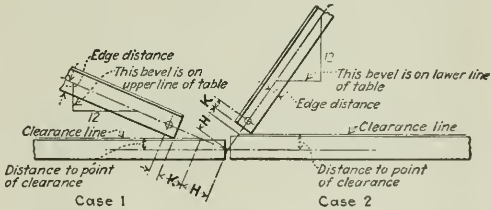
The program of observing adopted by the U. S. Coast and Geodetic Survey in making a crossing over the Mississippi River at a point where the width was 1,200 m. (0.75 mile) was as follows.

Two instruments were used and the observations on the two sides of the river were made simultaneously. The near rod for each instrument was first read and then, on a signal from the observer in charge, observations were begun across the river and continued until the observer in charge had made 25 sets of observations, when, on signal, observing across the river ceased. The observers then changed stations, carrying their instruments with them, using care not to disturb the focus or line of collimation, and the program was repeated, except that the near rods were read last. The observers changed stations again and a third repetition of the program was made. This constituted a day's program and was repeated on at least one other day.

The reduction of observations made by this method do not differ materially from the computation where the movable-target method is used.

Table for Locating First Rivet of a Gusset Connection

A CONVENIENTLY arranged table for finding the distance from the center of a gusset-plate connection to the first rivet of a connected member is given by L. S. Owen, of Nashville, Tenn. The arrangement of the table may be understood from the sketch herewith,



Bevel Upper is Flatter Slope	To Find H: Distance from Axis to Point of Clearance											To Find K: Edge on Angle etc.				
	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	2	11	1-0	1⅛ 2¼	1⅜ 2¾	1¾ 3½	1 2 4	1¼ 2½ 5
1	1½	3	4½	6	7½	9	10 7/16	1-0 1/16	2-0 1/16			1-1½	1-4½	1-9	2-0	2-6
	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	2	11	1-0 1/32	1/8	1/8	3/16	3/16	3/16
1¼	1 3/16	2 5/16	3⅝	4 13/16	6 1/16	7¼	8 7/16	9⅝	1-7 5/16			10 13/16	1-1 3/16	1-4 13/16	1-7 3/16	2-0
	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	2	11 1/16	1-0 1/16	1/8	3/16	3/16	1/4	1/4
1½	1	2	3	4	5 1/16	6 1/16	7 1/16	8 1/16	1-4 1/8			9	11	1-2	1-4	1-8
	1/8	1/4	3/8	1/2	5/8	3/4	7/8	1	2	11 1/16	1-0 1/8	1/8	3/16	1/4	1/4	5/16

TABLE FOR LOCATING CONNECTION RIVETS

in which for any given bevel of connected member the required rivet distance is found by reading from the table separately the items H and K, the first depending on the clearance width of the main member and the second depending on the edge distance of the rivet in the connected member. The table contains a double line of figures for each bevel, beginning with 1 in. in 12. The left-hand portion of the table, of which only a part is shown, gives the quantity H, the right-hand portion the quantity K. Values of H are given for various clearance widths from ⅛ in. to 1 in. by eighths, and from 1 to 12 in. by inches. The right-hand part of the table gives the values K for various edge distances of the connected member from 1⅛ to 2½ in., multiples of these values being read from the table by mentally multiplying the value K. The required rivet distance is the sum of H, K, and the end distance of the rivet.

The double line of the table for each bevel represents separately case 1 and case 2 of the sketch, the upper line being for case 1, members of flat slope, and the lower line for case 2, members of steep slope. The complete table for all bevels from 1 in. to 12 in. may be calculated by the use of existing tables, and inserted in a handbook for use in detailing or checking drawings.

Narrow-Gage Tracks Used in Moving Houses to New Location

By E. G. McGill
Contractor, Cumberland, Maryland

The Sewerage Commission of Hagerstown, Md., desiring to get an outlet for the sewer and build a boulevard at the same time 100 ft. wide, has just completed moving eight six-room frame houses and one 12-room double brick and stucco house, a distance of one-third of a mile. The frame houses were moved on double lines of 3-ft.-gage track with 56-lb. rails.

The ground was in celery ridges, but by using a four-horse road grader a good level roadbed was obtained and narrow-gage ties were used in laying the tracks. Four pony trucks of four wheels each were coupled together from track to track by a 5x10 timber with a truss rod support. Then a 14x14 timber, 44 ft. long, resting directly over the king bolts, coupled up each set to suit the length of the building to be hauled, with needles 12 in. x 12 in. x 36 ft. every 6 ft. crossing them as carrying timbers.

The houses all had full cellars, 6½ ft. deep, and by grading down and removing foundation walls the hauling frame was backed in under as far as possible. The fact that the buildings were all in a row and built up close together, high from the ground, made it easy to get in under them. Coming up crosswise to them it was necessary to turn each building one-quarter turn to set it on the platform. This turning was done on 4-in. rollers. In order to square each house with its new lot, and because a sharp curve had to be used in approaching new locations, tracks were laid on past the location and then thrown over the new site by crowbars.

FIG. 1—NARROW-GAGE TRACK USED IN MOVING HOUSES

When a house had to be turned around, a "Y" was employed.

The double brick house was not loaded on this railroad track but was rolled on six nests of alternating iron and wood rollers, ten to a nest.

A steel I-beam, 6x20 in. and 40 ft. long, was placed under each end wall of the building, and three pieces of 12x12 timber were placed up under the joist. Then 12x12's, 36 ft. long, and steel I-beams, 5½x15 in., 36 ft. long, were placed on 4-ft. centers as cross-needles.

The track was filled level with the surface of the rail with 4-in. crossing plank, with a third rail laid in the center, making a complete track of 3-ft. gage. Turning some very short curves, by cutting rollers to suit, the house was successfully moved. The time for truck moving was 10 ft. to the minute, and for the rollers 2½ ft. to the minute.

From Job and Office

Hints that Cut Cost and Time

FIG. 2—250-TON BRICK HOUSE MOVED ON ROLLERS LAID ON NARROW-GAGE TRACK

The frame houses weighed about 100 tons each, and the brick house about 250 tons. These houses were moved to their new locations through a peat marsh, much water being encountered at places.

This work at Hagerstown, Md., was contracted for by the writer.

Los Angeles Hotel Moved to New Site

In order to make room for the new Los Angeles County Hall of Justice, the 6-story reinforced-concrete Alhambra Hotel has been moved 122 ft. and set on a new foundation. The method of moving is similar to that used in moving a Chicago warehouse, described in *Engineering News-Record*, April 26, p. 754.

The hotel was moved on 19 tracks, the structure being supported and tied together by steel girders running transversely and steel needles extending longitudinally. Each track consisted of four 60-lb. steel railroad rails laid on 6 x 6-in. wood ties resting on four 12 x 12-in. wood sleepers. Each girder was made up of three 15-in. steel I-beams bolted together; and there is one over each track resting on 2½-in. solid steel rollers which travel over the rails.

Two steel cables were used to pull the structure, one 2,500 ft. and the other 1,600 ft. in length. These cables are ⅝ in. in diameter, of plow steel, consisting of 6 strands of 19 wires each, and having a tensile strength of 32,000 lb. The cables run through two lines of sheaves, one set being fastened to 12 x 12-in. timbers set against the ends of the steel girders on the south side of the structure and the other set being fastened to iron stakes driven ahead of the tracks. There are 45 of these sheaves and the cables run back and forth from one line to the other like the lace in a shoe. Moving the structure was accomplished by teams operating the capstans.

From Job and Office

For Contractor and Engineer

Crane Excavates and Builds Cofferdam for Filtered Water Basin

EXCAVATION for the cofferdam for the filtration and coagulating basins at Benton Harbor, Mich., was carried out by the use of a crane and by sluicing, after the top layer of earth and clay had been stripped. The stripping of this top layer was started by hand, the material being hauled by teams to spoil banks; later teams and slip scrapers were used to hasten the work.

The material encountered below the top clay layer is a fine water-bearing sand which when dry is very compact but when wet is almost liquid. In places where the ground water was near the surface, it was removed by the use of a 6-in. steam-engine-driven centrifugal pump, indicated in the diagram as Pump 1.

The crane was then used for driving the wakefield sheeting, bracing and anchor piles and for excavating. A 2,800-lb. steam hammer was rigged on the 30-ft. boom of the crane and a 2½-in. jet line was used to help sink the sheeting through the sand. The details of the cofferdam are shown on the sketch. The sheeting was from 14 to 16 ft. high and was driven from 6 to 8 ft. below the foundation of the basin.

For excavating after the sheeting was driven, a ¾-yd. clamshell bucket was rigged on the crane, and excavation was made to an average depth of 5 ft.

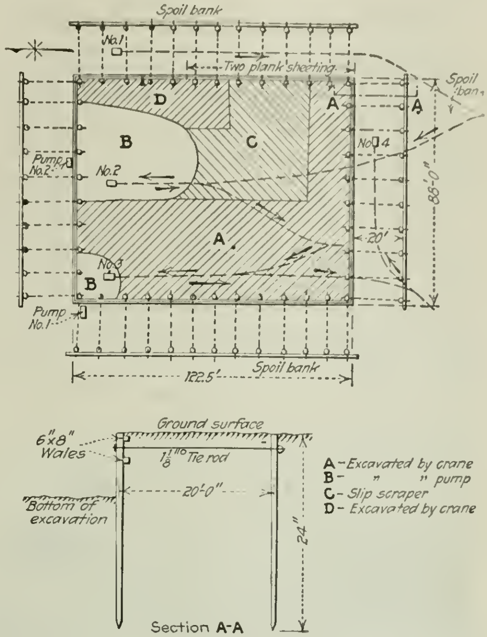
The work of the crane is shown in the diagram, starting at position 1 in the northeast corner and driving the round piles along the east side, then moving to

CRANE HAS 28,000-LB. HAMMER AND 30-FT. BOOM

positions 2 and 3 and driving the round piles and sheeting along the north side and excavating to grade. The final location of the crane was position 4 for excavation and driving on the south side, the west side driving and the excavation in section A having already been finished.

Sluicing was done in the two sections designated on the diagram as B. By the use of pump 1 and an additional pump 2, the excavated material was sluiced over the site for the coagulating basin; the sand was tirred up and held in suspension by means of a 2½-in. et line.

Location C could not be reached by either the pumps



DETAILS OF COFFERDAM OF FILTRATION AND COAGULATING BASINS AT BENTON HARBOR

Positions of the crane from which excavation and driving of the piles were done are numbered. Other methods of excavation are also indicated.

or the crane. So a slip scraper was rigged with a rope over the niggerhead of the crane and the material in C was pulled over to the south end of the cofferdam where the bucket could reach it.

When all the excavation had been made to approximate grade, drainage was accomplished by ditches along the sides of the cofferdam leading to a sump constructed in the northwest corner of the cofferdam. All mud holes were cleared and filled with clean material. Also, clean material excavated from the cofferdam was piled near by for use in backfilling.

When the concrete was poured, care was taken to keep the bottom of the cofferdam compact and solid, which was accomplished by the use of the pumps to keep the water level down. The finish grading was done by hand.

This work was carried out under the general supervision of Pearse, Greeley & Hansen, consulting engineers, Chicago.

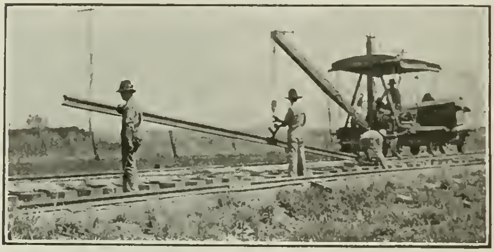
Concrete Mixer with 50-ft. Boom

IN PAVING a new concrete highway near London, England, having a width of 50 ft. between curbs, the mixer moved outside of one curb line and the concrete was placed by a bucket traveling on a steel truss or boom which spanned the entire width of road. One end of the truss was carried by the traveling mixer outfit and the other end by a steel frame or tower. The bucket was of the tilting type, carried in trunnion bearings on hangers attached to a trolley running on the bottom chord of the truss and operated by a cable and drum.

Renewing Rails with Small Power Crane

A LIGHT self-propelling power crane which not only reduces the labor force required in renewing rails but increases the amount of work done has been designed and used extensively on the Atchison, Topeka & Santa Fe Ry. This machine, shown in the accompanying view, consists of a small flat car equipped with a timber mast and boom and a gasoline engine. A similar car may be attached as a trailer to carry a tool box. Only four men are required, even with heavy rails: one operates the hoist, another handles the rail tongs attached to the fall rope, and the others (one at each end) guide the rail into place.

This crew has laid as many as a hundred rails in an hour, according to W. F. Muff, roadmaster, Newton, Kan. And with the use of the machine a gang of a hundred men can be kept busy spiking, gaging and bolting up the new rails. On busy main track, 300



RAIL-LAYING CRANE: A., T. & S. F. RY.

rails have been laid in the morning, while the afternoon was then occupied in full spiking and bolting the track and disconnecting the old rails.

The machine was designed jointly by the late J. Raymond, formerly general superintendent of the A., T. & S. F. Ry., and J. F. McNally, now assistant superintendent at Emporia, Kan.

Fourth Scale for Log Log Slide Rule

By C. S. Jarvis

Consulting Engineer, Salt Lake City, Utah

AMONG the special types of slide rule that have been developed from the original simple form, it is probable that the log log duplex slide rule has the widest range of application, as it combines the essential features of most of the other forms, and has the special advantage in the solution of exponential formulas. If the various formulas involved in the study of interest, annuities, and amortization are involved in such computations, it will be noted that a large percentage of the problems will require the use of factors from 1.0025 to 1.01, representing the amount of principal and monthly interest, where the rate per annum is from 3 per cent to 12 per cent.

Due to the rapid decrease in the values of the log log scale below 1.01 compared with the corresponding decrease in the series of numbers from which this scale is derived, the makers of slide rules have advised the use of suitable factors to render any number appearing between this limit and its reciprocal, 0.990, into a convenient form for use on the scales already provided. This necessitates the use of the same factor as a divisor, affected by the various exponents or root indices, thus

From Job and Office

Hints that Cut Cost and Time

requiring additional settings of the slide and increasing the labor involved and the chance for errors.

The writer had occasion to solve such problems, and found it worth while to provide an additional scale, which for convenience is called LL0, covering all values from the number 1.00105 to 1.01, or from the thousandth to the hundredth root of e, the base of Napierian logarithms.

The location of the graduations on the LL0 scale will be referred to the LL1 scale, and values given corresponding to various rates of interest per annum reduced to the monthly basis.

Interest per Annum, Per Cent	Interest per Month, Per Cent	Reading on LL0 Scale	Reading on LL1 Scale
1.26	0.105	1 00105	1 01
2	0 1666	1.0016667	1 01679
3	0 25	1.0025	1.0253
4	0.3333	1.003333	1.0338
5	0.41667	1.0041667	1.04245
6	0 5	1.005	1 05115
7	0 58333	1.0058333	1 0599
8	0 66667	1 0066667	1 0687
10	0 8333	1 008333	1 0865

While the above tabulation includes all of the most commonly used factors for computing interest compounded monthly, any intermediate value not provided for on either of the LL scales can be readily computed when account is taken of the relation existing between contiguous LL scales, the upper one being the tenth root of the lower. As an example, let it be required to locate the position on the LL0 scale of 1.0045833, principal and monthly interest corresponding to 5.5 per cent per annum.

Log 1.0045833 = 0.0019860.

Log 1.0468 = 0.019860 (the above logarithm multiplied by 10).

Therefore the position sought is immediately above 1.0468 of the LL1 scale.

Approximately this same value would be obtained by interpolation between adjacent graduations, but for best results it appears important that the entire LL0 scale should be added.

It will be observed that the above list of readings for the proposed LL0 scale shows a tendency of the numbers to the right of the decimal point to approach in value those immediately below on the LL1 scale, but the location is one space farther to the right. Thus the tenth root of 1.01 is 0.00105; of 1.03 is 1.003; and of 1.001 is 1.0001 to the nearest practicable reading, either from seven-place logarithmic tables or on portable slide rules. Therefore, if the LL0 scale is provided as above suggested, then the whole field will be effectually covered between 1.01 and 1.0001 for exponential formula computations involving factors within those limits.

As one of the most elementary illustrations of the use of the LL0 scale, let it be suggested to find the time required for an investment to double itself at interest compounded monthly, rate one-third of one cent per month, nearly comparable with 4 per cent per year.

Here the formula becomes $(1.003333)^n = 2$.

Taking logarithms of each side, n log 1.003333 = log 2.

From Job and Office

For Contractor and Engineer

Solving for n; $n = \dfrac{\log 2}{\log\ (1.003333)}$

Log n = log log 2 — log log 1.003333.

Placing the left index of the slide under 1.003333 of LL0, read 208.3 on C scale under 2.00 of LL2; 208.3 months = 17.36 years.

Following is the solution by logarithmic tables:

$$\log 2 = 0.3010300 \qquad \log 1.003333 = 0.0014451$$
$$\log\log 2 = 9.4786098 \quad \log\log 1.003333 = 7.1598979$$

Subtracting, 7.1598979

$\log 208.311 = 2.3187119$

The specific reason assigned by instrument manufacturers for not continuing the graduations below 1.01 on the log log scales, the steep slope of the log log curve which passes through minus infinity at abscissa = 1, is a favorable factor in computations involving the LL0 scale, as it effectively magnifies the graduations and conduces to accuracy.

Accounting for Highway Equipment

IN STATE road maintenance, accountability for the wide variety and great number of tools and equipment used has always presented serious difficulties. Because roads upon which equipment is used are so widely scattered, keeping track of tools is not always an easy matter. In a recent issue of the official organ of the Kentucky State Highway Commission, R. F. Albert, assistant engineer of maintenance, explains how that state takes care of its road equipment. The article as abstracted is given in the following paragraphs:

For the purpose of administration and field supervision the state is divided into six districts; at the headquarters of each is the district office, where equipment records are kept. In turn, each district is subdivided with a superintendent of maintenance in charge of each sub-district.

M-133 DUPLICATE

Commonwealth of Kentucky
DEPARTMENT OF STATE ROADS AND HIGHWAYS
Patrolman's Equipment Report

Sheet..... of.....

To District Superintendent:
Following is the equipment in use on Road.....
Sec.......... Dist... Sub-Dist.....
For month ending ......, 192 .

Article	No.	REMARKS
Axes..........		
Bars, crow....		
Bars, pinch....		
Brooms......		
Drills, churn......		
Tractors.....		
Rollers..........		
Autos, state owned.		

Patrolman
Foreman

M-132 DUPLICATE

Commonwealth of Kentucky
DEPARTMENT OF STATE ROADS AND HIGHWAYS
Superintendent's Equipment Report

District....... Sheet. of .....
Subdistrict... ....Month Ending , 192.

Articles	No.		Remarks
Road No......			
Section......			
Axes			
Bars, crow....			
Bars, pinch...			
Drills......			
Drags......			
Total			

Approved:..... Dist. Engr. Submitted. Dist. Supt.

That superintendent keeps all records pertaining to the various articles of equipment assigned for use on the roads in his sub-district and in storage at his headquarters. In order to account properly for the equipment both in use and storage three forms are used.

First, the patrolman's, foreman's or resident superintendent's form, shown herewith, carries at the end of each month a list of equipment actually in use on that project. This form is forwarded to the superintendent of maintenance, who checks up the report against the previous monthly report and data he has relating to the assignment or release of any equipment.

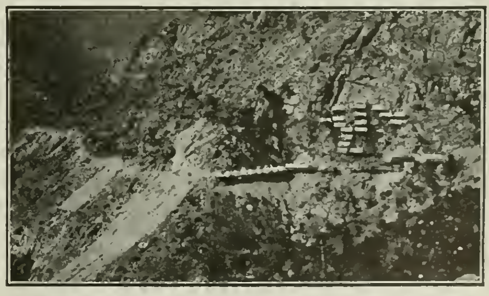
The second form is that compiled by the district superintendent from data contained in all reports from the patrolmen, foremen and resident superintendents. After such data are compiled, the equipment in storage in the sub-district is listed immediately following. Upon the receipt of this form at district headquarters, it is checked with the information contained in the previous monthly report on assignment or release of equipment. A copy of each sub-district report is retained in the district office, the originals being forwarded to the equipment engineer at the central office.

The third is compiled from the information contained in the superintendent's equipment report. This is filed in the district office and in the central office for each district. The form is designed to show the balance on hand of each article of equipment at the beginning of the month, the number of articles both assigned to and released from each district.

With the use of these forms it is possible to know at all times the number of articles of any kind of equipment in a district, its location according to project, and the amount and kind of equipment not in use. It saves time and expense in locating equipment, prevents loss through neglect and unnecessary expenditure for new material.

Construction Camp Built on Canyon Walls

IN DRIVING No. 3 tunnel which parallels the San Joaquin River for several miles, the Southern California Edison Co. found it necessary to establish several



ARRANGEMENT OF STRUCTURES AT BIG CREEK CAMP

adit camps, some of which are located upon precipitous walls of the canyon where level space could be obtained only by excavating benches. The accompanying illustration shows the arrangement of compressor house, mess hall and bunk houses at Camp 35.

The adit enters the canyon wall in a narrow draw or ravine and by excavating at the adit entrance, sufficient space was provided for the main buildings. The bunkhouses, however, could not be located in this limited space and accordingly were distributed as shown in the illustration. Some were made readily accessible by building them on timber trestle work alongside the road built for construction purposes through the canyon. Others, set on the steep hillside above, were made accessible by means of ladders or cleated ramps.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Determining Water Power Storage

Sir—Dr. George E. Lyon's article in your August 9 issue, p. 235, on "Determining Regulated-Flow Duration Curves Graphically," describes an admirable method for working out water power problems involving storage. The most efficient storage capacity for a given site is readily determined by its means.

The writer, having made repeated use of this method, wishes to submit the following additional suggestions with a view to simplifying the numerical work and adding to the utility of the methods. Instead of billions of cubic feet, the day-second-foot will be found the more convenient unit for this work. A day-second-foot may be defined as the quantity of water corresponding to one cubic foot per second flowing for a period of one day of 24 hours. It is, therefore, at once a rate of flow as well as a unit of volume. Its value will be apparent from the following.

In Table I, page 235, instead of writing down the mean monthly flow in second-feet as shown in the third column, head this column "monthly discharge in day-second-feet," and enter in it the total day-second-feet for each month, obtained by adding the daily discharges in second-feet for each month. These figures are nearly always available, being a step in the computation of the mean monthly flow figures used by Dr. Lyon. In fact, tabulated data of stream-flow such as are supplied on request by the U. S. Geological Survey always contain these monthly totals, except when the data are clipped from some publication. (In the latter case it would, of course, be necessary to multiply the mean monthly flow by the number of days in the month in order to obtain the total day-second-feet.) Next, obtain the last column of Table I by merely adding progressively the day-second-foot figures appearing in the preceding column, using an adding machine equipped to give sub-totals. This will save much time and effort over Dr. Lyon's method. Head this last column "accumulated discharge in day-second-feet."

The diagrams are then platted as before, except that the ordinates in Fig. 2, page 236, will be day-second-feet instead of billions of cubic feet, and the abscissas will be days instead of inches. Besides simplifying the numerical work, the principal advantage resulting from the use of the day-second-foot will be found to lie in its dual capacity above referred to. Thus, in the diagram (Fig. 2) it functions either as a rate of flow, or as a quantity of storage, depending upon which is desired. In the latter capacity it affords a quick conversion into acre-feet, as one day-second-foot is equivalent to 1.983 acre-feet, or for all practical purposes 2 acre-feet. Therefore, the ordinates of a diagram like Fig 2, when platted in day-second-feet can also be made to read acre-feet by multiplying the day-second-feet by two, the error so involved being less than 1 per cent, which is negligible in most studies of this kind.

The writer has been in the habit of platting across Fig. 2 a curve showing the state of depletion of the reservoir from day to day, and it will be seen from what has been said above that the acre-foot ordinates are most convenient for this purpose. Where evaporation is large and has to be taken into account, an evaporation curve can be platted likewise across the diagram, its ordinates being derived by computation from the state of reservoir depletion curve, and the evaporation in acre-feet applied as a correction to the latter.

In conclusion, the writer would suggest the use of the term "summation hydrograph" in lieu of "mass curve." The latter name was derived from earthwork computations in balancing railroad cuts and fills. It is a misnomer when applied to hydraulic computations. About 14 years ago the writer started the use of the term "summation hydrograph" as being the most appropriate name for a mass diagram such as is referred to in Dr. Lyon's article, and he has been gratified to note its adoption by many leading men in the profession.

Chattanooga, Tenn., Aug. 11, 1923.

GERARD H. MATTHES, Consulting Engineer.

A Passion for Straight Lines

Sir—The editorial, "A Passion for Straight Lines," in the Aug. 2nd issue of *Engineering News-Record*, brings to mind the following exposition in Balzac's "Seraphita":

"Your geometry establishes the fact that the straight line is the shortest distance between two points, but your astronomy shows you that God proceeds only in curves. Who can judge then between rectilinear and curvilinear geometry? Between the theory of the straight line and the theory of the curve? The bullet which a man would shoot straight really goes in a curve. None of your savants has drawn the simple deduction that the curve is the law of the material world, but the straight line is the law of the spiritual world. Does not the love of great souls for the straight line show in them an intuition of heaven?"

This last sentence may console some engineers who, like Mr. Friedman, have been accused of sacrificing beauty to an engineering passion for straight line. They may further fortify themselves by reading the introduction to Miss Wormley's English version of "Seraphita" where the occult doctrines of the circle as the perfect figure and the effect of the curve on the development of architecture are gone into at some length, and where it is explained that Balzac has departed from his Swedenborg in this instance and has considered the circle as symbolic of the created or the Material, which perhaps appears more beautiful to us on an earthly plane than the straight line, though this represents the uncreated or the Infinite.

RUTH CANAVAN, Librarian with Metcalf & Eddy.

Boston, Mass., Aug. 10.

A Curious Judicial Decision

Sir—I have read the review of the decision of the Pennsylvania Court of Quarter Sessions, declaring the Pennsylvania engineers licensing law unconstitutional, in your issue of Aug. 2, 1923. I could not but feel a considerable amount of self-contained amusement after studying the report of the decision. It brought me back to the days of my childhood, when we had to parse sentences. What struck me in reading over the resumé was the objection to the law on the ground that it was unconstitutional for the reason that it contained "more than one subject." As I said before, this brings me back to the days of my study of sentence formation and construction.

Is the subject of the bill in all fairness, and sensible interpretation, "an act to regulate the practice of professions," or is it an act to regulate the practice of engineering and land surveying? According to the judge's interpretation, if Pennsylvania is going to regulate the practice of the professions of lawyers, mechanical engineers, surveyors, civil engineers, "advertising engineers," electrical engineers, plumbing engineers, sanitary engineers, *ad infinitum*, I suppose that a special act would have to be passed for each of the particular kinds of engineers or occupations.

After all, does the foregoing not strike you as somewhat absurd especially when the regulation for all of the different kinds of persons in the several occupations might be a single regulation applicable to each. I predict that if there is any appeal from the decision there is a high probability of reversal on the ground I mentioned.

Cleveland, Ohio, Aug. 14, 1923.

J. F. ROBB, Attorney at Law.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

A Public Hearing on the Advisability of building a bridge across the Hudson River at New York City, will be held at the Army Building in New York on Monday, Aug. 27. The North River Bridge Co., of which Gustav Lindenthal is the head, has asked the War Department to approve the plans submitted by that company.

Abandonment of 122 Miles of the Hartford & Connecticut Western R.R., a subsidiary of the Central New England R.R., has been proposed by C. M. Sheafe, president of the H. & C. W. The reason given for the proposal is that the greater portion of the railroad is unnecessary and unprofitable. No action can be taken until the Interstate Commerce Commission has approved of the abandonment.

Premier Massey Has Formally Opened the new Otira tunnel at Arthur's Pass, on South Island, New Zealand. The tunnel links the east and west coast of the island and replaces the dangerous coach route which formerly connected the two electrical coastal railways of that island. The tunnel is 5¼ miles long and has a maximum gradient of 3 per cent. It is ¼ mile longer than the Connaught tunnel in the Canadian Rockies, the longest tunnel on the American Continent.

Proposing to Build a Bridge Across the Niagara River at Fort Erie for vehicular and electric railway traffic, the Buffalo-Ft. Erie Public Bridge Co., Ltd., has received both Canadian and American charters and has now applied to the U. S. War Department and to the Dominion Department of Public Works for authority to bridge the Niagara River at that point. The proposed bridge will supersede the present ferry service and will cost between $3,000,000 and $4,000,000. The officers of the new bridge company are as follows: W. M. German, M. P. of Welland, president; Dr. William Douglas, Fort Erie, and Donald McGillivray, Port Colborne, vice-presidents; F. W. Wilson, Fort Erie, secretary-treasurer.

To Demonstrate the Ability of the army engineers and to reproduce various kinds of maps quickly during field operations, the Army Engineer Corps is sending its mobile map-making train to important points in the country. The train consists of a completely equipped laboratory mounted on army trucks, with facilities for making maps or reproducing them by photography, printing and lithographic processes. The train is manned by men of the 26th Engineers, the same unit that did such efficient map work in France. The train has just returned from Rio de Janeiro, where it was part of the American exhibit at the Brazilian Centennial Exhibition.

Denies Reported Electrification of Boston & Albany

The report that the New York Central plans to electrify the Boston and Albany and its new yards near Albany in the immediate future is not confirmed by G. W. Kittredge, the chief engineer. Mr. Kittredge says that the engineering department prepared a report on such electrification more than a year ago as a routine matter and that as far as he knows nothing more has been done about it.

Court Upsets Hoboken Garbage Contract Award

As a result of a suit brought by a lower bidder the New Jersey Supreme Court has set aside the award by the City Commission of Hoboken on July 31 of a five-year contract for the collection and disposal of garbage and ashes. The award was made to James J. McFeeley, a brother of Bernard McFeeley, the latter being a member of the City Commission and director of the Department of Public Safety. The accepted bid was for $486,260. The lower bid of $476,580, by Peter A. Peluso, the present contractor for the work, was passed over on the ground that Mr. Peluso gave unsatisfactory service last winter.

U. S. Navy Starts Scrapping Ships

With the receipt last week in Washington of France's formal acceptance of the naval disarmament treaty, all of the other signatory powers having previously signed, plans were immediately put into effect by the United States Navy to scrap ships condemned under the terms of the five-power treaty. Of the condemned ships eleven are under construction, seven of which are battleships located as follows: the "Indiana" and the "South Dakota" in New York; the "Montana" at Mare Island; the "North Carolina" at Norfolk; the "Michigan" at Quincy; the "Iowa" at Newport News; and the "Washington" at Camden. The battle cruisers, "Lexington" and "Saratoga" are being converted into airplane carriers. The other four battle cruisers, two of which, the "Constitution," and the "United States," are under construction at the Philadelphia Navy Yard, and two, the "Constellation" and the "Ranger," are under construction at Newport News, will be scrapped at once.

In addition to these vessels under construction, the following already completed will be scrapped "Virginia," "New Jersey," "Rhode Island," "Georgia," "Nebraska," "Connecticut," "Louisiana," "Kansas," "Vermont," "Minnesota," "South Carolina," "Michigan," and "New Hampshire."

The Navy Department has adopted three methods in disposing of the ships which methods cover in brief the three situations with which it is confronted: disposal of ships being constructed privately, those being built by the U. S., and those completed.

Grunsky Is Nominated as Am. Soc. C. E. President

Second Ballot Gives Him 162 More Votes Than Francis Lee Stuart—Other Official Nominees

C. E. Grunsky, with 1,671 votes as against 1,509 for Francis Lee Stuart, has been selected as the official nominee for president of the American Society of Civil Engineers. A total vote of 3,203 was canvassed, the tellers reporting results of the second ballot to the secretary of the society, August 15, in accordance with constitutional provisions. An aggregate of 3,395 votes was registered but 189 voted who were ineligible, one affiliate, and three signatures were illegible. The other official nominees are:

For vice-president, Zone 1, Lincoln Bush; vice-president, Zone 4, Oscar S. Bowen; directors, District 1, Thaddeus Merriman and Paul G. Brown (two to be elected in this district); director, District 4, Robert Farnham; director, District 11, Arthur O. Ridgway; director District 14, Alexander Maitland, Jr.; and director, District 15, J. M. Howe.

The complete vote follows:

For President:	
Carl E. Grunsky	1,671
Francis Lee Stuart	1,509
Void	11
Blank	12
Total	3,203
For Vice-President, Zone 1:	
Lincoln Bush	845
Void	6
Blank	37
Total	888
For Vice-President, Zone 4:	
George G. Anderson	399
Oscar S. Bowen	520
Void	3
Blank	9
Total	931
For Directors, District 1: (2 to be selected)	
Paul G. Brown	455
Thaddeus Merriman	513
Void	4
Blank	34
Total votes cast	1,006
For Director, District 4:	
G. H. Blakeley	20
Robert Farnham	98
John Meigs	89
Void	1
Blank	2
Total	210
For Director, District 11:	
Arthur O. Ridgway	231
Blank	18
Total	249
For Director, District 14:	
E. A. Hadley	43
Alexander Maitland, Jr.	124
G. F. Maitland	11
Void	1
Blank	2
Total	181
For Director, District 15:	
J. M. Howe	140
J. H. Brillhart	60
Void	2
Total	202

W. F. Reeves is chairman of the Nominating Committee. The elections are to be announced at the annual meeting next January.

Secretary Work Explains Davis Removal

Answering Am. Soc. C. E., He Says Time Has Now Come for Business Administration

Secretary of the Interior Work has addressed the following letter to Secretary John H. Dunlap, of the American Society of Civil Engineers, in response to the request of that society for information regarding the recent removal of Arthur P. Davis from the position of director of the U. S. Reclamation Service:

"Your courteous inquiry of June 27, reply to which has been delayed because of my absence from the States, requires more than a categorical answer.

"The reclamation law, providing for the construction and operation of irrigation projects, mentions no official, but places the entire burden and responsibility of administering the law and of carrying out its purposes upon the Secretary of the Interior.

Responsibility on Secretary

"It creates no position known as Director or Commissioner of the Reclamation Service, nor any other position, but places the whole responsibility for selection of agencies for the performance of his work on the Secretary of the Interior.

"In the beginning, necessarily, the work was the construction of projects involving engineering skill, but with their completion there grew up another aspect, namely, the problem of the water-users and the collection of the original cost as contemplated by the law. It is thought that these problems, which involve dealing with the farmers individually, could be best handled by a practical business man familiar with the conditions peculiar to irrigation in the West.

"The return of the enormous investment made by the Government will necessitate help and advice to the farmers on the projects, along the line of subdivision of large land holdings, getting more settlers on the projects, securing creameries, sugar factories and other industrial enterprises; more intensive farming, diversification of crops and co-operation with the owners and tenants on 53,000 farms as to packing, handling and marketing their products by men who have been trained along these lines.

"This does not mean a diminished construction program, but rather an increased and accelerated construction, because with the money returned to the Government under efficient business management there will be freed a fund to continue construction that would otherwise be retarded.

"To handle the engineering work the engineering force of the service remains efficient, with the same chief engineer at its head who has been engaged in the construction work for many years. There is no thought of minimizing the importance of reclamation engineering. It was my purpose to retain Director A. P. Davis in the Reclamation Service as a consulting engineer, he at first consenting but subsequently declining the appointment.

"The Secretary of the Interior, who alone is charged with the execution of the Reclamation Act, desires the greatest possible efficiency—not alone efficiency in one phase of the work, but efficiency in every phase and aspect of reclamation. He believes that the change to which you refer is made necessary by existing conditions; for unless improvement can be brought about many projects will be abandoned entirely by settlers—some have already gone—and the Government not only will lose millions of dollars invested, but the settlers themselves will lose time, labor and money already placed by them on their farms.

"Although it is primarily essential to construct dams and ditches, these are not alone enough to secure successful farming to settlers, for whom reclamation was instituted.

"All of our reclamation projects are not prosperous. It is not a question now of engineering so much as it is one of business acumen and operation. The men on the project must reimburse the Government for its millions of dollars advanced for the reclamation of land through irrigation, and our reorganization with this in mind seemed necessary.

"Because of the publicity I am advised this matter has obtained, I am taking the liberty of giving my letter to you to the press, that it may answer other similar inquiries."

Moffat Tunnel Bids to Be Received Sept. 12

Bids for the construction of the Moffat tunnel through the Colorado Rockies, will be received Sept. 12, and not Sept. 16, as previously announced. Bids were originally to have been opened Aug. 25.

Grounds and Building Committee for Philadelphia Fair

The Grounds and Building Committee for the Sesquicentennial Fair in Philadelphia in 1926 has been announced by Ernest T. Trigg, chairman of the Fair Executive Committee. On the committee, which already numbers fifty-eight, are many engineers, architects and other notable Philadelphians. The chairman of the committee is Howard B. French, a former president of the Philadelphia Chamber of Commerce, and the vice-chairman is William F. James, ex-president, Engineers' Club of Philadelphia. On the executive committee, besides the two just named, are E. B. Temple, assistant chief engineer, Pennsylvania R.R., and George S. Webster, of the Delaware River Bridge Joint Commission.

White River Power Project

A hydro-electric development to produce 160,000 primary electrical horsepower on the White River in the heart of the Ozark Mountains is proposed by the North American Co. The proposed development includes the construction of a dam 225 ft. high and 1,800 ft. long at the crest, which will form a lake nearly 100 miles long to cover an area of 150,000 acres. The Dixie Power Co., which is authorized by the State of Arkansas to construct water power projects on the White River, has received a preliminary permit from the Federal Water Power Commission, and has given Hugh L. Cooper & Co. an option on all its rights and holdings.

Interior Department Tells New Reclamation Policy

Press Memorandum of Aug. 17 Calls for Greatest Efficiency From Officials Concerned

On Aug. 17 the Department of the Interior issued the following "Memorandum to the Press." This memorandum, and the foregoing letter from Dr. Work to the American Society of Civil Engineers, are commented on in the editorial pages of this issue:

"Inculcation of business principles into the operation of existing reclamation projects and in the construction of new projects is contained in a tentative policy adopted by the Reclamation Bureau of the Department of the Interior for the future.

"Made public today by Secretary of the Interior Work this tentative policy calls upon all project managers and engineers of the Bureau to bring about the greatest possible efficiency both in assisting the farmers in selecting, raising, and marketing of their crops and in reducing the cost of building new irrigation works. An outline of proposed policy follows:

"*Existing Projects* — Reduce overhead costs; deal with projects and water users as an engineering and business problem; encourage subdivision of large holdings into small farms, when better farming will follow; encourage and assist farmers to diversify and rotate their crops; aid in securing creameries, sugar factories, and other industries within or near the project limits to the end that a ready and profitable market for the products of the farm may at all times exist and be available; co-operate with the farmers in the packing, handling, shipping, and marketing of their products to the end always, that the maximum of return with the minimum of expense may come to the farmers; and impress on water users the idea that the Government money advanced for the construction of these projects was temporarily for their benefit in the nature of a loan without interest.

"*New Projects* — The West demands and should have additional reclamation projects where and when feasible; recommend against any new project where the cost is so high that there is no reasonable probability of farmers being able to repay construction costs (such action will advance and not retard meritorious reclamation projects); recommend against any new projects where the probable cost of operation and maintenance, through pumping or otherwise, will be too heavy a burden for the water users to carry annually; make not only engineering studies of proposed projects, but studies of soil, climate, and markets, including kinds of fruit, grains, or other crops which the soil and climate will permit to be grown profitably; make careful study of probable annual cost of operating and maintaining a project when built, including cost of drainage systems, if the project is undertaken see to it that cost of construction is accurately calculated, so that when the work is completed an unexpected and unestimated burden does not rest upon the water users because of underestimated construction cost; in brief, establish a real, actual and helpful working co-operation with the farmer."

Federal Building Contract Form Contains Arbitration Provision

The standard form of building\and construction contract to be used by all departments of the Federal Government contains provision for arbitration of disputes over time or finances, as tentatively agreed upon by the Interdepartmental Board of Contracts and Adjustments. Heretofore the general practice in Government contracts has been that there should be no appeal within the Government from the decision of the contracting officer.

The Associated General Contractors hails the adoption of this arbitration clause as "an epochal concession."

The adjustment clause as tentatively adopted is given in the following paragraphs:

"Except as otherwise specifically provided in this contract, all claims, doubts, and disputes shall be decided by the contracting officer and the contractor shall promptly proceed with the work under such decision.

"The decision of the contracting officer shall be final and conclusive except as to the element of time and the financial consideration involved, and, unless within twenty days after which decision the contractor applies in writing to the head of the department or independent establishment concerned for a review of the decision as to the elements of time and financial consideration involved, the decision of the contracting officer shall also be final and conclusive as to the questions involved in these elements.

"The head of the department or independent establishment shall promptly render his decision in writing. He may, however, before rendering his decision, refer questions raised upon review to either the board of contracts and adjustments of the department or independent establishment for which the work is being done or to the Interdepartmental Board of Contracts and Adjustments for report and recommendation thereon. His decision, when rendered, shall be final and conclusive and carried out by the parties as within the contemplation of this contract, unless within thirty days after such decision the contractor shall bring suit or give written notice to the head of the department or independent establishment of his intention to bring suit in court to determine his legal rights involved in such decision."

Members of Bureau of Housing and Regional Planning Named

Five lay members have been named to serve with three officials of New York State as a Bureau of Housing and Regional Planning in the State Department of Agriculture. The chairman of the bureau is Clarence S. Stein, an architect of New York City, who was secretary of the recent New York State Reconstruction Commission. Mr. Stein is also secretary of the Regional Planning Association of America. Another of the five lay members of the new bureau is Walter Stabler, controller of the Metropolitan Life Insurance Co., New York City. The ex-officio members include the state architect, state industrial commissioner, and Frederick Stuart Greene, state highway commissioner. An advisory commission is proposed.

Results of Engineer-Promotion Tests at Philadelphia

Announcements just made public show that there was only one candidate for the office of chief and three for that of deputy chief of the Bureau of Highways of Philadelphia, as a result of the non-assembled competitive promotion examinations.

John H. Neeson was the single candidate for chief. He has headed the Division of Street Cleaning since the city took over the work of street cleaning, garbage and ashes collection, etc., in 1921, and has been acting chief of the Bureau of Surveys since F. C. Dunlap was transferred from that position to chief of the Bureau of Water some weeks ago. It is expected that Mr. Neeson will receive the permanent appointment soon.

Percy F. Proctor led the three candidates for the position of deputy chief. He has been appointed to that position.

The two positions pay salaries of $8,000 and $6,000 a year. The examination for chief was open to all engineers in the service of the city of Philadelphia, receiving $4,000 or more per annum, while for deputy chief examinations were open to any engineer in the city service receiving $2,500 or more, the latter exclusive of the bonus. Candidates for chief were required to have an education equivalent to graduation in engineering from a university of recognized standing, besides fifteen years of general engineering experience, six years of which must have been in responsible charge and direction. For deputy chief, corresponding requisites held good except that ten years of general engineering experience and five years of highway construction and maintenance or street cleaning work were acceptable. Candidates were not required to appear at any place for written examination, but submitted a statement of their training and experience and wrote a paper on practical problems. They appeared before the Civil Service Commission for an oral interview on personal fitness. Training and experience was given a weight of 4.5; discussion of practical problems, 3; the oral interview for personal fitness, 2.5.

13 Countries Represented at Standardization Conference

An unofficial conference of the secretaries of various standardizing organizations was held early in July at Zurich, Switzerland. This was the second conference of its kind held, the first conference having taken place in London in April, 1921. At that conference the secretaries of seven standardizing organizations were present, whereas the Zurich conference was attended by secretaries of thirteen different countries—Austria, Belgium, Canada, Czechoslovakia, France, Germany, Great Britain, Holland, Italy, Norway, Sweden, Switzerland and the United States.

The conference, which lasted from July 3 to July 6, was given over to a discussion of the practical application of standards in the various countries and of the extent to which international collaboration is possible. Dr. Paul G. Agnew, of the American Engineering Standards Committee, attended.

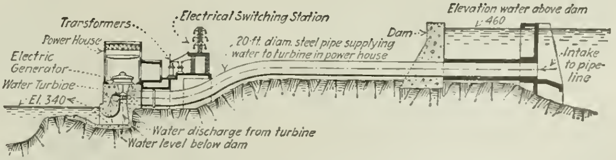
More Details of Nyack Accident Are Received

Further details of the accident which happened Aug. 9 near Nyack, N. Y., and which resulted in the death from scald and shock of six women (see *Engineering News-Record*, Aug. 16, p. 282), when a pleasure bus rammed a concrete mixer, have been received from James H. Sturdevant, division engineer of the state highway commission. Mr. Sturdevant reports as follows:

"Along the side of the freshly laid concrete, over a roadbed that had been fine graded, the first bus passed without any difficulty. The second bus struck the nut on the end of the bolt which holds the upper hand hole plate in place and pulled it to one side, allowing the live steam to pour into the bus and scald its occupants. . . . There are seven uprights to hold the roof over the seats of the bus, and it was the second upright from the rear which struck the nut on the mixer."

An investigation is now being made, but as yet no report has been made to any of the state highway officials.

Power Plant Proposed for Cherokee Bluffs, Ala.



WORK will start in the near future on the Alabama Power Co.'s new hydro-electric plant at Cherokee Bluffs on the Tallapoosa River near Dadeville, Ala. This new plant will have an ultimate capacity of 132,000 hp., but the first installation will be two units of 44,000 hp. each. The Cherokee Bluffs dam will have a height of 120 ft. from the base to the top of the crest gate. It will be 800 ft. long and contain nearly 200,000 yd. of concrete. The reservoir formed by this dam will have an area of 25,000 acres, and will contain over 25,000,000,000 cu.ft. of water. This large storage capacity will make it possible to use this reservoir to regulate the flow of the Tallapoosa and Alabama Rivers. As there is no town near the site that can be used for the accommodation of workmen and their families, the Alabama Power Co. will build a town at the site which will be able to accommodate 3,000 people. It will be equipped with water supply and sewage-disposal plant, hospital, recreation hall, a commissary and mess hall, and provided with electric light and power. The total cost of the work is estimated at $10,000,000.

Random Lines

The Way Out in Germany

Sir—Further regarding "belting," "kitchen," and "exterminating" engineers! It seems that we are now going through what some of the European countries — notably Germany—experienced some fifteen or more years ago. At that time there was such a craze for the term "engineer" that every safety-pin manufacturer so dubbed himself. The term fell into considerable disrepute, or at least may be said to have lost its standing, and it was followed by the new term "Diplom Ingenieur," abbreviated "Dipl. Ing." This very rapidly solved the entire problem, for it was illegal for anyone to use the title "Diplom Ingenieur" unless he actually had a diploma from one of the recognized engineering schools. The use of the title without the prefix "Diplom" was thus an admission that the holder of it was in fact no real engineer.

It must be borne in mind however that, in Germany at least, the object was more a desire to maintain the class distinction than the purely professional purpose which it is to be hoped is the end in view in this country. W. D. B.

* * *

A Unique Specimen

INTERVIEW
BY APPOINTMENT

HARRY ERNEST HEINRICH
CONSULTING ENGINEER
THE HUMAN ENGINE
SANITARY EXTERNAL & INTERNAL REQUIREMENT
THE VOICE ITS SUPREME INSTRUMENT

STUDIO
701 HEINE BUILDING
408 STOCKTON STREET
SAN FRANCISCO

HOME ADDRESS
1318 DROWAY
BERKELEY
PHONE BERKELEY 8678

* * *

After reading a few accounts of the coal controversy the average citizen begins to wonder how any such dispute is ever settled. Apparently the acceptance of one side's proposal by the other side is prima facie evidence to the first side that it has gone too far, so it withdraws the proposal.

* * *

Not Entirely Hopeless

Those in charge of one of our monthly magazines of review must be profoundly depressed if the contents of their August issue is any guide. Hidden among a few hopeful stories we find the following titles: "Wets Destroying Nation," "Decadent Fiction," "Focusing the Light on Our Indian Scandal." "Scrambled Households Menace Whole Fabric of Society," "Civilization Deteriorating—the Decay of Public Spirit, Disregard of the Law," etc., etc., etc. We do not belong to the Pollyanna school or hold entirely with the *American Magazine* inspirational type of current literature, but we find it hard to believe that we are going completely to the dogs here in this country. Any nation which can rise one morning to find that while it slept its ruler has died and another one already taken his place and which can then proceed with its normal business with no feeling of insecurity to add to its great sense of personal loss has gone far toward the stabilization of its whole mechanism which no amount of comparatively minor disturbances can destroy.

Montreal Increases the Capacity of Its Grain Elevators

Work on the first unit of the new grain elevators at Tarte Point, Montreal, is being carried on day and night. It will have a capacity of 2,000,000 bu. and the completed layout will have a capacity of 10,000,000 bu. The plan also calls for four traveling marine towers, for unloading from lake ships, and four unloading points for railway cars. It also provides for five berths for loading ocean ships, each berth having facilities for loading 30,000 bu. an hour, while the unloading facilities from lake ships will be able to handle 60,000 bu. an hour and from railroad cars of 48,000 bu. an hour. Work is also in progress on elevator B at Windmill Point to increase the capacity of that plant to 1,125,000 bu. This work is being done by the Montreal Harbor Commission.

Want Clearer Decision on Rate-Making Values

Washington Correspondence

Declaring that the decision rendered in the Atlanta Gas rate case was at such variance with the decisions in the Bluefield Water Works case and the Southwestern Bell Telephone case as to cast doubt as to the law, the Georgia Railway and Power Co. and its lessor, the Atlanta Gas Light Co., filed a petition in the U. S. Supreme Court on August 11 in support of their motion for a rehearing.

In rendering its decision in the Atlanta case the Supreme Court stated that the refusal of the Georgia State Railroad Commission to hold that for rate-making purposes physical property must be valued at replacement cost was correct; whereas in the Southwestern Telephone case the court said that contemporaneous reproduction cost must be taken into consideration in fixing rates for public utilities, and in the Bluefield Water case the Court said that the West Virginia Public Service Commission had not given due consideration to replacement cost.

The Atlanta Gas Company's petition also points out that its case was decided by a court of seven justices and that the other two cases were heard by a full bench. It was Judge Brandeis who handed down the majority opinion in the Atlanta case, and who rendered the minority opinion in the Southwestern Telephone case. In the latter case he stated that he differed fundamentally from the majority concerning the rule to be applied in determining whether a prescribed rate is confiscatory (*Engineering News-Record,* June 7, 1923, page 1010).

In concluding its petition the Atlanta Gas Co. states that this is the first instance in which a company has ever been denied the right to earn rates on the present value of its property.

Plans Under Way for Two New Bridges in Portland, Ore.

Bids are to be called for in September on substructures for two vehicular bridges across the Willamette River in Portland, Ore., and about the first of the year plans will be completed and bids will be invited on the superstructures. The funds for these bridges will be provided from county bonds authorized at an election last fall which allotted $3,000,000 for a new bridge where the Burnside bridge now stands and $1,600,000 for another bridge about 1½ miles further upstream.

After comparison of steel and concrete designs, concrete was selected for both structures despite the fact that it was the more costly. In the case of the new Burnside bridge the concrete arch design will cost $104.000 more than a steel structure. This bridge will have a total length of about 3,000 ft. with a 213-ft. double-leaf, trunnion-bascule center span, flanked on either side by a 255-ft. three-rib concrete arch with concrete viaduct approaches. Clearance above low water will be 65 ft. The width will be 86 ft., of which 66 to 68 ft. will be roadway.

The Ross Island bridge will have a clearance of 132 ft. above low water and no draw span will be included. This structure will be 4,000 ft. long, the channel portion consisting of six concrete arches of 270-ft. span with a rise of 90 ft. from springing line to crown. The width will be 54 ft. overall.

Hedrick & Kremers, consulting engineers, are in charge of design and construction on both bridges for the county. Traffic studies were made by J. P. Newell of the city planning commission. The Strauss Bascule Bridge Co. has the contract for the bascule span.

Bids Rejected for Delaware River Bridge Cables

Bids received Aug. 15 by the Delaware River Bridge Joint Commission for Contract No. 8 for the cables of the Delaware River Bridge were rejected because they exceeded the appropriation. Work will be readvertised and another opening held Sept. 19. Only two firms bid, as follows:

	Item	Estimated Quantities	Frederick Snare Co., New York		Oscar Daniels Co., New York	
			Unit Price	Amount	Unit Price	Amount
1	Wire cables	lump sum	....	$2,622,000	....	$2,741,000
2	Suspender rope	105,000 ft.	$1.82	191,100	$1.70	178,500
3	Steel castings	1,020,000 lb.	.16	163,200	.25	255,000
4	High tensile bolts	100,000 lb.	.15	15,000	.25	25,000
5	Hand ropes	lump sum	.....	6,800	.....	7,000
6	Structural steel	90,000 lb.	.20	18,000	.20	18,000
7	Cast iron	30,000 lb.	.12	3,600	.15	4,500
	Total bid			$3,019,700		$3,229,000

The bids cover the construction of the two cables of the bridge, together with suspenders, but do not include wrapping of the cables. The cables will be larger than any previously constructed, each one being 30 in. in diameter, and composed of 18,666 separate parallel wires of No. 6 gage, galvanized wire, 0.196 inches in diam. The cables will have a sag of 200 feet, and a length from anchorage to anchorage of approximately 3,560 feet. The cable band castings for attachment of the suspender ropes, the anchorage collar castings and all other cast steel portions are to be of electric furnace cast steel.

World Power Conference Planned for Next Year

British Electrical and Allied Manufacturers Sponsors for London Session

During the summer of 1924 there will be held in connection with the British Empire Exhibition in London a World Power Conference initiated by the British Electrical & Allied Manufacturers Association, Inc., but participated in by many technical and scientific institutions and industrial organizations in Great Britain and other countries. The object of the conference will be to consider how industrial and scientific sources of power may be adjusted nationally and internationally.

The objects of the conference are to achieve by: considering the potential resources of each country in hydro-electric power, oil, and minerals; comparing experiences in the development of scientific agriculture, irrigation and transportation by land, water, and air; conferences of civil, electrical, mechanical, marine, and mining engineers, technical experts and authorities on scientific and industrial research; consultations of the consumers of power and the manufacturers of the instruments of production; conferences on technical education to review the educational methods in different countries and to consider means by which existing facilities may be improved; discussions on the financial and economic aspects of industries, nationally and internationally; and conferences on the possibility of establishing a permanent world bureau for the collection of data.

The conference probably will divide itself into the following sections: Power resources, power development, power application, and the economic and financial aspects of power.

Americans to Participate

In response to invitation for American participation in the conference, twenty or more American engineering, technical and industrial organizations have appointed representatives to a committee of arrangements which has planned an organization with John W. Weeks, Secretary of War and chairman of the Federal Power Commission, as honorary chairman, and O. C. Merrill, executive secretary of the Federal Power Commission, general chairman.

Following conferences in London with Mr. Merrill and J. B. Challies of Canada, officials of the World Power Conference have agreed upon a tentative program. Participation of all western Europe except Russia and Germany is assured. It is planned to feature a concise statement of the existing situation in each country and to discuss conditions under which capital of one country can be invested in utility enterprises in another. All papers to be presented will be printed in advance so that the entire time of delegates at the meetings may be devoted to discussion. British manufacturers are convinced that they benefit greatly by improving the status of the engineer and a studied effort will be made to make this conference helpful to the engineer.

The organizing director of the World Power Conference is D. N. Dunlap, secretary of the British Electrical & Allied Manufacturers Association.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; Annual Conference, Chicago, Sept. 27-28, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga.; Nov. 12 to 16.

The American Institute of Architects, Denver Chapter, has given to the library recently established by the Colorado Engineering Council, technical books valued at more than $5,000. The engineers' library is maintained at the Denver Public Library.

Personal Notes

Lester L. Lessig has been made assistant contracting engineer of the Philadelphia office for the McClintic-Marshall Co., with address in the Morris Bldg., Philadelphia. For the past two and one-half years Mr. Lessig has been assistant to the chief engineer of this company.

Col. Charles Keller, who resigned as engineer-commissioner of the District of Columbia in April to investigate the possibility of engaging in hydro-electric work in the West, and who was granted a leave of absence from the Corps of Engineers, has had that leave extended another two months, thus being retained on the active list. Col. Keller is business manager for the El Dorado project being constructed by the Western States Gas & Electric Co.

Charles H. Ensign, construction engineer of Cleveland, Ohio, and Mark G. Snow, recently engineer of roadway, track and bridge costs with the Froelich & Emery Engineering Co. on the appraisal of the interurban railways of the state of Michigan for the public utilities of that state, have established offices at 517 National Bank Bldg., Cleveland, Ohio, for the practice of civil, architectural and appraisal engineering, under the name of Ensign and Snow.

John G. Sullivan, consulting engineer, Winnipeg, Canada, is president of a new company organized in that city under the name of the Canadian Engineering & Construction Co., Ltd., which will do general engineering and construction work and which has secured a contract for building 51 miles of high-tension line for the Manitoba Power Commission. The company will act as consulting, supervising and constructing engineers and in an advisory capacity to railways. Mr. Sullivan has been in private practice in Winnipeg since 1918. Before that he was chief engineer of the Western Lines of the Canadian Pacific Ry. He is a past president of the Engineering Institute of Canada. The vice-president of the new firm is Theodore Kipp, head of the firm of Kipp-Kelly, Ltd., and the secretary is C. A. Monkman who has been with the Manitoba Steel & Iron Co., Ltd.

Percy Cupper, state engineer of Oregon for five years and with the state engineering department for some eighteen years, was removed from office August 1, without notice, by the new governor of Oregon and was replaced by Rhea Luper who has been assistant state engineer for fourteen years. Reasons for the change are ascribed wholly to politics. Mr. Cupper, who has been admitted to the bar, will open an office in Salem, Ore., it is reported, for the practice of irrigation law.

Major James F. Case sailed August 18 for Montevideo, Uruguay, where he will take up his duties as chief consulting engineer for Ulen & Co., Inc., New York City, in connection with hydro-electric construction works in South America. Major Case has had long and varied experience with work of this kind in the Pacific Northwest and the Philippine Islands, and has reported on properties and projects in Italy, Spain, France, Mexico and Venezuela. As director of public works in the Philippine Islands from 1901 to 1910 he made exhaustive studies of the water-power possibilities of the Islands and in 1918-1922 studied and reported on the principal hydro-electric properties in Northern Italy. He is a Membre d'Honneur des Ingenieurs Civils de France and member of Joint Committee on Co-operation Between International Technical Bodies, appointed by the four founder societies in the United States together with the engineering societies of England, France and Italy.

Lieut.-Col. William B. Causey, who since 1919 has been technical adviser to Austria, has been appointed city manager of Norfolk, Va., at a salary of $20,000 per year. Colonel Causey was born in Suffolk, Va., 58 years ago. From 1883 to 1890 he was engaged in railway work in various capacities with the Atlantic & Danville R.R., the Suffolk & Carolina R.R. and the Union Pacific R.R. and then for a year was in private practice in Suffolk, Va. Then followed promotions in railway work from assistant superintendent, Milwaukee Division, to division superintendent, Chicago & Northwestern Ry., chief engineer of Elgin, Joliet & Eastern and Chicago, Lake Shore & Eastern Rys. From 1914 to 1917 he was vice-president of the Norwood, White Coal Co., Des Moines, Iowa, and fuel agent for the Buick Motor Co., Flint, Mich. Between 1917 and 1919 he served as captain and major in the 17th Engineers, a railway shop regiment, and lieutenant-colonel, Engineers, U. S. Army, in charge of hospital, camp, warehouse, dock and railway construction at Nantes and other places in Base Sec. 1 in France; in 1919 he was made president of the Allied Railway Mission, at Trieste and Vienna and American member of the Danube River Commission.

C. O. Fass, chief engineer of the New Brunswick Electric Power Commission, has resigned.

R. W. Armstrong has been appointed division engineer of the Northwest division of the Kansas State Highway Commission with headquarters at Concondia, Kan. Mr. Armstrong was formerly resident engineer on federal-aid projects in Doniphan County.

Prof. Frank P. McKibben, of Union College, has been appointed a member of the City Planning Commission of Schenectady, N. Y.

E. G. Shiebley, who served during the World War as a sanitary engineer in the U. S. Public Health Service, has been appointed sanitary engineer for the city of Los Angeles, Calif., in charge of sanitation and housing problems.

Obituary

Walter Smith, for many years a member of the organization of the Atlas Portland Cement Co., died August 1, 1923, at his home in Des Moines, Iowa, after a brief illness.

John C. Temple, hydraulic engineer and for the past fifteen years manager of the Chicago office of S. Morgan Smith Co., died suddenly August 8 in Davenport, Iowa; he was 65 years of age. Mr. Temple at an early age became interested in the hydraulic turbine industry, his father being one of the original members of the firm of Stout, Mills & Temple, Dayton, Ohio, who were among the pioneer water wheel builders of the country. His entire career was devoted to water power engineering and the manufacture and sale of hydraulic turbines and accessories, and covered experience in Philadelphia, New York City and Montreal, also exploration of water power possibilities in Mexico and Central America. He joined the S. Morgan Smith Co. twenty years ago.

Thomas Ellis Brown, for the past twenty years consulting engineer to the Otis Elevator Co., a pioneer in the design and construction of hydraulic and electric elevators, and the originator of the Brown type of bascule bridge, died of heart disease at his home in Morristown, N. J., Aug. 15, after a month's illness. He was 67 years of age. Shortly after graduation from Columbia University Mr. Brown was assistant to Prof. Shunk, of that institution in railway and topographic instruction. Later he became assistant engineer in charge of the design and construction of a part of the Ninth Ave. Elevated structure, New York City. About 1884 Mr. Brown joined the engineering staff of the Otis Elevator Co., becoming its chief engineer. He acted in that capacity until about 20 years ago when he established consulting offices; however, he was retained as a consultant by the Otis company until his death. One of the notable achievements of Mr. Brown was the design and installation of the elevators in the Eiffel Tower, in Paris. The first installation of his bascule bridge was made at Buffalo, N. Y., and was described in *Engineering News* Jan. 16, 1908, p. 51.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Standards Adopted for Tilting Mixers

Joint Committee Agrees On Three Sizes, 3½, 5 and 7 cu.ft.—Nameplate to Show Rating

At a meeting in Chicago, July 30, a joint committee of manufacturers of tilting concrete mixers and contractors agreed upon standards for the equipment under consideration. The following detailed report on the action of the meeting supplements the news article which appeared in *Engineering News-Record*, Aug. 9, p. 244:

1. *Standard of Measurement.*

(a) The standard of measurement of drum capacity shall be the cubic foot.

(b) The standard for water-tank measurement shall be the U. S. standard gallon.

(c) It is recommended that the question of rating engines and motors be taken up by the Joint Committee on Construction Equipment in conjunction with engine and motor manufacturers.

2. *Rating of Mixers.*

The size of the mixer shall be designated by a number indicating the nominal rating of the mixer according to its capacity in cubic feet of mixed concrete per batch.

3. *Table of Aggregate Proportions.*

A standard table of mixed aggregates derived from authoritative sources shall be adopted and published by the manufacturers. This table, based upon 40 per cent of voids in the course aggregate and 3.8 cubic feet of cement per barrel is as follows:

Proportions Of Mix	Resultant Concrete per Bag, Cu.Ft.	Proportions Of Mix	Resultant Concrete per Bag, Cu.Ft.
1:1½:3	3.55	1:2½:4	4 85
1:1½:3½	3.86	1:2:5	5.13
1:2:3	3.89	1:2½:5	5.47
1:2:3½	4 20	1:3:5	5.83
1:2:4	4.52	1:3:6	6.50

Values taken from Taylor and Thompsons' Tables of Aggregate Proportions.

4. *Sizes.*

It is recommended to mixer manufacturers that two sizes under 7-S be adopted as standard; namely, the 3½ and the 5 cu.ft.; and that sizes below the 3½ be omitted from the standardization program for the present.

5. *Standard Table of Batches.*

A standard table of batches based upon the table of mixed aggregates provided under Article 3, shall be adopted and published by the manufacturers. This table is as follows:

CAPACITIES OF STANDARD SIZE MACHINES FOR VARIOUS PROPORTIONS OF MIX

Proportions of Mix	Resultant Concrete per Bag Cu.Ft.	Building Mixers — Max. No. Full Bags per Batch 3½-S	5-S	7-S	14-S	21-S	28-S	Paving Mixers — Max. No. Full Bags per Batch 7-E	12-E*	13-E*	21-E
1–1½–3	3.55	1	1	2	4	6	8	1	3	3	6
1–1½–3½	3.86	½	1	1	3	5	7	1	3	3	6
1–2 –3	3.89	½	1	1	3	5	7	1	3	3	6
1–2 –3½	4.20	½	1	1	3	5	7	1	2	3	5
1–2 –4	4.52	½	1	1	3	4	6	1	2	3	5
1–2½–4	4.85	½	1	1	3	4	6	1	2	2	4
1–2 –5	5.13	½	½	1	3	4	6	1	2	2	4
1–2½–5	5.47	½	½	1	2	4	5	1	2	2	4
1–3 –5	5.83	½	½	1	2	3	5	1	2	2	4
1–3 –6	6.50	½	½	1	2	3	4	1	1	2	3

* Either the 12-E or the 13-E is to be eliminated, depending upon results of a referendum to the A. G. C.

The resultant concrete per bag is based upon 3.8 cu.ft. of cement per barrel and 40 per cent of voids in the coarse aggregate.

Building mixer batches are based upon 1½ gal. of water per cubic foot of mixed concrete.

Paving mixer batches are based upon 1 gal. of water per cubic foot of mixed concrete and upon a maximum operating grade of 8 per cent.

6. *Standardization of Mixer Equipment.*

(a) The 3½ and the 5 cu.ft. mixers may be equipped with power loaders and water tanks.

(b) Pressure water tanks shall withstand a working pressure of 150 lb. per square inch.

(c) Water connections on the 7-S and under shall be ¾-in. garden hose connections.

(d) Loading skips shall be made with closed ends on the 7-S and under.

(e) Auxiliary hoisting drums may be furnished on the 7-S and under.

7. *Shafts, Keys and Keyways.*

A. S. M. E. sizes of shafts, keys and keyways shall be used.

8. *Safety Devices.*

All working parts shall be guarded in accordance with the requirements of state laws.

9. *Standard Nomenclature.*

The nomenclature of the Concrete Mixer Association, with such additions as may be later approved by the manufacturers, shall be adopted as standard.

10. *Name Plate.*

(a) A name plate giving the standard rating of the machine and its capacity for different proportions of mix shall be affixed to each machine.

(b) Pending adoption of American Standards, the plate shall state that the machine meets the standard A. G. C. requirements as approved by the Joint Committee of Mixer Manufacturers and Contractors. (Note: A standard plate was adopted.)

(c) Until such time as the Associated General Contractors can take definite steps for approval of batch capacities of the standard mixers each manufacturer shall furnish to the A. G. C. an affidavit stating that the machines comply with the standards and will satisfactorily mix the batches listed on the name plate.

11. *Use of Standard Plates.*

(a) Manufacturers conforming to these standard requirements shall be allowed the use of the A. G. C. name plate—it being understood that due to manufacturing and competitive condi-

tions it may be necessary for manufacturers to continue their present non-standard sizes—it being further the sense that the manufacture of such non-standard sizes shall be eliminated by Jan. 1, 1925.

(b) After Sept. 1, 1923, any manufacturer bringing out a new size of mixer not in accordance with the established standards, shall forfeit his right to the use of the A. G. C. name plate so long as he departs from the standards, it being understood that mixers larger than 28 cu.ft. and under 3½ cu.ft. are not considered.

Adopt "Corduroy" as Trade Mark

To differentiate the type of traction employed on their revolving shovels, cranes and draglines from other similar types of endless chain tractions Pawling & Harnischfeger, Milwaukee, have adopted as a trade mark the word "Corduroy" worked into the design shown below.

CORDUROY

Excavators, the company points out, are called upon to do considerable traveling over soft ground. The first machines, which were mounted on wheels, used mats when operating in, or crossing, soft soil. The mats really amounted to short sections of corduroy road which were transported with the machine. They were picked up from the rear as the machine traveled along and set in front again, a slow process.

P&H Excavators were developed upon the principle of carrying and laying their own corduroy road. The traction consists of an endless chain of steel treads which are, in effect, the logs of a corduroy road since they lie close together and form a path upon which the machine travels. The first machines built by the P&H company had blocks of wood bolted crosswise onto the endless chains of the traction device, and the P&H design, therefore, is described as a Corduroy traction.

Lumber Course, by Mail, Has 3,000 Students

Three thousand students are now enrolled in the free correspondence course in lumber and construction information conducted by the National Lumber Manufacturers Association, and a goal of 6,000 is set for the season's enrollment. The purpose of the course is to give lumber merchants and others a background of knowledge of their material and its application in construction. The course consists of sixteen chapters on such subjects as merchandising, technical and physical properties of lumber, planning and designing, estimating and rules for taking off quantities, figuring stresses and sizes, shingles, wood preserving, heavy timber mill construction, blue print reading, and commercially important trees.

The student requests one chapter at at time from the National Lumber Manufacturers Association, International Building, Washington, D. C., or Conway Building, Chicago, Ill., and after having reported studying successively the sixteen chapters receives a certificate of graduation.

Contractors' Vote Favors 21-S Concrete Mixer

Of 132 Ballots Cast 83 Indicate a Need for the Three-Quarter Yard Size on Construction

By a vote of 83 to 49 members of the Associated General Contractors of America have gone on record in favor of retaining as one of the standard sizes the 21-S concrete mixer which was the subject of a ballot sent out after the meeting in Chicago, June 27-29, of the Joint Committee on Construction Equipment (see *Engineering News-Record*, July 26, p. 160). Some of the members gave the following reasons in explanation of their vote favoring or opposing the 21-S size:

In Favor

This size fits more jobs than any of the larger sizes.—Yakima Paving Co., Yakima, Wash.

Would give 21-S preference over 14-S or 28-S. Have been using for 12 years on our larger building operations.—Lundoff-Bicknell Co., Cleveland.

On work requiring rich mixtures 21-S is a size of value; many such jobs are overplanted with a larger mixer.—F. L. Cranford Co., Brooklyn.

Three-quarter yard mixer most desirable for work on buildings in general.—Henry Ericson Co., Chicago.

I prefer 21-S because more easily handled, costs less and is more economical. It is large enough for any ordinary building construction.—W. T. Hadlow, Jacksonville.

21-S considered more flexible than 28-S; operating satisfactorily and arguments do not warrant discontinuance.—John J. Kane & Co., El Paso.

21-E paver fits in more economically and is better adapted to general run of work than other sizes.—Crissey Constr. Co., Johnstown, Pa.

21-S is most convenient size for moving and installing; large enough for big jobs and not too large for medium size jobs.—H. B. Sproul Construction Co.,. Scranton.

While 28-S will do the work, its weight makes transportation and installation a serious matter. We should be very sorry to see 21-S go—we use it constantly.—Arthur S. Bent, Los Angeles.

We find 28-S too cumbersome to handle on our city jobs, where most times available space for plant is limited. We use 7-S, 14-S and 21-S, but no 28-S. —Walbridge & Aldinger Co., Detroit.

Opposed

A job justifying anything larger than a 14-S is suited to a 28-S.—Hogan & Humphrey, Little Rock, Ark.

Three-quarter yard mixer too large for a side loader. If large mixer is desired on large work, fed from bins and hoppers above, a 1-yard mixer is preferable—for medium sized work and under a one-half yard mixer does the work nicely.—E. L. Scheidenhelm, Chicago.

On a job requiring large mixer, 28-S is just as economical even when operated at three-quarter yard capacity, and, on a small job, 14-S is sufficient.—Wolverine Engineering Co., Mason, Mich.

We use 21-S least of all. On large jobs have not used 21-S since 1920.—John J. Turner & Sons, Amsterdam, N. Y.

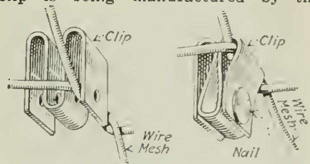
Business Notes

Pioneer Instrument Co., Brooklyn, N. Y., has purchased the business of Brandis & Sons, Inc., including their factory and equipment. The latter company has made engineering and nautical instruments since 1872, while the Pioneer company manufactures aircraft instruments exclusively. Each organization will continue the sale of its own product. Their manufacturing facilities will be combined, however, and operated as one plant. William F. and Henry A. Brandis will continue as president and vice-president of Brandis & Sons. Both companies will occupy the Brandis building at 754-758 Lexington Ave., Brooklyn.

Equipment and Materials

Furring Clip for Wire Mesh

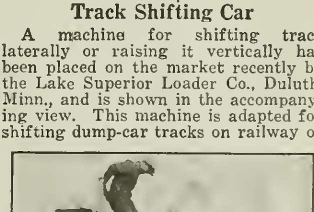
For holding wire mesh at the proper distance from surfaces to be plastered or covered with stucco, a simple furring clip is being manufactured by the



G. L. W. Manufacturing Co., San Diego, California. The clip, as shown in the accompanying illustration, consists of a bent strip of galvanized metal which is hung over the wire and fastened with a four-penny nail.

Track Shifting Car

A machine for shifting track laterally or raising it vertically has been placed on the market recently by the Lake Superior Loader Co., Duluth, Minn., and is shown in the accompanying view. This machine is adapted for shifting dump-car tracks on railway or

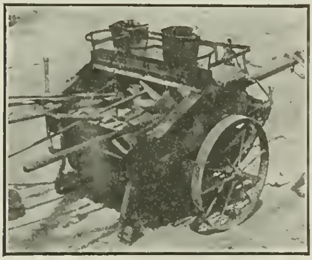


other construction, coal and ore stripping and similar work. In fact it is the development of a machine which has been in use for some months in shifting track on the waste dump of an iron ore mine in Minnesota. The four-wheel car, 10 x 7 ft. in size, has at the center a 7-ft. vertical spud raised and lowered by a rack and pinion, and fitted with a broad shoe on the bottom. The pinion mechanism has a lateral travel across the floor of the car. In operation, four rail tongs attached to the car frame are clamped to the rails.

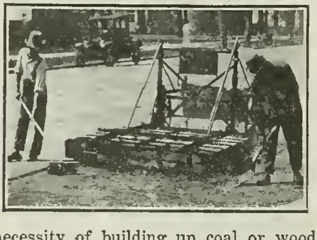
The spud is inclined in the direction the track is to be shifted and is racked down so as to lift the car, carrying with it the rails and ties. Owing to the inclination of the spud the whole structure slides laterally until the ties again rest on the ground. The tongs and spud are then released and the car is moved forward about two rail lengths to repeat the operation. A gasoline engine drives the car and operates the spud gear. The machine weighs about 2½ tons. It is stated that this machine with one man has replaced eight men in a track gang engaged in shifting track on ore stripping work. Track can be raised in the same way (without shifting it laterally) for ballasting, tie renewals or raising grade.

Oil Burning Tool and Surface Heaters for Asphalt Repairs

Improvements in its oil-burning tool and surface heaters for the repair of asphalt pavements, originally introduced about five years ago, are announced by the Chausse Oil Burner Co., Detroit. The tool heaters, illustrated in the accompanying photograph, are now equipped with Timken bearings, steady rests and a new type of burner. Rubber tires may be added to make possible



more rapid and noiseless transportation when hauled by motor truck. Fuel tanks provide sufficient kerosene or distillate for two 8-hr. days of continuous burning at maximum temperature. The tool heaters will bring fourteen or fifteen cold tools up to proper temperature in 15 min. and provide space for heating three buckets of asphaltic cement, so that two gangs can work with one machine. The burners generate maximum temperature in 5 min., eliminating the



necessity of building up coal or wood fires long in advance of the use of the machine. With the oil fuel employed there is no nuisance or danger from smoke, sparks or ashes.

The surface heaters are made in two sizes; one to cover 2 sq.yd. to work up to street car tracks without interfering with car movement, and the other to cover 4 sq.yd. Both machines are mounted on springs to facilitate transportation. With these heaters, the manufacturer states, it has been found possible to melt down old asphalt to a 1-in. depth in 4 to 5 min.

New Type of Light Gas Car For Narrow-Gage Railway

A new type of self-contained gasoline-driven railroad motor car has been supplied to the Nevada-California & Oregon Ry. Co. by The A. Meister Sons

Co. The cars are built to operate on 36-in.-gage track. On a test run of 520 miles one of them averaged 11 miles to a gallon of gasoline and less than one pint of lubricating oil. The average speed was 35 m.p.h. and the maximum 55 m.p.h. The car carried 28 passengers and negotiated grades of 2½ per cent. The car weighs 8 tons.

The length of the car is 32 ft. and the width 7 ft. The distance between the rear drivers and the center of the bolster bar on the front truck is 20 ft. The height from top of rails to center of roof is 8 ft., and from top of rails to floor of car 14 in. These cars are operated by one man, from the front end of car. They are equipped with 4-cylinder motors, Arcola hot water heater system, and electric starter, generator, lights and horn. There is absolutely no noise in the car body, this being due to the rubber cushion springs. By placing the motor to the rear of the driving wheels, all revolving parts in front of the rear axle have been eliminated, thereby permitting a very low-hung car and eliminating all motor noise, smoke, grease and gasoline odor from the inside of the car.

Practically all vibration has been eliminated by suspending the motor on coil springs directly over the rear axle, on one end of a sub-frame. This subframe has a swivel bolster bar built in the main frame at one end so that it will turn at curves, thus eliminating flange wear and relieving side thrust.

The car is equipped with a Westinghouse accumulator, taking air from the front cylinder, this air being used for sanders only. The breaking power is 175 per cent.

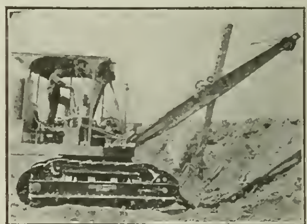
Similar cars are built in all gages from 2 ft. up.

Gasoline Dipper Shovel

A gasoline-driven power shovel operated entirely with gears and shafts and known as the O. S. Dependable, is announced by the Orton & Steinbrenner Co., Manufacturers of cranes, shovels, and buckets, of 608 So. Dearborn St. Chicago. The positive gear drive, the feature of the O. S. Dependable, is simple and the number of parts few. At the bottom of the boom connection is a shaft carrying double steel bevel gears and bronze friction clutches. This shaft is concentric with the pivot of the boom and consequently independent of its position. The boom can be used at any angle to suit the exigencies of the work.

Along the boom is a steel shaft carrying two bevel pinions, one meshing at the bottom with the gears on the horizontal shaft, and the other at the top meshing with gears on a countershaft located about half way up the boom. This latter shaft carries a brake and "slip friction," and is geared directly to the cast steel rack on the dipper stick. With this method, a minimum number of levers are required.

The hoisting mechanism is the same type as has been used in the locomotive



cranes built by the Orton & Steinbrenner Co. for fifteen years. The simplicity of parts is also of great advantage in converting the shovel into a clamshell outfit, dragline, or skimmer rig. The power is supplied by a heavy duty 4-cylinder "Climax" motor. Another exclusive feature of the machine is the flexible crawling tread.

Publications from the Construction Industry

Grab Bucket Cranes—PAWLING & HARNISCHFEGER CO., Milwaukee, Wis., has just issued a new bulletin covering its complete line of traveling grab-bucket cranes and monorail hoists. This bulletin has 32 pages and is freely illustrated with pictures of the various kinds of grab-bucket equipment and many views showing its installation in various industries.

Electrical Development — GENERAL ELECTRIC CO., Schenectady, N. Y., has issued to its stockholders a 34-p. booklet reviewing the 30 years' history of the company from its foundation in 1892 to 1922.

Air Compressors — INGERSOLL-RAND Co., New York, has issued a new 35-p. illustrated bulletin describing its medium and large sized steam-driven air and gas compressors built in a number of types and sizes. The capacities of the standard two-stage machine for 100 lb. discharge pressure range from 246 to 4150 cu.ft. per minute piston displacement. Single-stage compressors are built for furnishing 50 lb. discharge pressure. A feature of the equipment is the steam valve gear consisting of completely balanced piston valves with riding cut-off valves telescoping within the main valves. An automatic cut-off governor maintains constant air pressure, regulates the steam cut-off and adjusts the speed of the compressor to the demand for air.

Lumber in Architectural Construction — SOUTHERN PINE ASSOCIATION, New Orleans, has published in the form of a 16-p. booklet recommendations for the use of Southern Pine lumber in architectural construction, covering grades and sizes in accordance with the association's standards which have been approved by the Louisiana Chapter, American Institute of Architects, The General Contractors Association of New Orleans, and the New Orleans Retail Lumber Dealers.

Turbine Pumps—LAYNE & BOWLER Co., Memphis, Tenn., describes and illustrates its turbine pumps and well screens for railroad, mining, industrial, municipal and irrigation service in a 64-p. catalog just issued. Details are given regarding the Layne shutter screen for large bore wells, and also the Keystone wire wrapped screen manufactured of perforated pipe covered with a spiral brass winding. One chapter of the text is devoted to the development of underground water supplies. Complete data are given regarding the company's vertical turbine well pump and a number of typical installation views are shown.

Gasoline Motors—WAUKESHA MOTOR Co., Waukesha, Wis., in a 32-p. illustrated pamphlet, illustrates and describes its industrial power unit consisting of a 4-cylinder gasoline engine in sizes of from 20 to 45 hp. The unit is housed with sheet metal, is portable, and is recommended for use in operating sawmills, hoists, pumps, stone crushers, concrete mixers, air compressors and road machinery. The power take-off is a housing that can be attached to the flywheel housing of any Waukesha motor.

Waterproofing—GENERAL FIREPROOFING Co., Youngstown, Ohio, in the sixth edition of its "Waterproofing Handbook" describes methods and materials for waterproofing concrete and all forms of masonry, both above and below grade, and protecting finished surfaces of wood, plaster, concrete or metal against water, wear and stains. The volume comprises 72 p., illustrated, divided into five parts dealing with substructural waterproofing, superstructural waterproofing, cement and wood floor preservation, technical paints and coatings, and the company's waterproofings and preservatives. The text is supplemented by a number of photographs and drawings indicating waterproofing details.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Freight Movement for Half Year Greatest in Railway History

The railroads of the United States during the first six months this year carried the greatest freight traffic for any corresponding period in their history, according to tabulations just made by the Bureau of Railway Economics, based on reports filed by the carriers. Measured in net ton-miles, it amounted to 225,435,608,000, an increase of 7 per cent over the corresponding period in 1920 which had marked the previous record.

Ton-Mileage Figures

Compared with the first half of last year when, however, freight traffic was reduced by the miners' strike which began on April 1 and continued until late in the summer, the total net ton-miles for the first six months this year was an increase of more than 32 per cent. In the Eastern district, which was especially affected by the miners' strike, there was an increase over the first six months last year of 37.6 per cent in freight traffic, while the Southern district reported an increase of 29½ per cent. In the Western district the increase was 26 per cent.

For the month of June alone freight traffic amounted to 38,000,994,000 net ton-miles, or an increase of nearly 31 per cent over the same month last year when the miners' strike was in progress. The Eastern district showed an increase of more than 46 per cent in freight traffic, the Southern district 14 per cent and the Western district 17 per cent. Freight traffic in June this year has only been exceeded twice during that month in previous years, once in June, 1917, and again in the month of June, 1920.

Average Car Movement

The average movement per freight car during the month of June was 28.3 miles per day. This was the highest average for any June since 1917 when it was exceeded by 0.1 mile. It also was an increase of 4.4 miles over June last year, and 6.3 miles over June, 1921, but a decrease of 0.3 mile under the daily average for May this year. Every increase of one mile in the average movement of a freight car is equivalent to the addition of 100,000 freight cars to the country's transportation facilities without any increase in capital expenditures.

The average load per car in June was 28.2 tons. This was not only an increase of 0.2 ton over the average for May this year but was the highest average for any June since 1917, except in 1918 when the average was 28.3 and in June, 1920, when it was 28.9.

Bookings of Steel Castings

July bookings of steel castings, based on reports received by the Bureau of the Census of the Department of Commerce amounted to 52,066 tons, as against 84,878 tons in June, representing two-thirds of the commercial castings capacity of the United States. The following table shows the bookings of commercial steel castings for the past seven months by 65 identical companies, with a monthly capacity of 96,900 tons, of which 38,300 tons are usually devoted to railway specialties and 58,600 tons to miscellaneous castings.

BOOKINGS OF COMMERCIAL STEEL CASTINGS

Month 1923	Total		Railway Specialties		Miscellaneous Castings	
	Net Tons	Per Cent of Capacity	Net Tons	Per Cent of Capacity	et Tons	Per Cent of Capacity
January	100,605	103.8	47,879	125.0	52,726	90.0
February	90,152	93.0	39,845	104 0	50,307	85 8
March	143,564	148.2	76,409	199.5	67,155	114 6
April	90,968	93 9	39,610	103.4	51,358	87 6
May	89,493	92.4	38,788	101 3	50,705	86.5
June	84,878	87.6	42,773	111.7	42,105	71.9
July*	52,066	53.7	16,741	43.7	35,325	60.3

* Two companies with a capacity of 785 tons per month on miscellaneous castings now out of business.

Industrial Employment in July

The U. S. Department of Labor, through the Bureau of Labor Statistics, presents the following preliminary figures concerning the volume of employment in July, 1923, from 6,739 representative establishments in 51 manufacturing industries, covering 2,353,258 employees whose total earnings during one week in July were $61,174,094. The same establishments in June reported 2,396,012 employees, and total pay rolls of $64,176,205. Therefore in July, as shown from these unweighted figures for 51 industries combined, there was a decrease under June of 1.8 per cent in number of employees, a decrease of 4.7 in total amount paid in wages, and a decrease of 2.9 in average weekly earnings. This decrease in employment, the first appearing in this series of reports since April, 1922, is largely a seasonal one.

Increases in rates of wages for the month ending July 15 were reported by 302 establishments in 48 of the 51 industries covered. These increases averaged 8.5 per cent and affected 31,829 employees, or 35.3 per cent of the employees in the establishments concerned, and 1.4 per cent of all employees in the 51 industries.

Forty-one industries out of 51 show decreased per capita earnings in July as compared with 27 out of 50 in June.

Freight Cars in Need of Repair

The railroads of the United States on Aug. 1 had 189,014 freight cars or 8.3 per cent of the total number on line in need of repair. This was an increase of 393 over the total number in need of repair on July 15, at which time there were 188,621 or 8.3 per cent. Compared with the number on July 1, it was a decrease of 1,397. Of the total number on Aug. 1, this year, 144,566 or 6.3 per cent of the number on line were in need of heavy repair, an increase over the number in need of such repair on July 15 of 1,285.

Lumber Movement Declines

The nation's lumber movement declined noticeably during the week ending Aug. 11, says the National Lumber Manufacturers Association, as reflected by reports from 382 of the larger commercial sawmills as compared with reports from 406 mills for the preceding week. Shipments fell off about 15 per cent, new business about 10 per cent, and production about 7 per cent. With 122 mills reporting as against 131 for the week before unfilled orders of West Coast mills decreased from 320,039,832 ft. to 305,893,356 ft.; and 132 Southern Pine Association mills show a decline in the order file from 228,868,185 ft. to 218,769,525 ft.

For all the reporting mills shipments were 82 per cent and orders 78 per cent of actual production; for the Southern Pine mills these percentages were 95 and 81, and for the West Coast mills 85 and 98. Of the whole number of reporting mills 343 have an established nominal production for the week, in reference to which actual production was 102 per cent, shipments 88 per cent, and orders 85 per cent.

Wholesale Prices in Italy Up

Wholesale prices in Italy have notably increased during the past year, according to index numbers complied by the Chamber of Commerce of Milan. In June, 1922, taking average prices for 1913 as 100, the general index stood at 504.48, and in June, 1923, it had risen to 539.24. The group showing the largest increase is textile materials, which have risen from 556.44 to 653.91. Minerals and metals have also increased considerably. Food products show a further increase from 549.C5 to 564.66.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the the issue of Aug. 2; the next, on Sept. 6.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb.	$3.64	$4 00	$4.20	$3.40	$3.55	$4.20	$3 60	$4.10	—$4.00
Structural rivets, 100 lb.	4 40	4 75	4 90	3.75	4 25	5.40	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	—3.50	3.80	3 20	3.45	3.85	3.65	4.10	—3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	52%	45%	47%	53–5%	36%	33.2@42 2%	40%	47 43
Cast-iron pipe, 6 in. and over, ton	62.30	56.00	63.00	60.20	60.50	69.00	62.00	70.00	60.00
Concreting Material:									
Cement without bags, bbl.	2 70@2.80	3 00	2 25	2.20	2 50	2.84	2.63	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	1 89	2.00	1.25	1.00	1 50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.83	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	58.00	40 00	52.25	56.50	42.50@43.75	42.75	41.00	28.00	70.00
Lime, finishing, hydrated, ton	18.20	22 50	22.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	2.35	1.50	1.50	2.70	2.10	2.80	10.00
Common brick, delivered, 1,000	20.00@21.00	12.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	.115	.0724	.0816	.065	.....	.11	.....
Hollow partition tile 4x12x12, per block	.1573	.102	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	—.98	1.08	—1.14	—1.12	—1.04	1.25	—1.18	.86	1.26
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	—.50@.55	.35@.50	.50	.50@.62½	+.35@.40

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93⅜c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5⅜ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.78). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in., $119.

Few Price Changes Since Last Week

In the last few months the price changes have been of small consequence. This week lumber and brick are a trifle softer in New York. Linseed oil continues to decline in a number of cities. Steel is down in Montreal. These are local fluctuations that tell nothing significant.

St. Louis unions of bricklayers, according to *Engineering News-Record's* correspondent, have informed the contractors that, effective Nov. 1, 1923, the rate shall be $1.75 per hour—an increase of 25c. At present bricklayers and stone masons are receiving bonuses that with wages amount to about $1.75 per hour. Carpenters were recently granted an increase of 25c., to $1.50.

July building permits in 270 cities aggregated $243,004,821. This is a high normal value for this season of the year and indicates that despite a very high cost level much building is still being planned. The Eastern states report value of permits in July as 23.6 per cent over July, 1922, and a decline of 3.2 per cent from June of this year. Central states showed a very small increase over July a year ago and a still smaller loss from June of this year. Permits in the Southern states fell off about 10 per cent. The Pacific Coast states reported an increase of 42 per cent over last year and a decline of 17.5 per cent from June of the present year.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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Their Appointed Rounds

OVER the portal of the general post office building in New York City is carved a sentence which, possibly because of the felicity of phrasing, has been credited to Woodrow Wilson: "Neither snow, nor rain, nor heat, nor gloom of night stays these couriers from the swift completion of their appointed rounds." When these words were written the airship was little more than a county fair attraction, but how aptly they convey the spirit of those pioneer planes which last week carried the mail across the continent in less than 27 hours. Step by step the world progresses and each tiny movement forward seems so insignificant, until with time we find ourselves in new countries with new landmarks and new conditions. Thus will it be with air transportation; first a toy, then a weapon, still later an experiment for the rich and the curious, before long, as the world counts time, the airship will be a potent factor in transportation.

Traffic for Group Study

ANNOUNCEMENT has been made that the American Bar Association at its next annual meeting is to take up the problem of traffic congestion with a view toward suggestions of legal means of relief. This is an excellent idea. The proposals for congestion improvement involve many nice legal questions, such for instance, as the right of restriction of types of traffic and the redress to ground-floor owners for possible damage by second story streets, to say nothing of the limits to the police power in this new problem. Engineers, however, have much closer interest in traffic control and their societies could well take a leaf out of the lawyer's book. The American Society of Civil Engineers could find no more pressing or interesting subject for one of its annual meetings.

New Cement Possibilities

GRADUALLY emerging from the obscurity of the laboratory and the study the quick-setting high-strength alumina cements are beginning to take on practical importance. The review of their development in Europe by E. C. Eckel, given on another page of this issue, indicates that over there they are beginning to be taken seriously by construction men, which foreshadows a similar progress on this side of the ocean. On account of the nature of their constituents—and especially the concentration in occurrence of the alumina clays that they require—these new cements will never seriously rival the portlands for ordinary construction work. It is obvious, however, that their proved high early strengths make them of the greatest value in certain emergency works where time is the essential quality in completion. For city street work, grade crossings, water pipe repairs, and many easily noted cases, these new cements would be worth the high price they doubtless will require. So far, their other virtue—that is increased safety in saline exposure—is not so well proved, but if proved that too would make them in demand. Mr. Eckel's article intimates an interest in commercial production of the alumina cements in this country. Much remains to be studied in the behavior of these cements, but in view of their promised value, engineers and constructors will hope that the tests and studies now being made will show them to be commercially feasible.

Detours Versus Half-Roads

PROBABLY no car owner will arise to defend detours. They compel him usually to travel a longer way over ill-kept roads whose marking is generally just clear enough to keep him unsure of his course. The detour indeed is generally damned. To avoid it the practice of building only one side at a time has been developed in paving busy roads. By this procedure one half of the road is theoretically always open to traffic. Until one considers it, this practice seems to have very decided advantages over detours. With a little thought, however, and particularly with a little experience in traveling half-roads, there comes the realization that they are one-way routes, that they put a snail's pace on traffic and that they require very cautious driving to clear the construction operations on one side and the ditch on the other side. Indeed contractors can cite more than a few instances when they have had to reset side forms and restore other finished work because a nervous driver in avoiding the Scylla of the side ditch has risked the Charybdis of an irate foreman of form setting. There is no freedom indeed from more serious disaster. The collision near Nyack, N. Y., on Aug. 9, of a motor bus with the boiler of a paving mixer, which resulted in the death by scalding of six of the bus passengers, is an instance to the point. Truly, this was an extraordinary occurrence but it indicates what can happen. Overturning and slewing are the more ordinary risks run by the user of the half-road. They are real hazards and where the engineer and contractor have the alternative of a good detour they should give it careful consideration. Paving half at a time is by no means a universal remedy of the detour evil in road construction.

Making It Work

JUST how many sewage-works in this country do more than provide a mental protection to the citizen and a buffer for the administration against complainants downstream? Not many years ago an Eastern consulting engineer journeyed through the Middle West in winter to see what the best and some of the average plants were doing. Practically every one he visited was out of commission or producing a decidedly poor effluent. Recently state board of health officials have effected some improvements but at the great

majority of small plants there is still much to be desired. Sludge beds are rarely used, reliance being placed on a fortuitous flood which will enable the operator to dump the sludge at the crest. Holes are punched in the beds for the easy passage (by-passage) to the effluent line. Tanks are not cleaned until the passage ways become no more effective than an enlargement in the trunk sewer. A refreshing exception to the above condition was noted in these pages last week, where the mayor of Newton, Kansas, decided to make the plant work and to overcome the difficulty of foaming over the gas vents of the Imhoff tank. Until engineers got to building the vents high and wide, spewing over the top was the rule, excused by the assertion that the foaming would stop when the "plant gets older and better seeded." The way to prevent misuse, non-operation or careless control of sewage-works is to provide better technical supervision, under the direction of state authorities or, better still, by retaining the engineer who designed the plant. Let him make it work.

Joint Operation of Bus and Trolley

FOR nearly a month a large part of the great state of New Jersey, and all of its large cities, have been without street cars. Not so many years ago this would have been an unbelievable situation. Today, thanks to the automobile and the motor bus, business is proceeding with at least superficial regularity and the inconvenience to the public, while doubtless great, has brought forth no wave of protest which a dozen years ago for a similar condition would have forced some kind of trolley service. The situation which has arisen and the tentative moves toward its solution are so indicative of what may be expected before long in street transportation elsewhere that they are worthy of examination.

The Public Service Corporation of New Jersey, in addition to an enormous power and light business, has a practical monopoly on the street railway systems of northern New Jersey, especially in the metropolitan district, which includes the large cities of Newark and Jersey City. For a number of years it has been in the usual controversies with employees and with the Public Utility Commission trying on the one hand to restrict increase in wages and on the other hand to gain increase in fares. It has been operating for some time on an eight-cent fare basis, with one-cent transfer privileges, and with what is generally conceded to have been an exceptionally low wage scale. Matters were brought to a head on the first of August by a complete strike of the employees for higher wages. The company met the strike by the unusual method of shutting down all street car service. No attempt whatever was made to enlist new employees or to operate with such help as could be diverted from other branches of the service. Northern New Jersey was without street cars.

It so happens, however, that this section of the state has been exceptionally well served with motor buses; in fact, it is to these buses that the company ascribes a large part of the difficulties of the railway. Not only were many roughly paralleling bus lines established, but those streets on which were run the busiest and most profitable car lines were taken as bus routes and thus, the railway claims, the buses skimmed the cream of the traffic, running for the most part on a five-cent fare basis. Immediately upon the cessation of the street car service, additional buses began to run, short time licenses were issued, municipal buses of the city of New York were loaned, and private automobiles called into service. So for three weeks the communities went about their business hampered, to be sure, but at least getting back and forth in fair fashion.

Finally, the Public Utilities Commission ordered the railway to restore service and their order was answered by a proposition which marks an interesting point in city transportation development. The railway agreed to restore service only after the acceptance of the proposal which has five main features: (1), the purchase by the railway of all competitive buses at present fair physical value, the railway thereafter to operate both bus and street car systems, as will best serve the public in the judgment of the Public Utilities Commission; (2), the refusal by the cities and the commission of any further competitive bus licenses or franchise; (3), the increase of wages asked by the employees; (4), the acceptance of a certain disputed valuation of the entire railway property by the Public Utilities Commission, and (5), the establishment of a seven-cent general fare for both bus and street car. This proposition was accepted by the employees, but the utilities commission balked on the acceptance of the valuation proposal and on the proposition that the railway could make terms before restoring service. In the matter of the competitive buses a hearing is to be held.

The Public Service Corporation is not loved in New Jersey. Whether justly or not, the people distrust it and welcomed the competition that the buses gave. The general trend of opinion in the state, therefore, would probably be unfavorable to any scheme which would establish for the corporation the natural monopoly in city transportation which their proposal frankly states is inevitable if proper service is to be given. On the other hand, the situation which has developed points toward some such solution as the company proposes. It so happens that the bus development in this section has been so great that the controversy here has arisen somewhat sooner than it has in other parts of the country, but it is merely a feather in the wind to show which way the trend of city transportation is going. Sooner or later a similar situation is bound to arise in practically every congested area. The bus, on account of its flexibility of service, is bound to become a serious competitor of the street railway. On the other hand, the street railway is long established. It has been given certain privileges by the public, in return for which it has expended a vast amount of money, looking toward a long time return. It is not just and, in all probability, it is not legal that the public now should take advantage of the changed conditions, which neither the public nor the railway could have foreseen twenty years ago, to permit another type of transportation to arise and destroy, as it inevitably will destroy if not regulated, the investment of the street railways. The way out seems to be that suggested in New Jersey, that is, the taking over of the competitive bus lines by the street railway, and the operation of the two jointly to the best service to the public.

The advantages of street cars over buses and those of buses over street cars are fairly obvious. They need not be argued. What people are interested in is the best service and not the service of one to the exclusion of the other. They must be operated jointly and effectively and, from an engineering point of view, such operation can best be conducted under one head. There are in-

dications that the trouble in New Jersey is deeper than the mere question of bus versus street car, that the direction of the company has seized upon this crisis to put over its own idea of valuation. Probably the utilities commission will not permit any such solution of the difficulty. But if the corporation is in earnest about its street car trouble, it is to be hoped that the commission will be able to adjust the valuation difficulties in such fashion as to permit the monopoly control of the bus and street railway, so that we can have tested the experiment of this type of street transportation operation. Unfortunately, the public is not today as sure that the commission regulation of transportation will insure as good service as will competition, but it seems only fair that the theory should be tried out. The commission has the opportunity now to gain agreement to some arrangement with the railway company whereby the railway will be permitted to show the public how good service it can give by joint operation and in which, also, the commission will have full power to maintain proper service.

An Experiment Worth Trying

ENGINEERS and engineering societies use up a great deal of useful time discussing professional ethics, but they take very little real action which will lead to an improvement in practice. Codes continue to be written and interpreted as generalities, but specific cases in violation are either shrouded in the cloak of anonymity under which the offenders are invisible, or they are used merely as text upon which are written virtuous homilies. Last spring, for instance, an effort was made by the Board of Direction of the American Society of Civil Engineers to inaugurate a more personal application of code violations, but the conservative view characteristic of that society continues to prevail and the impersonal application of ethics remains as before. One can well recognize the difficulties in a more strenuous treatment of this ethics problem, but it is hard to escape the impression that the delicate way in which most societies handle code violations put most of the members in the position of fearing to cast the first stone. Some day some society is going to have the force and courage to take up the situation more vigorously. From that time professional ethics in engineering will begin to be elevated.

Just at present two specific cases of a practice in violation of code offer a suggestion as to how such things might be treated. Each of these cases is an illustration of the way too many cities are going about getting engineering service. In the first, the Board of Water Commissioners of a certain Eastern city, sent out letters to a number of engineers inviting them to submit a proposition covering a complete engineering report on a proposed water supply for the city. The details of the information required were supplied and the engineers were asked to bear in mind that the city wanted the best solution of the water problem and to furnish bids to cover the cost of making the investigation and of preparing plans in shape for decision by the State Board of Health. Thirteen bids were received on this advertisement and the contract awarded on a lump sum basis for the engineering work of investigation and for the engineering work of construction, without regard to the total amount of work that might be required either in investigation or construction.

In the second case, a certain city advertised for competitive sealed proposals from "experienced engineers for preparing preliminary plans and specifications and furnishing estimates of the cost for a modern power plant." The bid was asked as a lump sum and, in addition, engineers making the bids were asked to furnish a bond "for such engineering service." No indication was given as to the use to which such a bond would be put, but it is quite probable that it would be used by the authorities to assure the tax payers that they were receiving proper service and advice.

Both of these are illustrations of a common enough practice. Obviously it is in violation of a proper code of engineering ethics. Probably it is not illegal, but it cannot tend to good engineering because the extent and cost of a true professional investigation cannot be estimated. The consequence is a chance of lower standard of work and the selection of engineers who are willing to cut prices, but whose professional equipment cannot be guaranteed. It is not only detrimental to the engineering profession, but it is dangerous to the community.

The practice, however, will not be cured by individual complaint nor by society generalizations. That has been proved. There have been many such complaints and many such generalizations and the practice continues. It would certainly be an experiment worth trying for some society which has cognizance of a similar performance, and such performances are continually available, to attempt a new line of action. As soon as a city makes public such an offer let the society or the local chapter thereof take a page in the local newspaper noting the case and reviewing the reasons against it. This advertisement, of course, must be dignified and sufficiently authenticated to relieve any of the members of the society from the charge of self interest. It should not be published until after an argument by the society with the city officials had proved unavailing. If the city persists in its advertising after the notice by the engineering society and accepts bids, let the society then issue a second advertisement in which the names of the engineers who have bid are specifically mentioned with appropriate comment regarding the possibilities and probabilities involved in the whole transaction. If there is anything at all in the force of public opinion, or if there is any such thing as public respect for the engineering profession there will be few city administrations that would dare to go through with this advertising for engineering services after such a campaign by the representative engineers of the community.

It is recognized that any local society will probably contain in its membership certain of the engineers who will participate in such a competition. It is the privilege of these engineers to vote in open meeting on the desirability of the society entering into an open campaign against the practice of bidding for engineering services, but having spoken they have no redress in law or in ethics for public chastisement by their professional brethren provided always that these brethren have not themselves in the past participated in similar practices and are thereby disbarred from criticism.

Such a procedure would be in definite opposition to anything that has ever occurred. There should be somewhere, however, a group of engineers with sufficient courage to take up such a definite stand in specific defense of what every engineer will admit is a proper attitude of mind.

Building New Argentine-Chilean Transandine Railway

New Transandine Line Has American Viaducts and Equipment—Maximum Grade 2.5 Per Cent—Uses Switchbacks and Spirals—Tunnels, Cut-and-Cover Work—Summit 14,681 Ft.

By Richard F. Maury
Chief Engineer of the Salta-Chile Extension, Argentine State Railways

A SOUTH AMERICAN railway development which should mean much to the United States and which will probably cause important changes in trade routes, besides opening a rich section of country, is the Salta-Chile extension of the Argentine State Railways, now under construction, to connect the existing railway system with the Pacific port of Antofagasta. This work, after being under consideration for many years, was undertaken by the railway administration in March, 1921, work being started in May of the same year. Views on this Transandine section of a new transcontinental line are shown in Fig. 1.

FIG. 1—VIEWS ON NEW TRANSANDINE RAILWAY
A. Heavy rock grading by hand at K. 150. B. The Chani Pass, near line, El. 21,000 ft. C. Mule-team with dynamite for tunnel at K. 180. D. Typical viaduct.

The object of this line is mainly the development of the northwestern provinces of Argentina, which are little known and are practically isolated by the great distance from Atlantic ports. These provinces comprise one of the most promising regions of the world for extensive development, since this region offers a great variety of climate, is watered by numerous rivers and is capable of producing practically everything grown in tropical, sub-tropical and temperate zones. In addition to this, the completion of the line will undoubtedly affect the relations of the United States with Argentina, as a large part of the imports through the ports of Buenos Aires and Rosario de Santa Fé will probably seek this new and shorter route. By sea the saving in distance to America and Japan is striking, as shown in the following computation. The distance to

To	From Buenos Aires Miles	From Antofagasta Miles
New Orleans	6,260	3,419
San Francisco	8,640	4,600
New York	5,838	4,011
Tokio	12,100	9,300

European ports is but slightly increased by the new route, while relations with North America will be greatly facilitated.

Route and Profile—With a total length of 492 miles from Salta to Antofagasta this meter-gage railway will have 320 miles in Argentina and 172 in Chile, the new construction being about 300 miles and 75 miles respectively. As shown by the map in Fig. 2, the line leaves the existing branch of the State Railways at Rosario de Lerma, 18.6 miles from the city of Salta. Between these points track has been relaid and heavily ballasted to put it in condition for handling the new rolling stock. From the junction, 4,370 ft. above sea level, the line begins its climb on maximum grades of 2.5 per cent, through the gorge of the Toro River, which is followed to Km. 74 (mile 46). The first reaches of this section presented considerable difficulty as the grade of the river bed exceeds 2.8 per cent, the difference

being saved by two switchback sections. Maximum grades are continued, with some easier portions, to the first summit in Abra Munano which is reached in Km. 142 (mile 88) at El. 13,264 ft.

The climb out of the Toro gorge at Puerta de Tastil

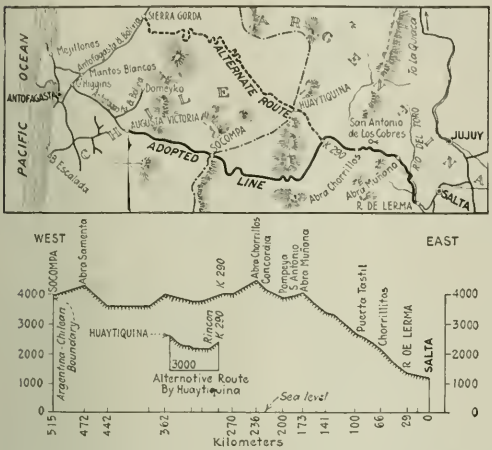

FIG. 2—PLAN AND PROFILE OF ARGENTINE-CHILEAN RAILWAY

is the most interesting feature of this long ascent, recourse having been had to some very heavy development, including two spirals, as shown by Fig. 3. Practically all the difficult part of the construction is comprised in the stretch between Rosario de Lerma and Abra Munano, which is passed with a tunnel about 1,000 ft. long. After traversing some 12½ miles of undulating plain to arrive at San Antonio de los Cobres, capital of the Andes Territory, the line again begins to climb and crosses the Abra de Chorillos, in open cut, at El. 14,681 ft. and a distance of 124 miles from Rosario. Between San Antonio and the Abra de Chorillos the important Concordia mine will be served by a station alongside the pit.

At the Abra de Chorillos the line, after a slight descent, enters on the plateau of the Puna de Atacama which is traversed with only surface work and with very easy grades until the frontier is approached, where 12½ miles of heavy cutting bring it to Socompa on the continental divide, some 310 miles from the start and at El. 12,989 ft. Crossing the plateau, there will be some very long tangents, the longest being 43½ and 25 miles, both completely level. From the frontier the line in Chilean territory will run around the Domeyko range to connect with the terminus of the existing railway of 30½-in. gage at Augusta Victoria, an important nitrate deposit, at El. 5,871 and 95½ miles from Antofagasta.

An alternative route, originally proposed, was to cross the frontier at Huaytiquina and connect with the Antofagasta & Bolivia Ry. of 30-in. gage at Sierra Gorda (see Fig. 2). The total distance by this route was 564 miles from Salta to Antofagasta, including 202 miles of new construction in Argentina, from Rosario to Huaytiquina, and 238 miles in Chile, from Sierra Gorda to Huaytiquina. By the adopted route the total distance is only 492 miles from Salta to Antofagasta, with 375 miles of new construction.

Climate—Climatic conditions on the first sixty miles of the new line are extremely unfavorable, the rainfall being very heavy during the summer months (December to March). Floods are frequent in the rivers and have made necessary the construction of massive protection walls and retaining walls to protect the line against bank erosion and landslides which are facilitated by the very loose character of the soil. The rains of this year have been of exceptional nature and have served the very useful purpose of demonstrating that the provisions made for the protection of the line are ample and that little difficulty is to be anticipated on this account.

In the higher reaches of the line, the precipitation is very light and there will be no difficulty from snow, as the only district where snowfall is appreciable is in open claim where drifts do not form. Above El. 9,840 the country is barren, but some vegetation (sage and greasewood) is found as high as El. 15,744 ft. and in sufficient quantity to serve as fuel for the grading gangs. The topography is very broken as far as Km. 200 (mile 124) where the undulating plain of the Puna begins.

Grades and Switchbacks—Grades have been kept down to 2.5 per cent throughout and are compensated for curvature, the compensation on curves of minimum radius, 492 ft. (150 meters) being 0.04, bringing the profile grade down to 2.1 per cent.

Curvature is extremely heavy, averaging 133 deg. per kilometer (200 deg. per mile). Tangents aggregate 52 per cent of the total line.

Switchbacks have been found unavoidable in two cases, but are short (2,624 and 3,938 ft.). Both of these are shown in Fig. 5. The tail tracks are 1,190 ft. long, laid out on easy vertical curves and having the ends covered with sand to check trains that may be run too far. The construction of the tail tracks has required in one case the introduction of a 230-ft. tunnel and in the other a small viaduct. Both switchbacks are located at stations, thus reducing the number of halts to a minimum and permitting the station force to look after the operation of the switches.

Bridges and Viaducts—Many important bridges and viaducts are necessitated by the crossing of numerous lateral valleys (see Fig. 1). Viaducts are of the general American type with steel towers on concrete pedestals, the tower spans being 32.8 ft. long and the

FIG. 4—RIO BLANCO STATION AT ENTRANCE TO TORO GORGE

plate girder spans between towers being generally 65.6 ft. Bridge steel is supplied partly from the United States by the McClintic-Marshall Co. and partly from Germany by the Krupp and the Guttehoffnungshutte concerns. Preference has been given to plate girder

construction with trough flooring and all small culverts have solid reinforced concrete floors. Bridge erection so far has been done by local contracting firms, but it is proposed to build some of the larger viaducts ahead of rail by giving the contracts for the erected structures to responsible and experienced firms.

Tunnels and Slide Protection Works—Tunnels will be twenty in number, varying in length from 230 ft. to 1,542 ft. They will be in all classes of material, from loose sand to very hard granite. Typical sections are given in Fig. 6. Complete drilling and compressor machinery has been supplied by the Ingersoll-Rand Co., but many of the tunnels are being excavated by hand. As a general rule the European contractors prefer the top heading method of tunneling, but some tunnels in harder material are being excavated by the usual American system.

In one case the character of the formation has given rise to a very serious difficulty. After completion of the lining the whole side of the mountain (in very badly shattered clay schist) sloughed off, the line of fault passing close to the springing line of the arch, and causing deformation of the lining (16 in. thick at the crown) due to the eccentric thrust of the slide.

To protect the line against slides it has been found advisable to build some 400 ft. of "cut-and-cover" tunnel (Fig. 6), but it is probable that experience will demonstrate the necessity of greatly increasing this figure. In one case the line crosses under a considerable affluent of the Toro in cut-and-cover, as it was found impossible to construct a bridge over it without loosening the support on the sidehill slope.

In the zone of heavy rainfall many heavy retaining walls have been built to protect the line against slides. All walls are of the gravity type. Toes of banks subject to flood attacks have been protected by defence walls. The Toro is the only river that has required work of this class, which has been limited, as far as possible, by carrying the line well up on the slopes beyond the action of the river. In most places bank protection has been carried out in concrete or rubble masonry, but where the action of the river is not particularly to be feared, "sausages" of stone wrapped in woven wire are used with excellent results.

Masonry defence walls at the toes of embankments are constructed with short spur walls or groins at right angles with the main wall, as shown in Fig. 7. These spurs are about 33 ft. long and 66 ft. c. to c. The author's experience of many years in this region has demonstrated the absolute necessity of providing the spur walls to avoid scour and undermining along the main wall.

Shops and Yards—Large shop plants and engine terminals are not required, in view of the proximity of the State Railway shops at Tafi Viejo. The roundhouse at Salta (which will be the starting point for all trains) will be enlarged and put in condition to handle the heavy locomotive equipment.

Temporary shops for construction purposes at Quijano, six miles from Rosario, are equipped with machine tools, oxy-acetylene and electric welding plants and everything necessary for the repair of the locomotive and motor-truck equipment.

Construction Plant—Two 70-ton Bucyrus steam shovels will be put to work for ballast and bank widening, using the American-built standard 30-ton side-and-

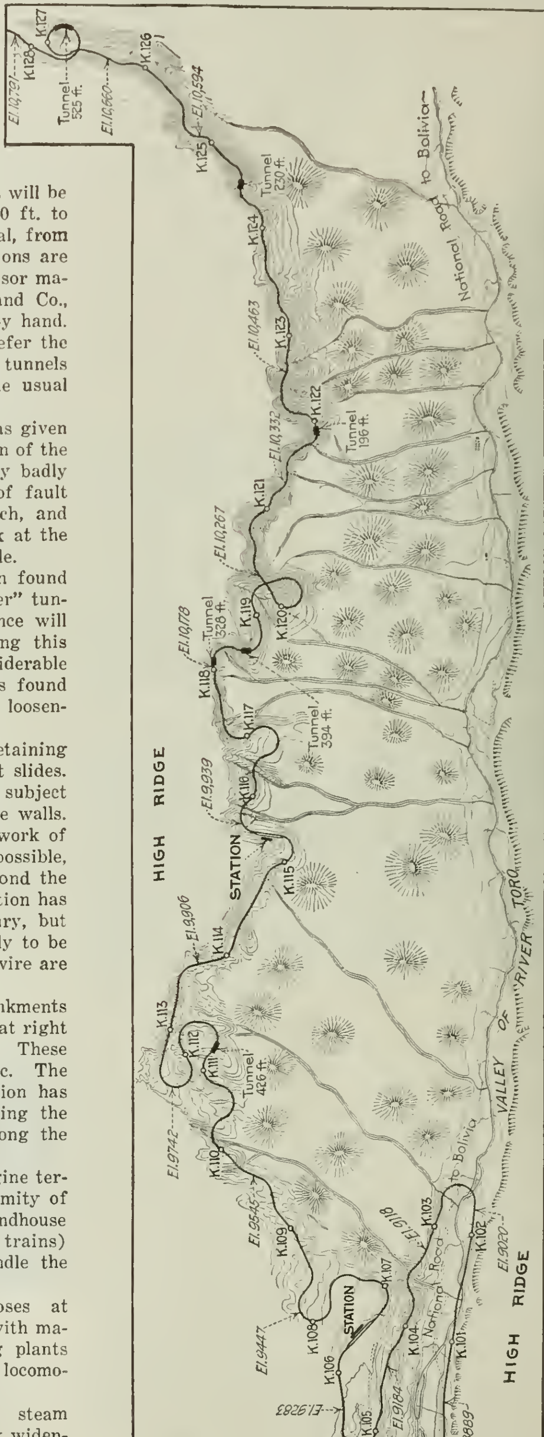

FIG. 3—DEVELOPMENT IN CLIMBING OUT OF TORO RIVER GORGE
Showing the two spirals and many loops used in gaining height at the expense of distance in this section.

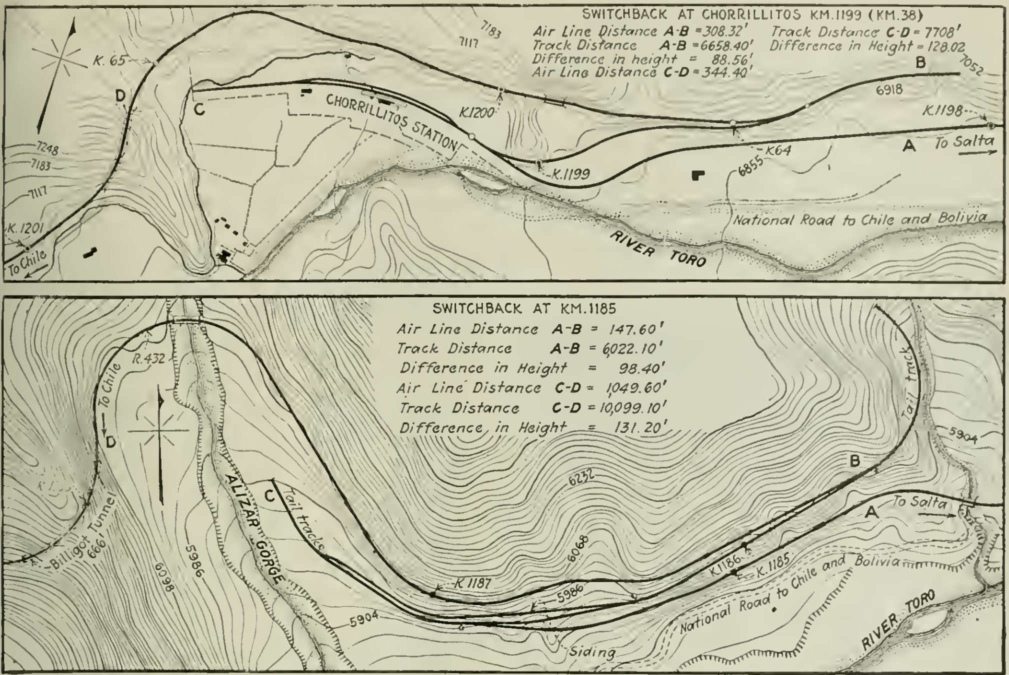

FIG. 5—SWITCHBACKS ON NEW TRANSANDINE RAILWAY

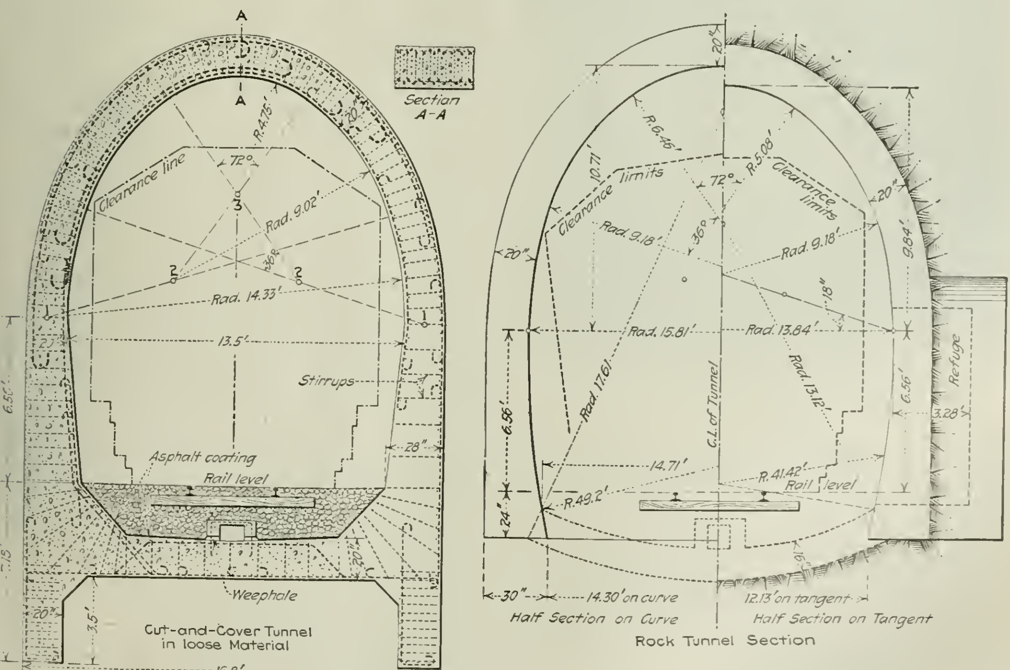

FIG. 6—ROCK TUNNELS AND GALLERIES IN LOOSE MATERIAL

center dump cars built for the State Railways by the Rodgers Ballast Car Co. and the Middletown Car Co. Earthwork has been attacked about 100 miles beyond the rail-head, supplies being carried in by carts and motor trucks. Practically all bridge and culvert masonry has also been completed ahead of rail.

Labor Conditions—All skilled labor is European or Argentine, there being practically no Americans in this part of the world. The peons are mostly natives from the hill country, Bolivians and Chileans, no others can stand the work in the high altitudes. Even with labor accustomed to the conditions, mountain sickness is very common.

Contractors pay by piece work, treating with the head man of each group of workmen. Working hours for men on the Administration force account are eight hours a day and the average daily pay the equivalent of $2 U. S. gold.

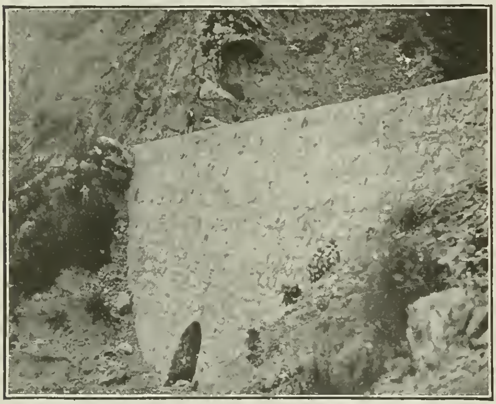

FIG. 7—MASONRY WORK ON TRANSANDINE LINE
Above: Concrete wall and groins protecting railway bank from flood erosion.
Below: Stone wall 45 ft. high to hold fill across ravine.

Engineering Staff—For construction the work is divided into sections (five at present), each under a sectional engineer with a full staff of assistants and inspectors. Each section is responsible for the laying out, inspection and payment for all work, as well as for the requisitioning and supply of material to the contractors and company forces.

Six survey parties are in the field, each chief of party reporting directly to the chief engineer. In difficult country, all surveys are revised by a second party, where possible, to avoid errors of omission in grasping the possibilities of the country.

Progress—The rail-head on Feb. 1 was at Km. 70 (43½ miles from Rosario de Lerma); earthwork was contracted and practically finished up to Km. 140 (mile 47) and was well under way out to Km. 200 (mile 124). No work had been contracted ahead of this point. Advance of the rail-head will be delayed for some months by uncompleted tunnel work, but should reach San Antonio early in 1924. Work from Socompa eastward, on Argentine territory, will be started shortly and it is hoped to have the rails at the frontier by 1926.

Work on the Chilean section has been limited to surveys, but a diplomatic agreement between the two governments will require construction to be started at once. This agreement has yet to be ratified by the Chilean Congress. The work to be done in Chile is comparatively light, consisting of the construction of about 74½ miles of line and reconstructing to meter gage the 95½ miles of 30.4-in. gage from Augusta Victoria to Antofagasta.

Track and Signals—Track on the Argentine section is being constructed in a very substantial manner. Rails are 75 and 80 lb. per yard, laid on red quebracho ties 4.8 x 9.6-in. and 6.56 ft. long, with 2,400 ties per mile. The roadbed is heavily ballasted with broken stone or clean river gravel and has liberal ditching. All stations will be protected by home and distant signals. Train movement will be controlled by the absolute staff system and in addition the Western Electric Co.'s system of train control will be installed at all stations. The operation of trains through the switchbacks will be protected by electric interlocking, while all main-line switches will be equipped with mechanical interlocking, working in conjunction with the signals. In short, the line will be put in condition to handle an intensive traffic efficiently.

Equipment and Traffic—Locomotive equipment includes ten Baldwin engines of the 2:10:2 type, six 4:8:2 and one 2:8:2. Those of the first two types are oil burners and are the most powerful locomotives in use in the Argentine Republic. The equipment includes sixteen motor trucks of 4- and 7-ton capacity and eighty cars of different types, but mostly flat cars. This equipment is supplemented with some 160 six-mule carts and a large number of pack animals.

This railway project is the most ambitious that has been undertaken in South America, limiting conditions of grade such as are here employed never having been attempted in crossing the main chain of the Andes. But the additional cost due to the low grades will be amply justified by the reduction in cost of operating. Freight traffic in sight, discounting increase due to opening up a rich country, is estimated at 478,000 metric tons annually, of which 220,000 tons is eastbound and 230,000 tons westbound and 28,000 tons local business. Passenger traffic will require a daily train in each direction. As the capacity of the 2:10:2 locomotives is 460 tons on the maximum grades, the line will have to provide at once a service of four or five daily trains in each direction.

Great credit must be given to the Argentine Government authorities and the officers of the Argentine State Railways for the courage with which they confronted this great work and for the way in which they have kept the working forces in the field supplied with materials and money in face of much opposition.

Notes on the French Industrial Situation

By Our Paris Correspondent

THERE IS but one compelling influence which dominates French economic, industrial and financial spheres today: the necessity for stabilization.

The most urgent reconstructions in France have been undertaken and for the most part carried to completion in the devastated regions where, on June 30 last, 7,875,000 acres out of 8,250,000 acres had been reclaimed and restored to cultivation, 20,000 factories out of 22,900 rebuilt and "reorganized," and 590,000 dwellings rebuilt out of 741,993 destroyed. The population of the invaded districts is today but 400,000 below that of pre-war figures and is already paying taxes to the government of 3 billion francs a year, whereas in 1920 the figure was but 600,000,000 francs.

Building costs are the obvious deterrent from a more intensive construction campaign of the moment, less so with respect to materials than to labor. In spite of this the very necessary reconstruction of the devastated regions, as well as the delayed public works which were left stagnant during the war period, have made a demand for most lines of raw and semi-fabricated materials such as was never before known.

Cement Demands—In so far as this has affected the portland cement industry recent reports of four leading French manufacturing companies are pertinent as to facts and figures showing the present value of such industrial property. Before the war a metric ton of portland cement sold in France for 30 to 35 francs; soon after the armistice it was quoted at 280 francs and today at an average figure of 115 francs, rising to 125 francs in some districts. The before-the-war price was nominally \$7 per ton at the then ruling rate of exchange; that of today (with a six-cent franc) about the same in case the product was bought with American cash by some American firm operating in France, but at a figure which is three and a half times that if the purchaser is a Frenchman buying with francs. This comparison shows the anomalous state of affairs which the American often ignores in quick estimates of the situation in France today.

A. Antoine, of the Bureau des Ponts et Chaussées, upon return from a recent visit to the United States made a report to the Comité Michelin d'Organization Rationalle and the Syndicate of Public Works Contractors, presided over by Monsieur Michelin, the automobile tire manufacturer, on his observations of the comprehensive and elaborate road building being carried out in America.

The mere mention by M. Antoine of 79,000,000 sq.yd. of concrete roadway having been laid in the United States in 1922—7,480 miles of an 18-ft. roadway, or the equivalent of almost the entire length of the Routes Nationales of the first class in France, was received with appalling silence. The next step was to find the ways and means by which this progress might be equaled in France There was the difficulty. Taxation in all its forms on automobile road users in particular, has reached the limit of tolerance. Above all he argued for the use of concrete as being the material which gave the best results in meeting an intensive light and heavy automobile traffic such as is at present being imposed upon the *macadam* and *tresaguet* French highways, which they were never intended to stand up under. His statement that such a road surface would, if properly laid as in America, last twenty years with a low maintenance cost was especially well received by the French authorities who well recognize the necessity of adopting some rapid and efficient measure which shall lift French roads out of the slough into which they were fast falling. It is claimed that all the raw material required for such roads can be found within the French frontiers. It is doubtful if the same can be said of the new machinery which will be required. For many kinds of modern machinery adapted to uses which were formerly carried out by manual labor, France is still dependent upon the outside world.

Housing Progress—Various organizations in France, without any specific government encouragement, are occupying themselves with low-priced dwellings for an ever increasing suburban population as distinct from town dwellers or the purely rural population. Italy, on the contrary, through a government department is actually offering financial aid to private enterprise in this direction. Belgium has a government-controlled standardization bureau where building materials of various kinds are offered at a "standardized" price.

In France private initiative alone has been able to show a homeless and home-desiring public—first by necessity in the devastated regions and later in suburban Paris, Bordeaux, Lyons and Marseilles—how to build a modest dwelling in a third of the time ordinarily required and at half or two-thirds the cost of construction by old methods. The following prices are quoted for the construction of small dwellings for workingmen in the Paris district:

	Two-Room	Three-Room	Four-Room
	(Prices in Francs at \$0.06)		
Wood chalet	6,000	9,975	......
Staff construction	5,940	8,335	......
Wood and plaster	6,400	9,770	12,500
Agglomerated slag brick	7,950	11,150	17,000
Compressed cement blocks and binder (System Charpentier—Etablissements Charpentier, 188 Boulevard St. Germain, Paris)	5,900	8,500	11,400

Some fifty-odd structures after the last mentioned method (compressed concrete blocks with a cement binder forced into the joints under pressure) have been erected by this firm, which abandoned a long traditional career to espouse this new idea of fabricating the modest cottage home at a lower figure and in a more solid manner than was known before. The figures translated into dollars, \$360, \$510 and \$684, respectively, are certainly cheap. The owner's handkerchief-plot of land may well be had for the equivalent of another \$150 within ten miles of the Paris fortifications. Here, perhaps, is the solution of a big economic problem.

Not wholly unrelated to the above project is that of the city of Paris which proposes, by competition, to erect a series of workers' tenement buildings. The plan is for the moment checked by reason of the attitude taken by the Society of Federated Architects. When it was learned that the project was to be carried out by four *salaried* architects whose designs should be accepted, a protest was made to the effect that such an arrangement would be the "reduction of a high class profession to that of a mere city employe without position or dignity or proportional honoraria." There the matter stands. The French are like that—sometimes.

Metal Production—Aside from the wholly enviable situation of France as a self-producing country in most things of the table its prime position in metallurgical affairs is what gives, or will give, it a predominant influence in European metal markets. Indeed, the part that France is likely to play in the export metal market, even to structural steel shapes and almost everything except wire, plates and sheets, can hardly be estimated as yet in view of the liquidity of the situation. Certain well-informed French "journals of opinion"—not what we know as newspapers, be it remarked, but printed sheets which are all potent in France—are daily urging an association of Ruhr and Lorraine metallurgical interests to control the combined output of the two contiguous regions, a plan which, if followed, will combine to make the most formidable iron and steel and allied industry—trust, consortium, call it what you will—in the world. The proposition is not without a logical backing. The ways and means have yet to be provided but there is an undoubted disposition on the part of many French and German elements tending toward this as a possible solution of a problem which is daily becoming more and more obscured by outside issues.

As to the possibility of France becoming a world factor in metallurgical affairs the following figures eloquently point the way:

FRENCH EXPORTS, FIRST SIX MONTHS, 1923

	Francs
Pig iron	128,897,000
Ferro-alloys	10,221,000
Semi-finished and finished iron and steel products	555,378,000

FRENCH EXPORTS TO UNITED STATES DURING ONE MONTH OF 1923

	Francs
Pig iron	3,950,000
Iron and steel products	1,440,000
Machinery and parts	1,378,000
Tools and manufactures of metal	1,424,000

Employment—That the French workingman, whatever be his trade, is well occupied is shown by the figures of the French Foreign Labor Bureau for the week of July 30 to August 4. There were actually placed 5,677 foreigners, including 2,307 Poles, 1,925 Italians, 511 Belgians, 239 Spaniards, etc. Of this number the iron mines took 85, coal mines 239, navvys accounted for 439, building trades 956, laborers 1,115, agricultural laborers 1,655, etc.

The trades union authorities in France have recently opened a "consultation" as to the actual operation of "workers' councils," or shop committees, where they have been introduced. This movement shows with what precision of detail the communists, the French political party, with representatives in parliament, with which the movement is associated, are studying the ways and means of replacing the power of the employer and capitalist at some future day with some species of sovietic regime and organization. It seems almost futile that they should hold out for any such solution in France, for the country and its people are by intent, preference and tradition wholly against interference with individual rights, among workers as among others.

Transportation—One of the biggest canalization jobs ever undertaken in western Europe is about to come into being in making the River Rhone navigable between France and Switzerland—Lyons in mid-France to Geneva at the western end of Lake Leman. France, in order to be sure of a sufficient water supply at all times, insists that Switzerland shall first raise the level of Lake Leman. Switzerland claims that this would prove a real inconvenience to river property owners and dwellers on the shores. At the last meeting of the International Rhone Conference the Swiss delegates demanded that Swiss barges and canal boats should be free of French taxes on their voyage from Geneva to the Mediterranean, the proposition being rejected or ignored by the French delegates. The reply of Switzerland was to protest that the level of Lake Leman could not be raised.

A big lock is to be built at Genissat between the Swiss frontier and Lyons and a great distributing port just outside of Lyons down-river. The entire work is merely under discussion and economic and political interests are at work to block it in favor of a direct railway from Switzerland due west to the twin ports of Nantes and Saint Nazaire, where there remain the embryonic port facilities which were elaborated by the American army in France and which can care for a far more considerable traffic than France alone can feed to them. One or the other or both these projects are bound sooner or later to come into being but financial matters and international common accord are yet to be reconciled.

The channel tunnel between Calais and Dover has come again on the tapis these last days but the French interests have manifestly not the available capital to put into it and British interests are still discussing the possibility of a tunnel being a danger to Great Britain in case of war. Real or fancied bogeys like these are what are holding back the progressives in France.

The already decided electrification scheme for French railways is one aspect which has not suffered from a like lethargy and both the Midi and the Orleans railways have already begun the erection of hydro-electric plants which in from five to ten years will give electric power for the running of trains over the greater part of the minor lines of their respective systems.

Lighthouse Power Increases in 2,600 Years

In describing the new 3010 candlepower harbor light for Port Said, *Engineering*, a British publication, states that: "To Egypt belongs the credit of the erection of the first lighthouse on record, namely, the tower built on the island of Pharos at the mouth of Alexandria Harbor, about 660 years before the Christian era. This tower was 100 feet high and stood as a monument to an ancient civilization until the fourteenth century when it was washed away by the sea. Its light consisted of an open fire of burning wood, and the same practice was followed in all subsequent lighthouses until the beginning of the seventeenth century. Even as late as 1790 the South Foreland lighthouse was merely a beacon fire of coal. The famous Eddystone Lighthouse, in 1759, was lighted by 10 lb. of tallow candles, a clock being provided to ring a bell every half-hour to remind the keeper to snuff them. In 1763 oil lamps with reflectors were used for the lighting of the Mersey Channel, and after the invention of the Argand burner twenty years later oil became the standard illuminant. Mineral oil was introduced in 1872, and the concentric wicks of the Argand burner in due course gave way to the incandescent mantle, which now furnishes light for all the most important lighthouses of the world."

Trapezoidal Portal and Eccentric Heel-Joint of Truss

By Camillo Weiss
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Analysis of statically indeterminate structures is usually laborious and time-consuming unless formulas are available. On the other hand the value of ready-made formulas depends on the exactness of premises and the reliability of typography, both of which should be checked by the discriminating user. A formula well understood is usually of great advantage as to speed and accuracy in practical application. Formulas are therefore given in the present article for a frequently occurring case, namely the trapezoidal portal carrying an unsymmetrical load. This type of structure is encountered more frequently than will be recognized at first sight. It is of common occurrence in the eccentric heel-joints of roof trusses.

Looking back only eight years, the heel-joint problem received considerable space and attention in the technical press, and brought forth some astonishing solutions. Finally, a graphical method was offered by Prof. E. H. Rockwell, in *Engineering News* of Oct. 21, 1915, which implied certain assumptions similar to those underlying this analysis, and which is in good agreement with the analytical method presented in the following discussion.

The relations given below were derived by the slope-deflection method which is described in detail in "Analysis of Statically Indeterminate Structures by the Slope Deflection Method," by W. M. Wilson, F. E. Richart and Camillo Weiss, Bulletin 108, Engineering Experiment Station, University of Illinois.

Trapezoidal Portal—For the portal in Fig. 1, hinged at C and T and carrying a load of R lb., the following relations may be established when deformations due to shear and to direct stresses are neglected:

Bending moment at A, in in.-lb.,

$$M_A = Rl_1\left(1 - \frac{l_1}{p}\right)\frac{\dfrac{l_1}{I_1} + \dfrac{3l_3}{2I_3}}{\dfrac{l_1}{I_1} + \dfrac{l_2}{I_2} + \dfrac{3l_3}{I_3}}$$

Bending moment at B, in in.-lb.,

$$M_B = Rl_1\left(1 - \frac{l_1}{p}\right)\frac{\dfrac{l_2}{I_2} + \dfrac{3l_3}{2I_3}}{\dfrac{l_1}{I_1} + \dfrac{l_2}{I_2} + \dfrac{3l_3}{I_3}}$$

Reactions and direct stresses, in lb.,

$$C = R\frac{l_1}{b}; \qquad T = R\frac{l_1}{a};$$

$$H_1 = \frac{M_A}{l_1}; \qquad H_2 = R\left(1 - \frac{l_1}{p}\right) - H_1$$

In these formulas I_1, I_2 and I_3 are the moments of inertia of the respective members, and l_1, l_2 and l_3, a, b, and p are lengths, in inches, as indicated. It will be noted that the sum of the two moments is

$$M_A + M_B = Rl_1\left(1 - \frac{l_1}{p}\right)$$

This equation, which may be obtained directly from the static conditions of equilibrium, shows that the sum of the two moments is independent of the shape and area of cross-sections. It approaches zero as l_1 approaches p, and equals the quantity Rl_1 if p becomes infinity, and the portal rectangular. This is exactly as should be expected.

Eccentric Heel Joint—The above derivations are immediately applicable to the eccentric heel joint of a roof truss, shown in Fig. 2. The direct stress in the top chord is $C = R\frac{l_1}{b}$, and the direct stress in the bottom chord $T = R\frac{l_1}{a}$. The quantity $\frac{l_3}{I}$ is relatively so small that it may be neglected for all practical purposes, simplifying the equations to

$$M_A = Rl_1\left(1 - \frac{l_1}{p}\right)\frac{\dfrac{l_1}{I_1}}{\dfrac{l_1}{I_1} + \dfrac{l_2}{I_2}}$$

and

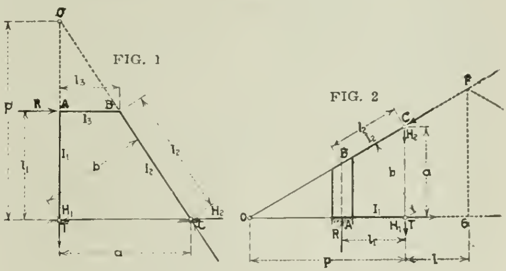
$$M_B = Rl_1\left(1 - \frac{l_1}{p}\right)\frac{\dfrac{l_2}{I_2}}{\dfrac{l_1}{I_1} + \dfrac{l_2}{I_2}}$$

For flat roofs the difference between l_1 and l_2 may also be neglected, furnishing the very simple formulas

$$M_A = Rl_1\left(1 - \frac{l_1}{p}\right)\frac{I_1}{I_1 + I_2}$$

$$M_B = Rl_1\left(1 - \frac{l_1}{p}\right)\frac{I_2}{I_1 + I_2}$$

In all cases the moments at F and G are found by the expressions $M_F = H_2\,l$ and $M_G = H_1\,l$.



DIAGRAMS FOR MOMENT FORMULAS

Nothing has been said so far to fix the location of the points of contraflexure, except that their relative position is implied to be in a vertical plane. The actual location of points C and T will depend on the relative degree of restraint at points A, B, F and G. If points F and G were pin-connected, which assumption underlies all truss analyses for primary stresses, l would be zero, point C would coincide with point F, and point T with point G. If the restraints at A, B, F and G are of equal degree, the points of contraflexure are at the centers of the members AG and BF respectively. Special conditions in any given case will influence the location of the points of contraflexure and require the judgment of the engineer.

Assuming contraflexure at the mid-points, the bending moments at A, B, F and G will be greatest when the end panel is about six-tenths of the full panel length, i.e., if $l + l_1 = 0.6\,(l + p)$. The influence line for these moments, as the heel A moves from O toward G, is part of a hyperbola, the axes of which are inclined toward the line OG.

Rapid Construction of Earth-Fill Dam in California

Half Million Yards of Embankment Constructed in Six Months Using Hydraulic Fill Between Dry-Fill Slope Embankments

By Charles H. Richards
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HENSHAW Dam on the San Luis Rey River, San Diego County, California, was designed and built in eight months and is now impounding water. It is believed that this time establishes a record when the size of the dam and its remoteness from facilities are considered. The nearest railroad point is 40 miles distant and the nearest supply point, San Diego, is 65 miles away. The dam is also at an elevation of 2,700 ft. above sea level and the roads leading to it are generally mountain grades.

The dam was built for the San Diego County Water Co. to impound water for domestic and irrigation supply, the latter being the larger demand. Power will also be developed at various points along the course of delivery. It will impound the runoff from 210 square miles of mountain watershed, with elevations of 2,600 to 5,000 ft. above sea level, and will create a reservoir of 203,000 acre-feet capacity, which will afford a net safe yield of 28,000 acre-feet annually. A characteristic of the San Luis Rey River is its periodic high flood discharge which has been measured as 28,000 cu.ft. per second. It was the possibility of having such a flood condition that necessitated the building of the dam between two rainy seasons.

In the locality of the dam the rock is more or less fractured and did not assure stable foundations for a concrete structure, but core drill exploration of two sites indicated that an earth-fill dam was adaptable. Again a large spillway is necessary to pass the waste flood waters and since the material in the wasteway was suitable for the outer portions of an earth dam, with a hydraulic-fill center, this type was decided upon. The excavation from the spillway was decomposed granite, with relatively small quantities of fines, and therefore it would have been difficult to construct an impervious dam using this material alone. In order to store the coming winter's runoff it was necessary that all possible speed be made in raising the dam. The site was so narrow that it would have been impossible to complete the dam within the required time by the dry-fill process alone, due to team congestion.

As shown by Fig. 1 the main dam is 117 ft. high from the river bed and the core trench was excavated to a depth of 33 ft. below the stream, giving a total height of 150 ft. Owing to the fractured nature of portions of the cutoff trench, holes 2 in. in diameter and about 20 ft. deep were drilled in the bottom. There were two lines of holes, 6 ft. apart and on 6-ft. centers, staggered. Grout under 100 lb. pressure was forced into the rock through these holes.

The slopes on the two faces of the dam are symmetrical, $2\frac{1}{2}$ on 1 for the first 50 ft. and $2\frac{3}{4}$ on 1 for the remaining height. These slopes required a bottom width of 600 ft. and the top width was fixed at 20 ft. The main dam is 650 ft. long and contains 400,000 cu.yd. exclusive of the bottom trench. There were 10,000 cu.yd. in this trench, excavated and placed in the outer toes of the fill. A core trench varying from 13 ft. to 5 ft. in depth and from 8 to 5 ft. in width was carried up the slopes of the abutments connecting at its lower end with the bottom trench. All loose and trashy material was stripped from the abutments.

Two smaller dams adjacent to the main dam, Fig. 1, containing about 50,000 cu.yd. were also constructed during the period of building the main dam. These dams are dry earth fills, sprinkled and tamped with petrolithic rollers.

As indicated by Fig. 1, the upstream faces of all the dams are paved with 4 in. of 1:3:6 concrete, reinforced by 6 x 6-in. wire mesh of welded steel. The concrete was poured in 15-ft. panels, alternate joints being made expansive. The lower 45 ft. of the main dam is riprapped with large boulders to a depth of 3 ft. These boulders were wasted from the dry fill as they delayed the progress of the wagons delivering material. Also the downstream toe of the main dam has a riprap apron 10 ft. deep extending 20 ft. in elevation above the toe. In addition to this apron there is a mattress of large boulders covering the original stream bed to a depth of 10 ft. and extending down stream from the toe 100 ft. for the full width of the canyon. This mattress was placed to protect the toe from the back wash of the spillway discharge. The rocks used average about 20 cu.ft. and were placed by a stiff-leg derrick with a 75-ft. boom.

Accessory Structures—The spillway is practically a continuation of the main dam. It is 10 ft. lower than the dam and has a crest length of 500 ft. After leaving the lip the water will flow down a 1 on 1 slope varying from 5 to 15 ft. deep vertically, into a channel paralleling the lip. This channel is 35 ft. wide at its upper end and 180 ft. at the lower end. From it the water will drop to the stream bed on a $1\frac{3}{4}$ on 1 slope, discharging into the stream after passing over a hydraulic jump designed to reduce the cutting velocity. The wasteway is lined with concrete 6 to 9 in. thick, reinforced with $\frac{3}{8}$-in. corrugated bars on 12-in. centers in both directions. The steel is placed near the top for expansion and contraction stresses. Expansion joints filled with asphaltum are spaced 30 ft. both ways. Cutoff walls of plain concrete are spaced about 100 ft. apart and extend into the rock 2 ft. below the bottom of the concrete. At the point where the stream leaves the concreted section a cutoff wall 5 ft. thick and 15 ft. deep has been constructed. All concrete is 1:3:6.

When the dam was begun it was thought that possibly sufficient height could not be attained before the early rains set in. To provide for this contingency a flood culvert, as shown by Fig. 1, of horseshoe shape, was designed. Crushed rock was not available at that time so a concrete of 1 cement to $2\frac{1}{2}$ sand, heavily reinforced, was used. Gates are not provided, but two recesses, one at the upstream entrance and one at the center of the dam, were left for plugging when the dam was high enough to store possible floods. From these plug recesses 6-in. pipes were carried through the dam to the top to be used later in pouring the concrete in the plugs. The pipe to the central plug was embedded in 3 ft. of concrete which was the thickness of the culvert shell at this point. Notwithstanding this support, the weight of the pipe and the settling of the clay hydraulic fill pulled the pipe 9 in. down through the concrete. A flange on the pipe above the concrete would probably have prevented this.

An outlet tunnel of the section shown by Fig. 1, was bored through the south abutment, lined with concrete and grouted under 100 lb. pressure. On the axis of the main dam a two-compartment shaft 100 ft. deep connects with the tunnel. At the bottom of the compartment nearest the reservoir an emergency wooden gate and a cast-iron gate, both 4 ft. square, are installed. A 36-in. gate connects the two compartments 35 ft. from the bottom. A similar gate 70 ft. from the bottom has also been installed. The four gates are operated from a gate house on top of the dam.

Construction Equipment—Four steam shovels with $\frac{7}{8}$-cu.yd. buckets were used in the excavation, each working two nine-hour shifts for six days a week. The material in the dry fill was hauled from the shovels in $1\frac{1}{2}$-cu.yd. dump wagons drawn by two mules. When the grade became too steep, snatch teams, tractors and electric hoists were utilized to assist the single team. When tractors were used, two wagons were coupled into a train. A maximum of 2,800 cu.yd. was obtained in one day of two shifts, or an average of 466 cu.yd. per shovel per nine-hour shift for each of the three shovels. The maximum for one shovel for one nine-hour shift was 809 cu.yd. A large fresno, with shovel teeth, was built to pull the material from the $1\frac{3}{4}$ on 1 slopes in the spillway to a point where the shovels could pick it up. This was operated by a 50-hp. double-drum motor, having a $\frac{5}{8}$-in. tail rope leading to blocks on a cable strung across the top of the steep slope, while a $\frac{3}{4}$-in. cable was used to drag the scraper with its load.

The hydraulicking equipment was in duplicate, each unit consisting of one 10-in. two-stage, centrifugal pump and two 12 x 30-in. single-stage centrifugal rock pumps. The 10-in. pump delivered 7 sec.-ft. at 140 lb. pressure at the nozzle, which was 1,000 ft. away at its maximum distance, and was driven by a 400-hp. motor.

The pipe used was 10 in. in diameter, of flanged, riveted steel. This pipe carried the water to 3-in. giant nozzles, used to break and wash down the clay banks. From these faces the material flowed through ground sluice ditches on a 3 per cent grade to the 12-in. rock pumps. These pumps required 10 sec.-ft. of water, therefore an auxiliary supply of 3 sec.-ft. was delivered to them. The average of solids transported was 9.6 per cent. From these pumps the material was transported to the dam 2,000 ft. away, through 12-in. diameter welded slip-joint pipe, the steel composing it being known as hard red metal. Two hundred horsepower variable-speed motors were direct-connected to the rock pumps. The pumps were lined with white iron, the liners lasting for about 50,000 cu.yd. before renewal was required. Power under 22,000 v. was brought in through a line 18 miles long. A synchronous condenser of 350 amp. was installed at the dam to improve the load factor, etc.

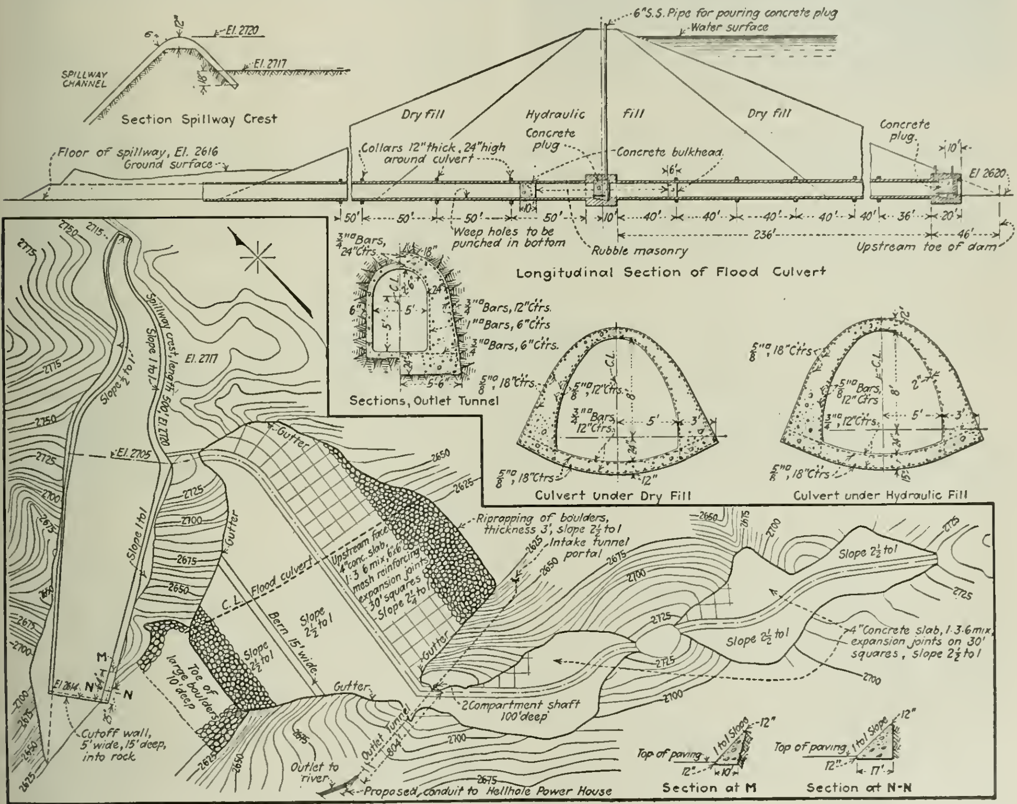


FIG. 1—PLAN, SECTION AND STRUCTURES OF THE HENSHAW DAM

FIG. 2—UPSTREAM SEAL OF FINE CLAY DISCARDED FROM HYDRAULIC FILL

To insure a continuous supply of power, a standby electric plant was installed at the dam. This consisted of two 200-hp. semi-Diesel engines, each direct-connected to a 176-kw. alternator.

Portable compressors were used for furnishing air to the drills. Small drills and a large churn drill boring 6-in. holes were used in the excavation of the spillway.

This analysis shows a relatively large fine clay content. With the fast schedule of construction it was deemed desirable to waste some of these fines as several notable examples of failure of hydraulic-fill dams indicated the danger of rapidly building a dam of this type with a large per cent of very fine material. The fines were allowed to flow off with the excess of water and were deposited above the upper toe of the dam, making an effective seal on the sand at this point. This condition is shown in Fig. 2.

A mechanical analysis of a sample of the clay core material after deposition was as follows:

2-1 mm. (F. G.)	1.560
1-5 mm.	1.560
.5-.25 mm.	1.600
.25-.10 mm.	18.040
.10-.05 mm.	58.662
.05-.005 mm.	12.948
.005 mm.	5.846
	100.216

The sandy portions of the fill had 26.4 per cent voids and weighed 111 lb. per cubic foot in place, while the clay portion weighed 120 lb. per cubic foot when dried to the consistency of putty.

When the dry-fill toes had reached the point where they were too narrow to work teams, dry-fill material

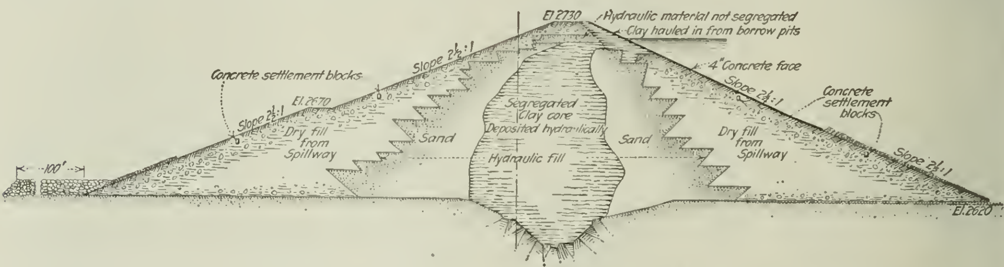


FIG. 3—CROSS-SECTION SHOWING DEPOSITION OF EMBANKMENT MATERIALS

Method of Placing Fills—The dry fill was placed by wagons, spread with small mormon scrapers, and kept wet by sprinkling. Tamping was accomplished by the continual stream of wagons and mules; 1 cu.yd. of loose material compacted to 0.8 cu.yd. in the dam and weighed 3,510 lb. per cubic yard in place. A large percentage of rock was incorporated in the dry fill, particularly on the down-stream toe. An excess of rock made the going too severe for the wagons; when this condition arose the larger rocks were placed on the faces of the dam to form riprap protection. There has been 13 in. of rain on the slopes unprotected by riprap and due to the rocky nature of the face, washing has not taken place. The dry fill was carried approximately 10 ft. above the water level of the summit pool used in the separation of materials in the hydraulic fill.

The hydraulic fill material in the borrow pits was approximately 66 per cent sand and gravel and 33 per cent clay, and analyzed as follows:

Per cent passing 200 mesh	22.30
Per cent passing 100 mesh	39.50
Per cent passing 80 mesh	52.50
Per cent passing 50 mesh	66.00
Per cent passing 40 mesh	72.80
Per cent passing 30 mesh	80.00
Per cent passing 20 mesh	89.60
Per cent passing 10 mesh	98.45
Material washed out, per cent	34.25
Per cent material passing after washing	20.75
Total fines washed out and passing 100 mesh, per cent	55.00

Abrams test for humus indicated a small quantity of organic matter.

was dumped upon the sand beaches of the hydraulic fill. These could then be driven on in two or three hours after placing. This method gave an inverted saw-tooth profile, Fig. 3, to the line between the sand beaches and the dry fill. The progress of the various units of the work governed this line to a large degree. A delay to either of the fills usually meant an encroachment beyond the theoretical line between the fills. These theoretical lines were established by survey and were followed generally, being deviated from only when necessary to avoid stoppage of work.

The hydraulic-fill material was brought through pipes and deposited in about 5 ft. of water, Figs. 4 and 5. A maximum of 3,000 cu.yd. in 24 hours was sluiced out of the borrow pits and when placed in the dam increased in volume by 16 per cent due to the separation of the clay from the voids in the sands. An average of 65,000 cu.yd. per month was obtained, while putting in the bottom portion of the dam. A 16-in. overflow pipe made up of double well casing in 24-in. lengths carried the surplus water back to the reservoir where it was again used for transporting clay to the dam. A collapse of an angle in this pipe was the only defect in the hydraulic equipment.

Test Results—Continuous tests were made of the consolidation if the clay core, using a 6-in. cast-iron ball as the measure of penetration with the following results:

Date	Elevation of Water Surface	Depth to Clay	Penetration in Clay
Sept. 15	2632	4.0	5.2
Oct. 1	2645	3.0	5.4
Oct. 8	2663	5.0	6.2
Oct. 17	2675	7.0	5.1
Oct. 19	2675	5.0	2.7(1)
Oct. 23	2682	9.0	3.0(2)
Oct. 30	2688	4.0	3.0(3)
Nov. 10	2692	3.0	3.5(4)
Nov. 17	2702	6.4	3.3(1)
Nov. 27	2713	3.0	2.0(1)

(1) Average of three; (2) Average of five; (3) Average of two; (4) Average of four.

In addition to these tests, holes were drilled through the culvert into the clay and fitted with 2-in. pipes with valves. Pressure gages were connected at various times and the pressures recorded. On Oct. 19 when the static head on the clay and gravels was 50 ft., the water pressure recorded in the gravels was 8 lb. per square inch and the pressure in the clay was 5 lb. per square inch. When this pressure obtained, the 2-in. pipe would exude the clay material at the rate of 0.13 cu.ft. in one hour. With the clay in this condition a 1¼-in. pipe could be worked into it by one man for a distance of 7 ft. On January 31, 1923, no pressure showed in the clay. No exudation took place in twelve hours and a ⅝-in. bar sharpened at one end could be pushed into the clay for a distance of 5½ ft. showing a very high degree of consolidation.

Tests were made to determine the settlement of the dam. Blocks of concrete were set on each face (Fig. 1) at points one-third and two-thirds of the vertical height above the river bed. Two per cent was added to allow for shrinkage. The following table indicates both the vertical and horizontal movements of the mass.

Upstream Blocks, One-third Way Up; Average of Two.

Date	Vertical Movement	Horizontal Movement
Sept. 13, 1922	0.0′	0.0′
Jan. 2, 1923	0.16′	0.175′ up stream

Upstream Blocks, Two-third Way Up; Average of Two.

Date	Vertical Movement	Horizontal Movement
Oct. 26, 1922	0.0′	0.0′
Jan. 27, 1923	0.39′	0.025′ down stream

Downstream Blocks, One-third Way Up; Average of Two.

Date	Vertical Movement	Horizontal Movement
Sept. 13, 1922	0.0′	0.0′
Jan. 27, 1923	0.29′	0.09′ down stream

Downstream Blocks, Two-third Way Up.

Date	Vertical Movement	Horizontal Movement
Oct. 26, 1922	0.0′	0.0′
Jan. 27, 1923	0.47′	0.04′ up stream

Top of Dam.

Date	Vertical Movement	Horizontal Movement
Jan. 1, 1923	0.0′	——
Jan. 27, 1923	0.15′	——

The dam and reservoir are the fulfilment of the dreams of many people and the project has been under consideration for some thirty years. The realization has been possible only through the foresight and financial courage of Wm. G. Henshaw of San Francisco, Calif., President of the San Diego County Water Co., and John Treanor of Los Angeles, manager of Mr. Henshaw's business affairs in Southern California.

FIG. 4—BEACHES AND POOL OF HYDRAULIC FILL NEAR TOP OF DAM

FIG. 5—PLACING LAST LIFT OF CLAY CORE

Henshaw Dam was built on a cost-plus-a-fixed-fee contract, with bonus and penalty clauses. Bent Brothers of Los Angeles, Calif., were the contractors, their superintendent M. H. Slocum being in charge. The late R. C. Starr, of Thebo, Starr & Anderton, San Francisco, Calif., acted as consulting engineer. J. B. Lippincott, of Los Angeles, is the chief engineer for the San Diego County Water Co. and the writer was construction engineer in charge of the work at the dam.

Cut Building Cost and Increase Floor Space by Study of Plans

A REDUCTION of $250,000 in cost and an increase of income in the Straus office building now under construction in Chicago, has been effected by submitting the plans to the National Association of Building Owners and Managers for criticism and suggestions as to interior arrangement and equipment.

According to a statement by the owners, the lateral corridor space between the two banks of elevators from the first to the 13th floors, where express cars will not stop, is to be utilized for extra office space. From the 16th to the 21st floors the elevator corridor space in front of the local elevators will be used for office space not previously planned. This arrangement, together with the gain made by making the walls of the interior court perpendicular instead of terraced, is said to give additional rental area equivalent to adding about $24,000 to the annual income from the building. Further, the elimination of a set-back in the central court at a cost of $50,000 gave additional rentable space equivalent to $25,000 annually.

Chair rails on office walls were eliminated, as it was considered that they do not protect the walls, and with thousands of feet of rail at 35c. per foot the saving was appreciable. Other savings were effected by eliminating sidewalk lights, locks on inside office doors, exterior windows in elevator banks, and one stack of toilets throughout the building.

The Straus building, now under construction, will be 32 stories high and its estimated cost is $15,000,000. Graham, Anderson, Probst & White are the architects for S. W. Straus & Co.

State Engineering In the Highway Bridge Field

Being a Discussion of How Seriously the Field of Private Practice Is Affected By State Highway Bridge Design, By Searcy B. Slack, Atlanta, Ga., and M. W. Torkelson, Madison, Wis.

Charges made against state highway departments by bridge companies and engineers in private practice assert that bridges designed by the state are wasteful, that the engineers employed by the state are incompetent and lack experience, and that the public money would be spent to much better advantage if private engineers were employed to design the bridges. In contrast to present methods, the virtues of the old-time bridge-builder and the methods of a quarter-century ago were extolled by a correspondent in Engineering News-Record *of Sept. 28 last, p. 533. The editors have been urged by other correspondents to denounce the paternalistic system of state bridge engineering and advocate a return to freely competitive practice in the interests of the public as well as of consulting and contracting engineers. A committee of the American Association of Engineers has just taken up the study of how seriously state highway bridge design injures the field of private engineers. In Maine a public statement by the governor recently declared that less costly bridge construction would be adopted; a complete reply to this statement was given by L. N. Edwards, the state's bridge engineer, in the issue of April 19, p. 720. In order to develop the facts of the whole situation,* Engineering News-Record *asked a number of state highway engineers for facts and views. Below are given two of the replies to this inquiry. Without a single reference to the notorious "bridge letting" conditions of an earlier generation they nevertheless picture very clearly certain evils of former practices, now largely eliminated by the effect of state control. At the same time the two articles suggest certain professional problems of the present day.* —EDITOR.

Former and Present Problems in the Southeast

By Searcy B. Slack
Bridge Engineer, Georgia Highway Department, Atlanta

UNTIL the comparatively recent organization of the state highway departments, except on the large projects and work in a few progressive counties, highway bridge engineering in the Southeast was conspicuous by its absence. The road and bridge work was handled entirely by the county officials, who were generally inexperienced, and exploitation of the field by unscrupulous salesmen and so-called bridge men was the natural result. Honest companies found it difficult to sell good bridges in the face of such competition, and practically all companies were forced to furnish "free engineering." As a result the people, as well as the county officials, did not know what constituted good bridge work and there was little demand for highway bridge engineers.

Realizing the serious side of this situation, in 1912 the engineering department of the University of Georgia organized a good-roads department. The primary object of this department was to help the counties with the road and bridge work and incidentally, by education, to create a demand for highway and bridge engineering. A similar movement was later started in several of the neighboring states. Funds available for this educational work were limited, however, and while good work was being done, it was making slow progress.

With the passage of the Federal Aid road act in 1916, requiring the organization of a state highway department before a state could participate in federal aid, highway engineering took a new lease on life. Highway departments were organized, and work on a better basis was started on the highways and highway bridges. Since this time the education of the county officials and the public in highway and bridge work has advanced rapidly, and there is now some demand for highway bridge engineering. Naturally the counties are turning to the agencies most responsible for the advance of their education and are calling upon the state highway departments for services which possibly could be more properly rendered by county engineers or practicing engineers. Before the organized highway movement, however, both highway and bridge engineers had, in a large measure, failed in selling their services.

Now that the "good roads" movement has gained great headway and there is some demand for highway bridge engineering, it is a proper time for a discussion within the profession concerning the extent to which it is wise to centralize highway bridge work in state and federal departments. There is undoubtedly a field for both the state highway bridge engineers and the specialized bridge expert. The extent of the fields will vary widely with individual cases. The state departments must needs handle a wide variety of structures, the great majority of which a practicing engineer could not economically handle. In exceptional cases, however, such as deep foundations, spans of unusual lengths or unusual movable bridges, expert advice and direction is generally needed.

Many thoughtful people are beginning to catch a glimpse in retrospect of the exploitation and abuses which have been going on at the hands of both bridge companies and engineers, and as a result demand some kind of general supervision by a recognized state agency. Matters of concern to the engineering profession are the abuses within the profession which are so largely responsible for shaking public confidence in engineers. These abuses are quite general, but a few specific examples of more glaring cases may be cited.

An engineering firm with an established reputation in another line accepted design work on several highway bridges. The first bridge or two which they designed proved both unsightly and not economical. Subsequently they accepted designs prepared by a bridge company for several other bridges. Later the board by whom they were employed learned that the engineers had accepted a fee for designs which they had not prepared and on which they were really not competent to pass.

In several cases dissatisfaction has been caused by so-called customary clauses in specifications prepared by

engineers. To the lay mind a fee for the "preparation of plans and supervision of construction" includes all necessary engineering after field work and borings. Some engineers accept fees for this work and then write into the specifications clauses requiring the contractors to pay for testing and all engineering help, except usually the resident engineer, and further require the contractor to furnish the resident engineer an office near the job. When some enterprising layman finds this out after contracts are all signed and work has started he is sure that the engineers are not playing fair. The practice may or may not be right, but by the general public it will certainly be regarded as a questionable practice.

Examples of abuses and foolish designing are, unfortunately, not unusual. Bridge engineers occupy positions of public trust, and no effort should be spared to secure proper standing before the public, but until a more concerted and sincere effort is made by engineers themselves to correct abuses and prevent exploitation, only meager results in securing recognition of professional standing may be expected.

There is a strong sentiment throughout the country for organization of government along business lines. Nearly all large, well organized corporations engaged in a business involving engineering have a staff of engineers capable of carrying out practically any work which is undertaken. If special help on any particularly difficult problem is needed, a consulting engineer is called on to assist the regular engineering staff. In this case the consulting engineer is selected and his work is passed upon by men who are qualified to judge such matters. This system has justified itself economically in the business world. Everyone looks forward to the day when government departments will be organized in such a manner that they can be justified economically. It behooves both the state bridge engineers and the consulting bridge engineers to justify themselves from the purely business point of view and to work together in upbuilding the engineering profession.

* * *

State Work in Wisconsin Has Improved Bridges and Engineering

By M. W. Torkelson
Engineer-Secretary, Wisconsin Highway Commission, Madison

OBJECTIONS made by private engineers and bridge contractors to the practice prevailing in many states of having bridges designed by the state highway departments charge two kinds of waste, that resulting from extravagant notions on the part of state designers concerning the kind of bridge needed, and that due to the incompetence of state designers. When incompetence is alleged it is variously charged to the low salaries paid, to the youth of the men concerned, or to their being state employees and therefore lacking in that progressiveness which is produced only by competitively sharpened wits.

Bad Bridge Work of the Past—Back in 1907, when our state highway department, with advisory powers only, began the work of giving engineering assistance to municipalities desiring to build roads and bridges, both road work and bridge work were in a deplorable state, particularly bridge work, which was not only poorly designed and poorly built but oftentimes carried out with a great deal of plain graft; I know whereof I speak. Contractors and engineers in private practice had been in the field a great many years and had not improved conditions. I believe it is not going too far to say that the improvement in ordinary highway bridge design is due entirely to the activities of the state highway departments.

It may be true that some of the men employed in state departments are incompetent. It certainly is true that many of them are young and that they are underpaid, but all of these objections can be met. Remove those who are incompetent and replace them with other men who are competent; raise the salaries of those who are underpaid. The youth of the remainder will correct itself if given time. There is no proof that engineers in private practice are any more competent than those employed by the state, and certainly those are rare who have the experience in this particular line that is possessed by any one of a dozen state bridge engineers.

Private Engineers and Lawyers—Engineers in private practice claim that the state department is depriving them of business which is theirs legitimately. These engineers never occupied the field when it was vacant. The ordinary township official never would pay a cent for engineering service; he was skeptical of its value, and distrustful of any individual who came to him standing to profit through the transaction. If the engineers in private practice can go out now and continue to get the business, it is because the state departments have educated the public up to an appreciation of the value of engineering services.

Certainly engineers are not the only professional men that the state employs. One of the constitutional officers is the Attorney General, who employs a considerable staff of men belonging to the legal profession. It has never been thought advisable for the state to farm out its legal business in an attempt to advance the interests of the legal fraternity.

Co-operative Spirit—The Wisconsin highway commission has never solicited the employment of its services. Where local officers have shown the slightest tendency to employ the services of an outside engineer, the state department has withdrawn as gracefully as possible. It has never entered a city even on invitation of the city officials unless it was plain that a refusal to do the work desired would result in a bridge letting under the old conditions, where there would be no standards of any kind whatever. Whenever any engineer in private practice has made a request for any information in the possession of the commission, the information has been cheerfully and immediately furnished. We believe that the more engineering there is on our public work, the better it will be.

Before the state entered the field there were less tnan a half dozen engineering firms, most of them struggling for a precarious existence. At the present time there is not a single one of the good-sized cities of the state but supports an engineer in private practice, and the most of them are not only existing, they are prospering. And the state highway department in a number of instances has been able to give them business where otherwise municipalities would have undertaken the work in the most unscientific manner. I have in mind a small city which found it necessary to increase its water supply. One of the highway commission's engineers happened to have a conversation with a member of the board of public works and learned that they were just

about to conclude arrangements with a well driller to go ahead and dig a well, on the chance of striking water. Through the representations of this employee of the highway commission, the city council became convinced of the necessity of making some tests before digging the well, and after making investigations of various engineers finally employed a competent waterworks engineer.

Charges of Waste—I do not believe that our highway department has ever constructed any bridges very much in excess of minimum needs. Where we have spent some money in an attempt to produce a pleasing effect in the appearance of the work, this has invariably had the greatest appreciation. I remember one county where we had a hard time getting started, because of a hard-boiled county committee, but the committee was pleased with the first bridge and built several, each an improvement in appearance over the one before; finally, a survey for another bridge came in from that county with the request that I "spread myself" on that job.

I have no doubt that cheaper bridges could have been built in some cases, but this would be through a resort to the time-honored process of skinning the job. And as a man cannot, by taking thought, add one cubit to his stature, neither can he by any mathematical process replace the strength and durability lost by cutting out materials that are needed for an enduring piece of bridge work.

I do not believe that a state department should attempt to monopolize the field, but where it can perform a service it should not hold back. This is the policy we have tried to live up to in Wisconsin and we believe it is the correct one. I think there is a place for the state highway departments and for the consulting engineers as well, and that each will be better off because of the prosperity of the other.

Ten Years' Progress in Lighthouse Engineering

AT THE International Congress of Navigation held in July in London (see *Engineering News-Record*, Aug. 2, 1923, p. 175) one section was devoted to the subject "Principal Advances Made Recently in Lighting, Beaconing and Signaling of Coasts." Two of the papers, abstracted here, indicate the recent developments in this, one of the oldest of the engineer's arts. The first abstract is from a paper by George R. Putnam, United States Commissioner of Lighthouses, and a delegate to the Congress, and the second is by the General Reporter of the Section, D. W. Hood, engineer-in-chief to the Corporation of Trinity House (the British lighthouse service).

United States Developments (G. R. Putnam)—The most important advance in lighthouse work in the United States is the establishment of radio fog signals. The lighthouse service on May 1, 1921, placed in operation three radio fog signals in the vicinity of New York harbor, and a number of additional stations have been established or are now being prepared. Each station during fog or low visibility automatically sends radio signals on a 1,000-meter wave length, with a distinctive characteristic. Such signals are used by vessels equipped with radio compasses, and reliable results are being obtained.

Bells operated automatically by carbon dioxide gas have been installed on several buoys and at beacons, taking the place of attended aids, at a large saving. The oscillator, a heavy metal diaphragm electrically vibrated, has been tested for use as a submarine fog signal.

The proportion of sirens and diaphones has been increased, and of steam whistles diminished. A number of distantly controlled fog signals have been installed. A gong buoy, provided with four gongs, has been designed to give a signal distinctive from that of the ordinary bell buoy, and is in successful service.

A great advance has been made in lighted buoys, the number having nearly doubled, and the types improved; there are now 638 in service. The most efficient thus far is the type using dissolved acetylene gas. Over 100 outside lighted sea buoys have been established, supplementing the lightships. Tall type iron buoys have been extensively employed in recent years, and can be more easily seen. A small and inexpensive type of buoy built of thin steel plate has been introduced recently to replace wooden spar buoys in channels subject to ice conditions and heavy traffic.

The United States lighthouse service has in commission 117 tenders and lightvessels and steady progress has been made in improving their design. The latest lightvessels are provided with propelling power, usually steam plants burning oil, but Diesel engines are to be installed on several vessels under construction. On new vessels the illuminant is incandescent electric or acetylene and the principal ones of each type are equipped with radio communication. In ten years the number of automatic gas lights has quadrupled, and the number of incandescent oil lights doubled. There has been a large increase of electric lights for subordinate stations and large economies have resulted.

The greatest change in lighthouse construction in recent years has been the more extended use of reinforced concrete, seven lighthouses having been so constructed, one of which is a tower 162 ft. high. This construction has also been used for foundation caissons, for lighthouses and beacons.

The lighthouse service maintains 16,373 aids to navigation, doubtless the largest number under one control. There has been an increase of 28 per cent in ten years, while in Alaska the number has more than doubled.

Summary of Conclusions (D. W. Hood)—As regards the luminary for optical apparatus, authorities are generally agreed that for buoy and beacon lighting, and in many instances for secondary lights, acetylene gas, either in an open flame burner or with an incandescent mantle, is the most popular form of illuminant where electricity is unobtainable. For larger optics an incandescent mantle on a petroleum vapor burner is the most suitable illuminant unless electricity can be readily obtained at reasonable cost, when the incandescent electric filament lamp may advantageously be employed. The need for continued development in the illumination of lighthouses has not in the least diminished, and in no circumstances must it be neglected in the endeavor to develop Hertzian or acoustic fog warnings. The greater its power the more penetrative will be the beam from the lighthouse and the greatest security is afforded to the mariner by providing a signal which he may see and recognize with his eyes.

Little has been said in the reports about the combination of aerial and maritime lights, and your general reporter is of opinion that such a study is worthy of this conference, in order to avoid separate aerial and maritime lighthouses on the coast.

In connection with acoustical fog signals, authorities generally recognize the superiority of the siren or diaphone over other types. Position finding by wireless is destined to be one of the most important navigational aids of the future, whether employed alone or in conjunction with sound to obtain synchronous signals.

Various countries have different direction-finding systems of their own, nevertheless the problem of the most effective type should be investigated not by each country individually, but by common international agreement, and it appears to your general reporter that a system applicable to stations both ashore and afloat which employs a wireless beam whose direction is ascertained by the navigator himself is the primary basis for such investigation and development.

Alumina Cement in France

Use of Quick-Setting High-Strength Cement Is Growing in France—Possibilities of Its Manufacture and Use

By Edwin C. Eckel
Consulting Engineer, Washington, D. C.

THE TERM alumina cement is here used as a convenient designation for the high-alumina fused cements which are now made and sold on a largely increasing scale under the trade names of *ciment fondu*, *Alciment*, *ciment electrique*, and others. It has the advantage of avoiding any implication as to the invention or ownership of the new cements; and as yet there is a very excellent reason for such carefulness in discussing property rights.

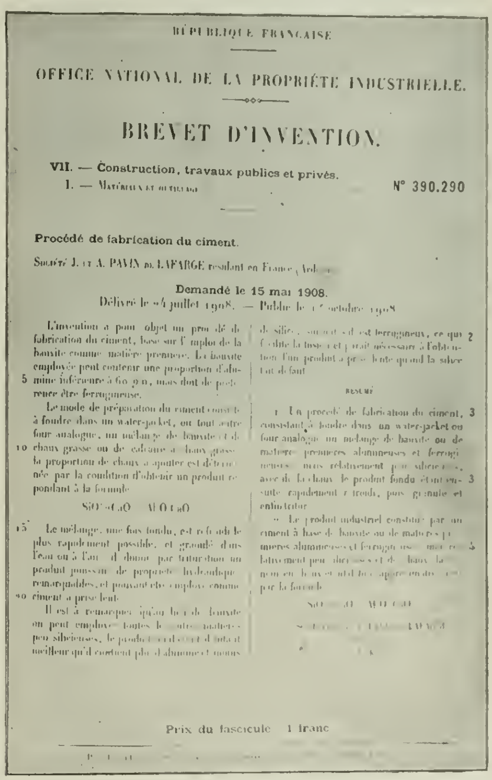
Around 1908 a new type of cement was invented—a cement characteristically very high in alumina, resistant to sea water and to sulphate waters, and hardening with extreme rapidity, so that in a day or two its concrete showed the same results as a normal portland cement concrete after a month or more. In its earliest days its resistance to chemical attack was its chief interest; during the World War it was adopted by the French army for rapid work on gun emplacements and roads; since the war it has been used extensively for ordinary engineering works.

It happened that I was, during the war, in command of a post of which the new fused cements were manufactured and used; and it is probable enough that I was the first American engineer to become acquainted with them. In the summer of 1918 I secured an option on the small available surplus of fused cement, for our own army use; but my immediate superior could not at that time appreciate the advantages of using a quick-hardening product for military uses. Today the situation has changed, and I do not think that any army would dream of using portland cement for front-line work or indeed for any other war-time constructions—provided of course that it had access to a supply of alumina cement.

In the years that have elapsed knowledge of the new product spread gradually, but there was an absolute lack of definite knowledge concerning the actual status of the alumina cement industry in Europe, considered either technically or commercially. There was indeed no lack of publications on the general subject, but these did not, for very good reasons, contain the sort of information which was needed if the developments of the new industry were to be taken up seriously in America. During a recent conference at Le Teil, one of the Lafarge directors noted ironically that the mass of publication was a curious tribute to the public interest in fused-cement, since out of thirty or more articles and papers that had come to his attention, only two were written by men who had ever seen a fused-cement plant, and only three by engineers who had ever used fused-cement in more than laboratory quantities.

Under these circumstances advantage was taken of the fact that examinations of certain European coal and iron fields were desired by one of my British clients, to spend some six weeks of additional time in a study of the status of the alumina cement industry abroad. This was done during May, June and July of 1923, the actual expenses of this part of the trip being paid by a leading American manufacturer of portland cement. The results were rather better than we had expected, in the way of securing detailed data on all phases of the matter. Much of these data, insofar as they relate to ownerships, manufacturing methods and costs, are of course confidential; but certain matters of general interest, relating to the actual growth of the new industry and to the actual utilization of the new product, are summarized in this article

Method of Making—To begin with, we may say briefly that the new alumina cements are made by fusing a mixture of bauxite (aluminum ore) and limestone in a furnace, and grinding the product to powder. That is a


RÉPUBLIQUE FRANÇAISE

OFFICE NATIONAL DE LA PROPRIÉTÉ INDUSTRIELLE.

BREVET D'INVENTION.

VII. — Construction, travaux publics et privés.

N° 390.290

Procédé de fabrication du ciment.

Demandé le 15 mai 1908.

Prix du fascicule 1 franc

FIG. 1—FACSIMILE OF THE BASIC FRENCH PATENT

Issued in 1908, covering first fused high-alumina cements made at the Lafarge works. This early process has been changed in essential points so that present methods of manufacture are unlike those here claimed.

brief statement of a complicated series of processes, which have evolved from very different beginnings, and which are yet in process of active development. For example, if we build a mill in America I am very sure that it will be markedly different from any existing French mill; I am almost equally sure that within five years we will make even greater changes and improvements. It is therefore merely as a matter of historic interest that I reproduce herewith, as Fig. 1, a facsimile of the original French patent to Lafarge in 1908.

The claims of the patent, translated, are as follows:

1. Process of cement manufacture, consisting in melting in a water-jacket or similar furnace a mixture of bauxite or of material primarily aluminous and ferruginous, but

FIG. 2—CONCRETE PILING FROM ALUMINA CEMENT
These piles, in Holland, are driven three days after casting.

relatively little silicious, with lime, the fused product being then rapidly hardened, then ground and finally pulverized.

2. The industrial product constituted by a cement with a bauxite base or from material primarily aluminous and ferruginous but relatively little silicious, and lime, the content of lime being defined approximately by the formula $SiO_2 2CaO + Al_2O_3CaO$.

The reader must consider this patent with the distinct caution in mind that the alumina cement of today can not possibly be made by following the description of that patent. Not only is that the case, but so far as I can see no commercial cement could ever have been successfully made in that fashion. Fifteen years of hard work have changed plant, processes and product so that those of 1908 are no longer recognizable in the modern industry. The result is that the European alumina cement industry of today is rather a matter of more or less secret processes than of patents.

Production—As to the physical growth of the industry, the best data obtainable indicate an output of some 300,000 bbl. ol alumina cement in 1922, of around 350,000 bbl. probable in 1923; and in 1924, with the new mills now reaching completion, a French output of some 400,000 to 450,000 bbl. The significance of these figures can easily be overlooked, if we compare them to American cement outputs; but if we recall that all France does not produce much over six to seven million barrels of true portland cement a year, we see that in four years of actual civil use the new cement has reached an output of about 7 per cent of the total portland output of France.

But though we must admit that the new product can easily reach an important tonnage figure, we must not conclude that it will replace our portland cements for all uses, or that it will ultimately destroy the present cement industry. There are distinct limitations with regard to the commercial placing of the new product, so that its competition with portland—or rather its replacement of portland—will have certain quantity limits which we can fix with sufficient exactness. The carefully weighed opinions of a number of eminent engineers in France, Great Britain and the United States give results ranging between ten per cent and twenty per cent of the portland output as representing the amount of alumina cement that we can reasonably hope to make and sell within the next ten years.

The extent of the competition will be determined solely by cost. Alumina cement will always be, in most parts of the United States, dearer than portland cement, and in many regions it will be very much dearer. That means that it will be to some degree a specialty product, used for such purposes or under such conditions as will justify its extra cost per barrel. Along sea-coasts and in the alkali region of western Canada and our own western states, alumina cements will be used, provided that they are not too dear, because they are resistant to chemical attack. Elsewhere, on repair or construction work where time is an object, alumina cements will be used so far as their higher cost per barrel is counter-balanced by saving on time, labor and forms. For cement products they have very definite advantages, as permitting prompt shipments.

Summary—It may be possible, in a later article, to discuss some of these uses more fully, with illustrations from actual works. But at present perhaps the best commentary on the situation abroad is afforded by the two entirely separate facts which I now note:

(1) In Great Britain, one of the greatest of the contracting companies is about to undertake the manufacture of alumina cement for its own use and for sale, under one of the two processes that are known. As a corollary, perhaps, one of the greatest of British cement manufacturing groups is also about to take up the manufacture of alumina cement, under the other process. In both these cases the necessary bauxite will have

FIG. 3—SUBWAY WORK IN PARIS WITH ALUMINA CEMENT

Photograph taken in 1923. Twenty-four hours after concrete slabs had been laid, back-filling was in progress. The view is at the Chaussée d'Antin station of the Metropolitan subway.

to be imported, so that the incentive to make and use alumina cement must have been very strong.

(2) In Paris, though portland cement is still used on alleys and second-class streets, most of the repair work carried on by the city engineers on first-class streets and bridges, as well as that on the subways, is done with alumina cement. By its use a street intersection can be completely repaired with a three-day tie-up of traffic, as against three weeks or so with portland. In Paris today alumina cement costs almost exactly three times as much as good portland. If the slow and economical French mind can see an advantage under such conditions, we may fairly expect that in the course of time Detroit, Chicago and New York may also find it profitable to save time at the expense of first cost.

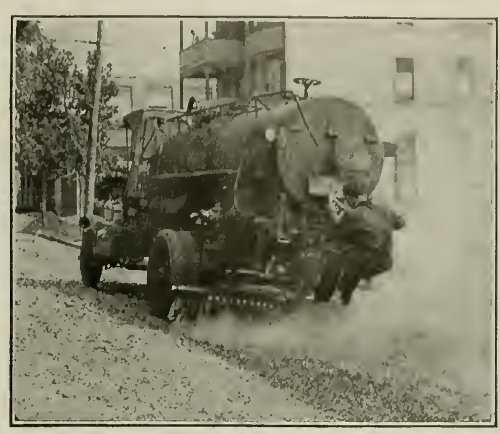
Asphalt-Penetration Resurfaces Old Macadam Streets

Less than a Dollar a Yard Makes Excellently Surfaced Streets Out of Worn Macadam in Bridgeport, Conn.

OLD WATERBOUND macadam streets, dilapidated by modern traffic, are being converted into excellently surfaced thoroughfares in Bridgeport, Conn., by covering them with asphalt macadam. Not including overhead, the cost in 1922 of 140,000 sq.yd. of 3-in. surfacing was 87.1c. a square yard; and this season, with higher wages and prices, the cost, based on figures for a part of the season, is expected to keep well under a dollar a yard. These low costs are being obtained by a combination of contract and day-labor work which also has given rather excellent progress, the work of 1922 having been done in 140 days—an average of 1,000 sq.yd. a day.

At the beginning of operations in 1922 careful plans were formulated for doing the work by a sequence of crews each performing a particular task. These plans were improved and continued in 1923. This year three crews have done the work for which four were employed in 1922 and also the size of some of the crews has been reduced. It is this reduction of force which has enabled costs in 1923, despite higher wages, and prices, to be kept about as low as in 1922 for which detail figures are given in the accompanying table. In the work tabulated, wages were 35c. an hour and stone per cubic yard delivered cost, for 1½-in., $2.55,

PLACING NEW WEARING STONE ON OLD MACADAM BASE



SPRAYING ASPHALT ON STONE SURFACING

and for ¾-in. and ½-in., $2.65. The quantities used were: 1½-in. a 3-in. layer; ¾-in., 20 per cent, of the 1½-in., and ½-in., 0.1 cu.yd. per square yard. Average costs for the 140,000 sq.yd. were as follows:

Grading	$0.072
Extra stone in base	.064
Stone	.290
Asphalt	.330
Surface labor	.087
Coal for surface roller	.004
Heating asphalt in car	.015
Office force	.009
Total	$0.871

In all figures the costs of stone and asphalt are contract prices for these materials in place. The differences in price and quantity of asphalt per square yard are in a considerable measure due to differences in the amount of stone per square yard required to bring the old street to surface. In general the old macadam was badly worn and full of pot holes. Its only usefulness was as a base. Reconstruction consisted of four principal processes, grading, placing stone asphalting and finishing, which in 1922 were conducted as follows:

After the engineers had established the new grades the first crew to enter the street was made up of one foreman, about ten men and a steam roller equipped with a scarifier. The street was scarified and reshaped, some of the surplus material being used to fill in the low places. Where the foundation was poor, new stone was added and the whole street rerolled and left in shape 3 in. below the new grade. The finished crown was ¾ to 1 in. to the foot. With a season's experience it was possible this year to reduce the grading gang by two men. This reduction was aided by the plan of not scarifying the center of the old macadam but was chiefly due to greater skill of the foremen following a year's experience.

The second gang, consisting of one foreman and six men, followed with the stone. The stone, trap rock, was unloaded from a barge by a clamshell bucket directly into a hopper, from which it was loaded into trucks. When a truck arrived on the street the tail gate was chained so that it would open about 6 in. The truck would start as soon as the load was hoisted, and in this way the stone was fairly evenly spread; men with forks corrected any unevennesses. The stone then was rolled by another roller which remained with this crew.

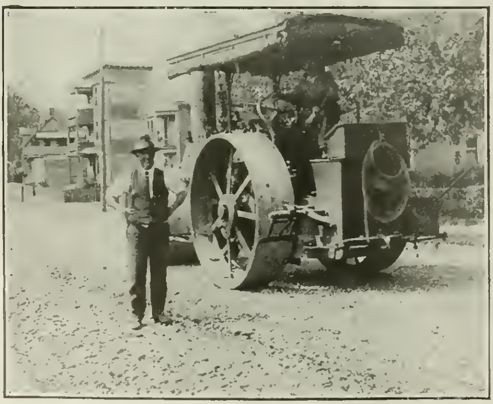
COSTS OF SURFACING WATERBOUND MACADAM WITH BITUMINOUS MACADAM, BRIDGEPORT, CONN.

Street	Area Sq.Yd.	Cost per Square Yard: Grading	Stone Base	Stone Surface	Asphalt	Surface Labor	Heating Asphalt in Car	Coal for Surface Roller	Total	Gal. Asphalt per Sq.Yd
Dewey St.	11,600	. .	.	.	. .		. .	. .	$0 95	2 29
Mt. Grove St.									95	2 29
Hancock Ave..	8,100								.83	2.01
Wordin Ave.	4,925	$0 081	$0 061	$0 300	$0 374	$0 110	$0 025	$0.003	.959	2 49
Hazelwood Ave	4,200	085	.050	284	332	096	.025	002	.879	2 21
Washington Terrace	3,080	.107	.016	.288	.325	123	025	001	.890	2 44
Sanford Pl.	1,983	.064	.	298	294	.100	025	003	.784	2 68
Lyon Terrace	1,670	.088	030	305	311	.132	.025	.003	894	2 49
Chapel St	1,682	059	033	316	293	.136	.025	003	.865	2 77
James St	3,093	.084	.028	322	351	.111	025	.003	924	2 35
Fulton St.	1,820	.068	.039	300	328	.096	.025	004	860	2 87
Franklin St.	1,190	.093	.055	.294	307	179	.025	.004	957	2 70
Frank St	6,151	.066	.060	.300	291	.085	.017	.003	822	2 48
Center St	5,618	.056	.069	.289	276	.078	017	.002	787	2 71
Charles St	9,090	.062	.054	.298	272	.075	.017	003	.781	2 35
Whitney Ave	3,758	.065	.095	.310	.379	.066	017	.003	935	3 09
Wells St	4,693	.089	.068	.297	.290	.078	017	.003	842	2 69
Park St.	2,724	.072	.062	.323	304	082	.017	003	863	2 84
Kossuth St	718	.125	.128	.324	.242	075	017	002	913	2 25
Brooks St.	6,457	.073	.090	.320	.347	.076	.013	.004	923	3 22
Jane St.	8,970	.066	.077	.275	.309	.079	.013	.003	822	2 79 / 3 01
Maple St.	9,262	.072	.066	294	.298	.093	.013	.004	860	2 77
Beach St.	4,694	.054	.097	.294	.342	077	.013	.005	882	3 00
Ford Place	1,753	.079	.102	.294	.308	.060	.013	.003	.859	2 87
Grant St.	4,267	.077	077	.294	.292	074	.013	.003	830	2 72
Crescent Pl	857	.059	.092	285	323	.085	.013	003	860	3 01
California St.	792	.086	193	.292	.250	.101	.013	.003	938	2 27
Cedar St.	2,540	.054	.119	.292	.327	.081	013	.003	889	2 97
Johnson St	1,636	.083	097	.299	.304	.082	013	003	881	2 76
Park Terrace	2,190	.052	.045	.299	.315	.082	.013	.003	.809	2 86
Ellsworth St.	8,637	.095	.119	.294	.321	.108	.013	.005	.955	2 91
Brewster St.	1,245									
Norman St.	5,323	.053	080	.294	.326	.108	.013	.005	879	2.97
Housatonic Ave	1,028	.313	.072	.288	.367	.087	.013	.007	1.147*	3.32
John St.	1,070	.085	.115	.313	.382	.099	.013	.008	1.015	3.47
Middle St.	1,486									
High St.	2,940	.060	.082	.280	.365	192	013	006	.998	3.31
Courtland St.	635	.366	.050	.300	.370	.241	.013	.006	**1.346	3.36

* Grading includes removing 6 in. of old macadam and cinder base. ** Grading includes setting curbs and cutting old road about one foot.

Any low places were brought to grade by one or two men who were placed behind the spreaders. As soon as the stone was ready this gang went ahead to the next street which by this time had been prepared by the grading gang.

The third gang was made up of a foreman and ten men, equipped with a steam roller and one of the new White distributors. Asphalt heated in tank cars at the city yard was applied by this gang at the rate of about $1\frac{3}{4}$ gal. to the square yard. Three-quarter and half-inch stone had been placed in piles on both sides of the street about 25 ft. apart, the piles on each side alternating. As soon as the asphalt was applied the $\frac{3}{4}$-in. stone was spread and rolled. When the stone was thoroughly rolled a second application of about $\frac{3}{4}$ gal. of asphalt was applied and covered with the $\frac{1}{2}$-in. stone. To keep up the speed of the work it was necessary some days, particularly after a wet spell, to apply 6,000 to 8,000 gal. of asphalt a day.



ROLLING AFTER FIRST ASPHALT APPLICATION

In 1922 a forth crew consisting of three men and a team, was employed to touch up places not thoroughly covered, and to clean up the surplus material, but this season this finishing was made a part of the work of gang three.

The following method adopted by the fireman of the boiler used for heating the tank cars helped to assure a continuous supply of asphalt. The exhaust steam from car 1 was piped to car 2 and the exhaust steam from that to car 3. In this way a full head of steam was on the first car and it was ready for use at any time. The second car was almost ready and the third could be made ready in a couple of hours. All shifting of cars was done at night.

Intelligent scheduling of the sequential operations is required but otherwise the procedure involves no special care or unusual methods. In Bridgeport operations are in charge of City Engineer James McElroy and Director of Public Works George Coughlin. City forces do the work except that, as stated, stone and asphalt are contracted for at a price in place.

Humber River Development Well Under Way

Sir Richard Squires, former premier of Newfoundland, in discussing the proposed power development on the Humber River in Newfoundland, states that the project is well under way and that 2,100 men are now employed on work of a preparatory nature which includes the re-location of a considerable portion of the railroad where it traverses the bed of the proposed reservoir. It is hoped that the work will be well under way by the fall of 1924, and that by the following fall the paper plant will be ready for operation. The total development will be somewhere in the neighborhood of 200,000 hp., a considerable portion of which will be used in the manufacture of pulp and paper, as the new plant is expected to produce 400 tons of paper a day.

New Rose Polytechnic Institute Building at Terre Haute

Engineering College on New Country Site Has Main Building of Unusual Design—Laboratories Not in Separate Rooms—Sale of Old City Property Necessitated Rapid Progress

NOVELTY in design, economy in cost and rapidity in both planning and construction are marked features of the main building completed this year for the Rose Polytechnic Institute on its new site just outside Terre Haute, Ind. This triple combination was effected largely in order to meet financial limitations and emergency conditions. The building, Fig. 1, is the first of a proposed group, but for the present it houses all the departments of this engineering college.

FIG. 1—NEW BUILDING FOR ROSE POLYTECHNIC INSTITUTE

Rose Polytechnic Institute was founded in 1874 by Chauncey Rose, of Terre Haute, Ind., one of the promoters of the Vandalia Line. Until 1922 the institution was located in Terre Haute at 13th and Locust Sts., being housed in a four-story building which was erected in 1876 and had practically no grounds. In recent years the extension of railroad yards in the vicinity has rendered the location unfavorable, while the building was inadequate for the requirements of a modern engineering college and there was no room for expansion. Under these conditions it was decided to remove to a more suitable location in open country which had been provided in 1913 when a site of 120 acres was presented by Anton and Herman Hulman, of Terre Haute, former students of the institution. This site is about 2½ miles from the city, on high ground and fronting on the concrete-paved "National Road," which is paralleled by an electric interurban railway.

A general plan for a group of buildings following somewhat conventional lines for institutions of this kind was prepared in 1916 by Herbert Foltz, architect, and the cost was estimated at about $800,000. A more elaborate plan was desired by the alumni and was worked out in 1918 by John Van Pelt, of New York, but the estimated cost of $1,000,000 for the first building was far beyond the reach of the institution. No further action was taken at the time. But in 1918 the institution had sold its building and property to the city for school purposes and early in 1921 the city demanded possession, since it desired to use the building for a vocational high school. Thus the institution was compelled to move but had no buildings of its own.

At about this time, Dr. Philip B. Woodworth, Dean of Engineering at Lewis Institute, Chicago, was made president of Rose Polytechnic Institute, and the work of providing quarters was his first and most pressing problem. An analysis of the finances showed about $300,000 available. Dr. Woodworth then called in Mr. Foltz, the architect of the original plan, and between them a design was worked out for one main building which could be made to serve all purposes for a few years. It is this building which is now completed.

In its interior arrangement, however, the building presents a new departure in the design of educational buildings. In plan the structure is about 150x400 ft. and with the exception of the two end portions, front and rear, it is one story high. The central portion is divided into sections by transverse partition walls of

FIG. 2—DEPARTMENT OF DRAWING AND MACHINE DESIGN

Northeast corner of room. Civil engineering laboratory beyond first low partition. Well diffused light from large windows and skylights. I-beam at left will carry mezzanine floor for toilets.

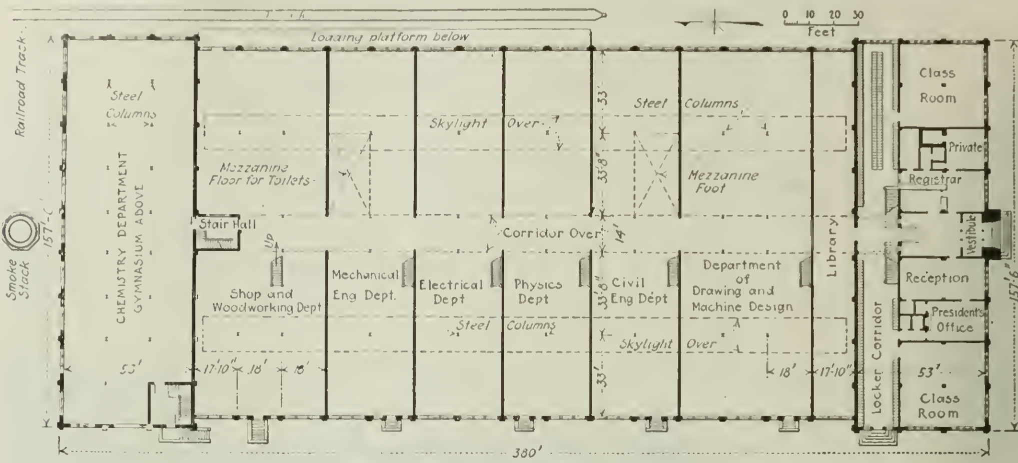


FIG. 3—COMPARTMENT ARRANGEMENT OF LABORATORIES

brick, as shown by Fig. 3 and the accompanying interior views, but these walls are carried only to a height of about 10 ft., so that the upper part of the one-story structure is open from end to end, giving free diffusion of light from the skylights. The first partition at each end, however, is carried somewhat higher, as shown by the drawing Fig. 5 and the view Fig. 6.

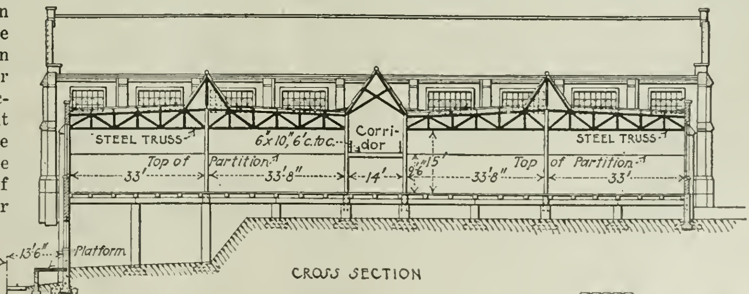
It was originally intended that each partition should be continuous between the side walls, forming isolated sections for the laboratories. At present, however, there is a central line of openings permitting direct communication Along the center line of the building and about 9½ ft. above the floor is an open gangway or corridor 14 ft. wide, having iron railings along the sides and an iron stairway to each laboratory. In addition, each laboratory has a door in one side wall. In Fig. 6, the first partition, which extends above the corridor, is that between the library and the drafting room. Beyond it, the partitions between the sections or laboratories are about level with the floor of the corridor. These sections, Fig. 3, comprise the following: Library, drawing and machine design, civil engineering,

FIG. 4—CIVIL ENGINEERING LABORATORY
Southwest corner of room. Prof. R. L. McCormick teaching class. Note low brick partition separating this room from drafting room at left.

FIG. 6—ELEVATED CORRIDOR CONNECTING LABORATORIES
High partition in foreground separates the library from the drafting department, access to which is by stairs at left. Triangular skylight above. Heavy I-beam beyond first partition wall at right will carry mezzanine floor.

physics, electrical engineering, mechanical engineering, and shop and woodworking department. Of these the drafting and shop department and the chemical engineering laboratory (under the gymnasium) have each 8,000 sq.ft. of floor area; the others have 5,000 sq.ft. each, except the library with 3,000 sq.ft. Under the drafting department is a shooting gallery 36 ft. wide extending the full width of the building.

In the two-story front portion of the building, 54 ft. wide, the administration offices and some of the class rooms are arranged on the first floor and other class rooms are on the second floor, which is about 3 ft. above the level of the longitudinal corridor in the central one-story part of the building. The rear two-story portion, also 54 ft. wide, has the assembly room or gymnasium on the second floor and the chemical laboratory on the main floor. Beneath the latter are the boiler room and the foundry, each occupying half the width of the building. Owing to the downward grade of the ground towards the rear these two rooms do not form a closed basement but the floor is level with the ground at the rear of the building. Toilet rooms are arranged on a mezzanine floor over



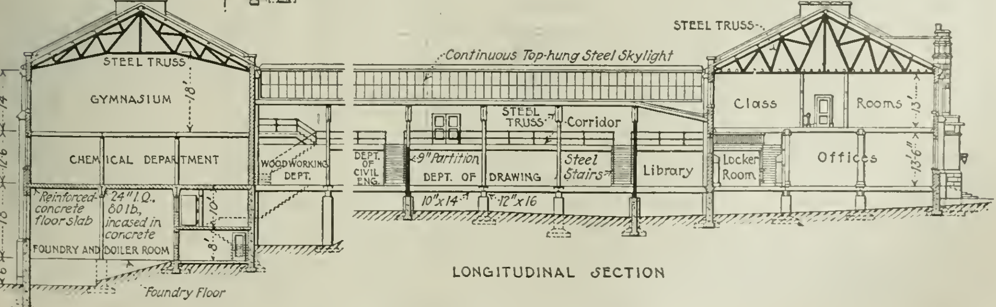


FIG. 5—GENERAL DESIGN OF MAIN BUILDING

a portion of the laboratories and at the level of the corridor. Only one of these floors has been built as yet, but on Figs. 2 and 6 will be noted a heavy I-beam which will support the second mezzanine floor section.

Structural design includes brick walls, steel columns and steel roof framing, with mill construction for the upper floors of the two-story end sections. A reinforced-concrete floor on I-beam framing is provided for the chemical department, but elsewhere there is 2⅝-in. wood mill flooring on joists, generally 10x14-in. and 6 ft. apart, these joists being carried by 12x16-in. girders on concrete foundations. For the corridor the joists are 6x10-in., 6 ft. apart, fitted between the flanges of two lines of 12-in. channels riveted against the interior steel columns. Steel sash forms a large proportion of the side walls, as glazed areas are cheaper than masonry. The partitions and interior facing of the side walls are of dark red face brick and will not be plastered. Transverse steel roof trusses supported on columns in the side walls and on intermediate steel columns in the central one-story part of the building carry three continuous longitudinal skylights of triangular section, with movable panels for ventilation. In this way abundant light is provided, but shades will be needed in sunny weather. The intermediate portions of this roof and also the roofs of the end sections of the building have plank sheathing and composition roofing, which will be covered eventually with red tile. Rough texture brick with white stone trimmings is used for all exterior walls.

Water for drinking purposes is pumped from a driven well to an 80-gal. storage tank. For laboratory and general purposes and for fire protection there is a 200,000-gal. concrete tank or cistern in the basement to collect rain water. This cistern is connected with a small lake 660 ft. distant by a 10-in. cast-iron main, at the middle of which is a sump from which fire engines can draw water. The normal level of the water in the cistern and lake is 13 ft. above that of the boiler room floor. With the power plant located in the building there is a saving in heat loss and fuel cost as compared with an outside power house and pipe tunnel. Two hand-fired water-tube boilers of 160 hp. are installed. Coal is delivered by cars on a railroad spur.

This one building serves all purposes of the institution at present. The next building, as planned, will be Deming Hall, a students' union building, for which $100,000 was provided in the will of Demas Deming, of Terre Haute.

With the exercise of economy in design and construction, the cost was about $240,000 for the building and $320,000 including equipment. In proportioning the cost, the limit of expense (including equipment) was $3.50 per square foot for the class rooms and drafting room, $3.80 for the civil engineering laboratory, $4 for the physics and electrical and mechanical laboratories, and $5 for the shops and the chemical laboratory. A complete foundry equipment was the gift of E. D. Frohman, Pittsburgh, Pa.

Dr. Philip B. Woodworth, president of Rose Polytechnic Institute, is now on leave of absence; Frank C. Wagner, vice-president and professor of mechanical engineering, is acting president; R. L. McCormick, professor of civil and architectural engineering; H. A. Thomas, professor of hydraulic engineering; John White, professor of chemical engineering and C. C. Knipmeyer, professor of electrical engineering.

The Paradox of Hydro-Steam

An Analysis to Show That Energy Generated by Combined Steam and Hydro Prime Movers Can Cost Less Than Either One Separately

By George Holmes Moore
Senior Electric Engineer, Public Service Commission of Washington, Olympia, Wash.

ONE of the most interesting of the problems encountered in hydro-electric engineering is the computation of the economic size of the steam auxiliary. In fact, certain of the conclusions arrived at by an intensive study of this economic size relation are so unexpected as to seem at first glance preposterous. Thus, when the student has become convinced that hydro-electric energy can be sold with profit at 6 mills per kw., and that steam-electric energy can be so sold at 10 mills per kw., it is extremely difficult for him to conceive that energy, generated by the two methods operating in conjunction, can be profitably sold at 5 mills per kw.

And yet this condition of affairs is by no means impossible of attainment, as a review of such articles as those of Stott, Gorsuch and Baum may suggest. Baum has declared in his paper on the "Economic Proportion of Hydro-Electric and Steam Power" (A. I. E. E., *Trans.* 1918, p. 1471), that: "It is, of course, well known that steam power is usually less expensive for low load factors than hydro-electric power, and that the latter becomes economical only when the load factor is favorable."

Another author in an article directing attention to "The Possibilities of Hydro-Electric Power in the Pacific Northwest" (*Engineering News*, Vol. 73, p. 342), shows that: "The immense preponderance of water-power drive throughout the Pacific States admits of but one conclusion—the local superiority of water over steam. There is little room for doubt as to the economic standing of the two prime movers on the Pacific Coast"; from which it is readily apparent that seemingly contradictory statements may emanate from trained investigators, even in the same locality and in the same field of research.

However, the paradoxical condition can—and doubtless does—exist. Electric energy can, in certain instances, be produced at a lower unit cost by hydro and steam stations operating in parallel than by either when operating alone. And it is the purpose and intent of this paper to present, as simply as may be, those essen-

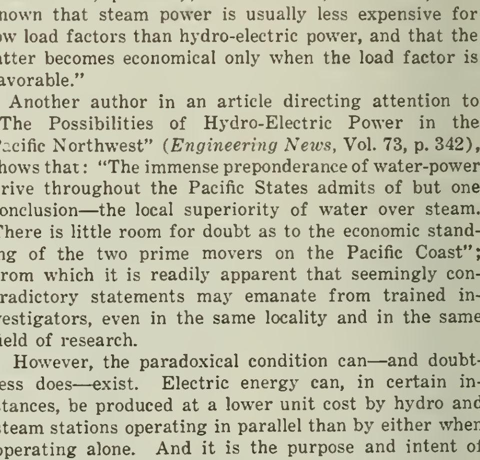


FIG. 1—DAILY LOAD CURVE FOR A REPRESENTATIVE CITY LIGHT PLANT
Composite mean form for yearly load factor of 50 per cent.

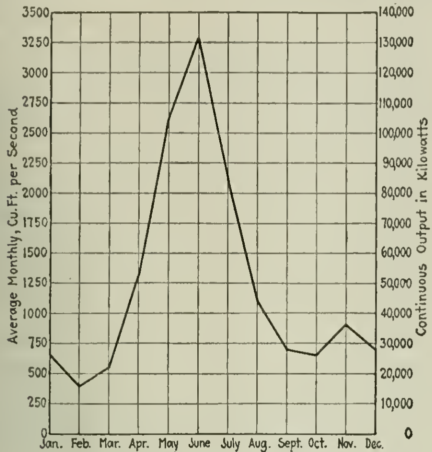


FIG. 2—ANNUAL RECORD OF STREAM FLOW

tial elements of control which, at least for Pacific Northwest conditions, dictate the economic proportionment of hydro-electric and steam-electric generating plant capacities.

Two of the most important of the basic data required for the analysis of a power stream destined to supply any particular distribution system are: 1. Annual System Load Curve and 2, Annual Record of Stream Flow.

System Load Curve—In Fig. 1 is presented a composite mean form of daily load curve as obtained from a certain large system from a record extending over a number of years. This particular annual load curve has a load factor of 50 per cent, so that a 100,000 kw. power station supplying it would have an annual output corresponding to 50,000 kw. continuous; or an annual total of 50,000 $\times$ 8,760 = 438 million kw.-hr. per year.

Annual Record of Stream Flow—Of the many surprising elements disclosed by the careful hydrographic study of a power stream, there are three which may be said to control. These are respectively:

(a) Minimum Stream Flow
(b) Storage Requisite for Daily Regulation
(c) Storage Requisite for Annual Regulation.

Of these three, the one first sought and most commonly used as a basis for station capacity estimate is that of Minimum Flow, and just because the commonest hydro-electric installations are those designed to operate at full capacity during the months of Minimum Flow, the paradoxical inter-relation of hydro and steam has not yet received the attention its importance merits.

Daily Regulating Storage—An analytic consideration of Fig. 1 will prove that the station capacity which may wisely be installed upon any given power stream can be exactly doubled if sufficient storage can be secured to provide daily regulation of the stream flow. Daily Regulating Storage may be here defined as that volume necessary to change the normal flow so as to conform to the daily load requirements of the system supplied. The acre-feet of storage required for this purpose is relatively small, but, if the average stream flow will generate 50,000 kw. continuously, such storage will allow of the installation of a 100,000 kw. plant under the load conditions shown in Fig. 1.

Further study of this load curve discloses that the energy necessary for load between 50,000 kw. and 100,000 kw. is only one-sixth of that necessary to generate 50,000 kw. continuously, so that in this case the reservoir volume for daily regulation would be one-sixth the volume of daily stream flow.

Economic Utilization of Stream Flow—Let us assume that the load demanded for the curve of Fig. 1 is supplied by a power station located on a stream whose Annual Record of Flow is that shown in Fig. 2. If the static head of this development is 600 ft., each cubic foot per second of water should produce 40 kw. of continuous output; or, on a daily load factor of 50 per cent, it should produce 80 kw. at time of peak if daily regulating storage is available.

Let us assume that the reservoir volume developed is sufficient for daily regulation of the average annual flow as shown in Fig. 2. The 1,250 sec.-ft. of mean flow will then be just sufficient to drive a 100,000-kw. hydro station with an average output of 50,000 kw. continuously. From the foregoing, the storage necessary in this case is:

$$0.165 \times 1250 \times 60 \times 60 \times 24$$
$$= 17.82 \text{ million cu.ft.}$$
$$= 409.09 \text{ acre-feet.}$$

This reservoir volume would be sufficient to store the Minimum Flow of 400 sec.-ft. for a period of:

$$17{,}820{,}000 \div (400 \times 60 \times 60)$$
$$= 12.375 \text{ hr.}$$

From which it follows that, if the steam auxiliary can supply the demand during 12.375 hours of the lightest load, enough water will accumulate in the reservoir during that period to operate a 50,000 kw. station during the hours of peak load, and thus to supply all demands between 50,000 kw. and 100,000 kw. during that time.

Adding to this 50,000 kw., the 16,000 kw. available from the Minimum Flow of 400 sec.-ft., it becomes evident that only 34,000 kw. of steam auxiliary need be provided in order to supply 50,000 kw. continuous and 100,000 kw. peak even under the limiting condition of Minimum Stream Flow.

Hydro-Steam Cheaper than Hydro or Steam—It now remains only to demonstrate the major proposition advanced herein, namely: that energy produced by the combination of hydro and steam is cheaper than that produced by either hydro or steam when operating alone.

From the foregoing, it is evident that a 32,000 kw. hydro station is the largest that should be installed on the given stream under the conditions as assigned, if no steam auxiliary is provided; and the following tabulation presents an estimate of installation and operating

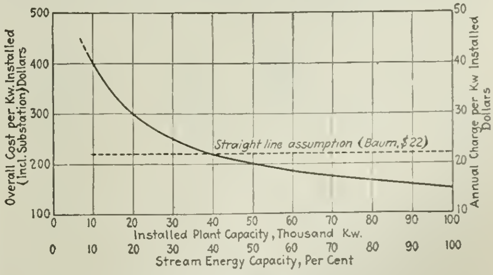


FIG. 3—INSTALLATION COST OF HYDRO-ELECTRIC PLANTS

Curve showing decrease of unit cost and annual charge with increase of installed capacity.

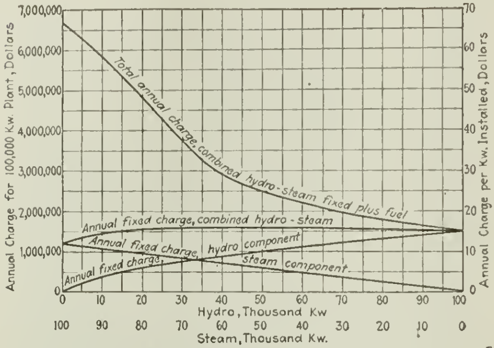


FIG. 4—ECONOMIC COMBINATIONS FOR HYDRO-STEAM ELECTRIC PLANTS

	Hydro	Steam
Cost per Kw.:		
20,000	$300	$100
30,000	250	..
50,000	200	..
100,000	150	100
Fixed Charge:		
Interest	6%	6%
Depreciation, etc.	4%	6%

Fuel charge, oil @ 200 kw.-hr., per $2.50 bbl.
Load factor yearly, 50% installed.
Load curve, typical city light plant.

costs for a 32,000 kw. hydro station supplying a demand whose load factor is 50 per cent. Such a load will require an energy production equivalent to a continuous average of 16,000 kw. throughout the year.

Installation cost of hydro is assumed to vary as shown in Fig. 3, being $400 per kw. installed for a station capacity of 10,000 kw., and decreasing to $150 per kw. for an installation of 100,000 kw.

Installation cost of steam is assumed constant at $100 per kw. installed, regardless of the station capacity.

Base data for the computation of annual operating expense are given in Fig. 4, among which that of oil at $2.50 per bbl. will be revised to $1.40 per bbl. in a later study.

Applying the data of Figs. 3 and 4, the following comparative tabulation results:

Item	Hydro	Steam
Installation cost (32,000 kw.)	$7,744,000	$3,200,000
Annual fixed charge	$774,400	$384,000
Annual fuel charge	......	1,752,000
Total annual charge	$774,400	$2,136,000
Annual kw.-hr. $\left(\frac{\text{kw.}}{2} \times 8{,}760\right)$	140,160,000	140,160,000
Annual cost per kw.-hr.	$0.0055	$0.0152

Changing only the item of fuel from $2.50 to $1.40 per bbl., and adding another column for a hydro steam plant of the size indicated, we obtain the tabulation given below.

Item	32,000 Kw., Hydro	32,000 Kw., Steam	32,000 + 18,000 Kw., Hydro-Steam
Installation cost	$7,744,000	$3,200,000	$9,344,000
Annual fixed charge	$774,400	$384,000	$966,400
Annual fuel charge	......	981,120	153,300
Total annual charge	$774,400	$1,365,120	$1,119,700
Annual kw.-hr. $\left(\frac{\text{kw.}}{2} \times 8{,}760\right)$	140,160,000	140,160,000	219,000,000
Annual cost per kw.-hr.	$0.0055	$0.0096	$0.0051

A word of explanation as to the reason for choosing an 18,000 kw. auxiliary is due just here: Referring to the load curve of Fig. 1, it will be found that, if the peak load is taken as 50,000 kw. instead of 100,000 kw., the annual daily average will be 25,000 kw., and this will, in the 8,760 hours of a year, amount to the 219 million kw.-hr. of column 4. Also, closer inspection will reveal that all loads above 64 per cent of the peak, (which 64 per cent is, in this case, 32,000 kw.), will demand only about one-tenth of the annual energy, or 219 million kw.-hr., to be furnished by the steam plant. This energy, at 7 mills per kw.-hr., will produce the fuel charge of $153,300 as given in column 4.

Even this is not the most favorable proportionment that could be obtained, since it entails an annual load factor for the steam plant of nearly 14 per cent, whereas a 10 per cent load factor for the steam auxiliary would probably result in a greater economy of output. This would probably decrease the 18,000 kw. as here chosen, but the resulting decrease in energy cost is unimportant here.

From which it is evident that the paradox—which Webster defines as "something apparently absurd or incredible, yet true"—really does exist. Not only does a carefully chosen proportion of steam to hydro cheapen the unit cost of the energy produced, but also it makes possible the conservation, by use, of enormously increased quantities of power stream energy.

Thus, in the case cited, it will be found by further analysis that 32,000 kw. is only, in a manner of speaking, the beginning of the installed capacity that may economically be installed on the stream as chosen.

The available storage will usually be far greater than that requisite for daily regulation, and probably will be sufficient to materially augment the Minimum Stream

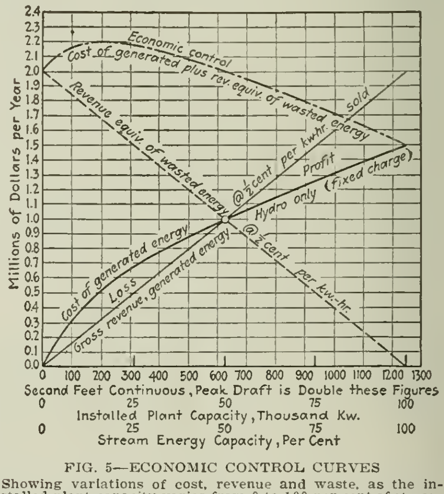


FIG. 5—ECONOMIC CONTROL CURVES

Showing variations of cost, revenue and waste, as the installed plant capacity varies from 0 to 100 per cent of stream energy capacity. It is assumed that, under a static head of 600 ft., each sec.ft. will produce 40 kw. continuous and 80 kw. peak, under an annual load factor of 50 per cent. Also, that, of the 4,380 kw.-hr. generated per year by each kw. of plant capacity, 4,000 kw.-hr. will be sold.

Flow. So that the installable hydro station capacity will increase from 32,000 kw. toward 100,000 kw., and sometimes above that figure.

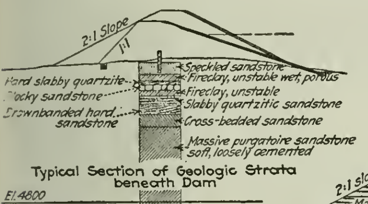
Indeed, if we define the economic control for power stream development as "the cost of generated energy plus the revenue equivalent of wasted stream energy," it will be seen from Fig. 5 that this sum in "millions of dollars per year" is a minimum only when the stream is developed to its ultimate capacity. Which statement may be, itself, a paradox.

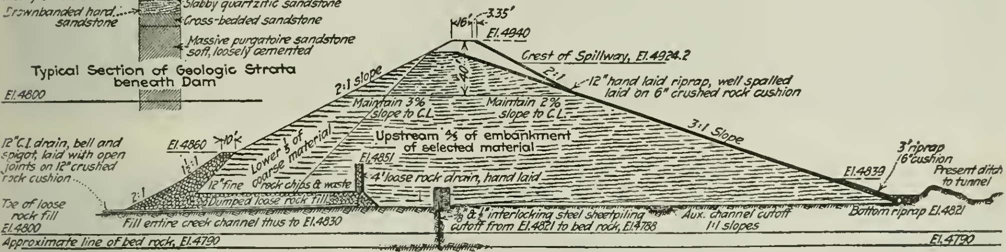
Failure of Apishapa Earth Dam in Southern Colorado

Structure 115 Ft. High Above River Bed Goes Out After Stream of Water Breaks Diagonally Through Upper Portion

With Telegraphic Reports from Special Correspondents

THE APISHAPA DAM, near Fowler, Colo., an earth structure 115 ft. from stream bed to dam crest, failed on Aug. 22, with a water level behind the dam variously reported as from 2 to 3 ft. below the spillway and 10 to 13 ft. below the crest, the water being some 10 ft. higher than it had ever been before. Leaks attributed to settlement cracks had been observed a year ago. Just before the failure a crew of men under the chief engineer of the Apishapa Consolidated Irrigation Co., owners of the dam, had, as was thought, practically stopped the leaks. These leaks were at each end of the dam, about 25 ft. below the crest.





MAXIMUM CROSS-SECTION OF APISHAPA DAM IN SOUTHERN COLORADO AS COMPLETED IN 1920.

The dam was 585 ft. long at the crest and 300 ft. at the bottom. The thickness at maximum cross-section was 594 ft. The crest of the dam as built is at the top level of the cross-lined section (El. 4932). The additional section up to El. 4940 was so designed by the engineer, after certain discrepancies in the preliminary survey were discovered, but was never built.

Warning of failure came when water was seen entering the dam at the water surface at one end, to be followed soon afterward by a discharge at the other end, some 25 ft. lower down or about 35 ft. below the crest. The water level fell slowly for an hour, then more and more rapidly until within three hours the reservoir had lost 18,000 acre-ft. of storage. Meanwhile the dam, except for portions at either end (and perhaps some of what was under water), had gone downstream with the flood.

The dam, which was described at length in *Engineering News-Record*, June 16, 1921, p. 1030, by Clair V. Mann, engineer in charge of construction, and also of re-design, was completed in September, 1920. It was designed to guard against underflow along either the earth on which it rested or along the rock below, and drains had been provided in the rock fill beneath the downstream third of the dam. The original plan, Mr. Mann stated in his article, was to build "a concrete cutoff wall extending down to bed rock, and up from stream bed a height of 50 ft.," but as this was not "within the company's means," the cutoff just described was substituted. Mr. Mann also states in his article that as originally planned the dam was to have been carried 120 ft. above the stream bedrock but that "financial considerations" restricted the height to 115 ft., thus leaving the crest of the dam "only 7.8 ft. above the spillway crest, and the writer [Mr. Mann] considers this insufficient margin for safety."

Mr. Mann is on record even more specifically than this as to this danger. In a protest and warning printed on the official record plans filed in the office of the state engineer of Colorado (the plans being dated July 15, 1919; the protest Sept. 18, 1920; and the approval of the plans as of March 21, 1921, being signed "Addison J. McCune, State Engineer"), Mr. Mann mentions "a discrepancy between the elevations of the spillway" and the "crest of the dam as staked out by Chase & Barto and as shown on their plans." He says:

> The changes on this sheet are due to the fact that the undersigned assumed the previously mentioned plans and surveys were substantially correct, and, because both time and help were limited in making surveys for the revised plans, did not make the revised survey of spillway until after construction was well under way. The above noted discrepancy was then found, and to correct it and make the dam safe, the changes shown on this sheet were made and staked out on the ground by me, in accord with the specifications, and well in advance of construction at the levels involved. Neither the company nor contractor would agree to the change although fully advised that the dam would settle perhaps 5 ft. after filling, and that with much spillway discharge and simultaneous south winds, the dam will be overtopped. The state engineer was likewise fully informed as to all facts in the case, but required no change. I absolutely decline to accept any degree of responsibility for any future damage the dam may suffer by reason of failure of company or others concerned to have indicated changes made when they were possible, or in the future, nor for failures to build rockfill toe or line tunnel as provided for in my plans and specifications.

While awaiting fuller details there are given below telegraphed reports on the failure from A. J. McCune, state engineer of Colorado, who was consulting engineer for the dam when it was built; from John E. Field, representative of Mr. McCune at the scene of the failure; and from O. N. Floyd and Barton M. Jones, Pueblo representatives of the Dayton-Morgan Engineering Co., who visited the scene of the failure:

Mr. McCune — Dam break due to settlement cracks. Water was 2 ft. below spillway and 13 ft. below dam crest at time of break. Break occurred at 3 p.m. At 5 p.m. had discharged 18,000 acre-feet. Apishapa Creek at Arkansas River, forty miles below dam, discharged about 60,000 sec.-ft. and was 3 ft. below flood crest of 1921; at La Junta was about 14 ft. below 1921 flood.

John E. Field—Failure probably due to settlement cracks. Previous maximum filling, 20 ft. below spillway. No lives lost. Financial loss about $1,000,000.

O. N. Floyd and Barton M. Jones—Dam 70 miles southeast of Pueblo and 35 miles south of Fowler. Outlet tunnel 10 x 11. [10 x 10¾ ft., according to Mann article, and built to deliver 2,000 sec.-ft. to satisfy prior water rights], through rock in West bluff, partly lined with concrete. This tunnel, with gates and tower, undamaged.

Spillway 10 ft. [Mann article, cited above, says 7.8 ft.] below top of dam and one mile from dam, through natural gap. At time of failure water was stationary 10½ ft. below top of dam. Previous high stage, which occurred last winter was 10 ft. lower.

Flood caused by cloudburst in headwater region without excessive rains near basin.

Fill placed by wagons in layers of 1 ft., sprinkled and rolled with smooth concrete roller weighing one ton per foot width. Lower 60 ft. built of earth taken from valley bottom, balance taken from high ground east of dam. Small part of valley material was left in west upstream toe and appeared to be fairly well saturated. Small amount of upland material left at each end of dam appeared to be finely powdered, earth containing some sand and gravel. Water had penetrated this material 5 ft. at a depth of 20 ft.

Dam was being watched by the owner's chief engineer, who had a large crew on hand because of small leaks underneath at each end, about 25 ft. below the top. These leaks had given trouble last year, but had been practically stopped before the failure occurred. When all danger was considered past a large flow of water was discovered entering the dam at the water surface near the east end. A few minutes later a muddy stream the size of a man's body burst from the downstream slope near the west end at about 35 ft. below the top of the dam. In spite of all efforts to stop the inflow it increased very rapidly and it was soon apparent that the water entering at the east end was the same water coming out of the downstream slope at the west end. A caving in of the top soon exposed the diagonal flow through the dam. This open channel flowed several minutes before the general failure began.

The workmen left the dam at 3 p.m., when the flow was beyond control. At 3:45 the water surface in the reservoir bed had fallen 2 ft.; at 4 p.m. it had fallen 3 ft. and during the next thirty minutes it dropped 25 ft. This 25 ft. represented a storage of 9,300 acre-feet or half the original contents, discharging at an average rate of 225,000 sec.-ft. During the next fifteen minutes the water level dropped 13 ft. which left a storage of 3,600 acre-ft.

The narrow rock canyon continues about a mile below the dam. At a point 1,000 ft. below the dam the maximum high-water mark was 45 ft. above the creek bed. Below the canyon the flood plain widened to a mile and a half in some places with a maximum depth eleven miles below the dam of about 15 ft. The flood reached this point at 5:20 and at 8 o'clock it reached the railroad bridge near Fowler, 35 miles below the dam. Here the railroad embankment acted as a retarding dam and reduced the flow, already greatly modified by the valley storage, to 50,000 sec.-ft. The flood wave continued down the Arkansas River at about four miles per hour.

No loss of life has been reported and the property damage [below the dam?] is much less than would be expected. None of the numerous diverting dams along the Arkansas River was destroyed.

The foregoing information was gathered from personal inspection of the site of the dam and valley and from interviews with persons who saw the failure and some who were familiar with construction of the dam.

The dam was the property of Apishapa Consolidated Irrigation Co. It was constructed under the general supervision of the state engineer and it is apparent that care was exercised to obtain a first-class job.

Photographs from John E. Field

VIEWS OF APISHAPA DAM AND RESERVOIR, COLORADO, BEFORE, AT INCEPTION OF AND AFTER FAILURE

1. Part of upper slope with water surface at about 76 ft. as shown by gage on outlet tower at left. Gage reading at time of break was 83 ft.
2. Water coming from lower slope of dam, near west end, at beginning of failure, about 3 p.m., Aug. 22.
3. After the failure: looking downstream. Remains of dam above water level show at each end. Note cutoff wall at right end.
4. East end of what was left of dam after failure, with concrete cutoff wall that was carried up and into canyon side and projected into earth dam. Also shows cast-iron drain pipe.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Am. Soc. C. E. Nominations

Sir—May I call your attention to one error in the report printed on p. 319 of *Engineering News-Record* for Aug. 23, showing the result of the second ballot for official nominees of the American Society of Civil Engineers, canvassed Aug. 15?

In District 1 the two candidates for the office of Director were both to be voted for, as there are two vacancies to be filled. Paul G. Brown received 455 votes out of a possible 551—the total number of members who voted in that district. Thaddeus Merriman received 513 votes from the same 551 members. Since these men were not in competition with each other, the addition of the figures to show a total of 1,006 is misleading.

JOHN H. DUNLAP,
Secretary Am. Soc. C. E.

New York, Aug. 24.

Street Docks for Parking Cars

Sir—Referring to the enclosed clipping, and the author's suggestion that "traffic officials take the attitude that parking spaces should be so arranged as to accommodate the greatest number of cars," etc., why not, instead of painting white lines on pavements (which few drivers heed when parking) build out from the curbs at the proper angle and at curb height, concrete barriers, thus giving the curb line plan a "harbor appearance" like that of the Hudson and East River pier lines, only with greater uniformity. These permanent "berths" can be rented by the city authorities to motorists on some similar basis to that charged by pier-owners for the use of their piers by the ships which dock at them. Car owners who want to store their cars all day in front of some one's place of business, to the latter's inconvenience, and perhaps his financial detriment, would pay a storage charge in proportion to the time they occupied the berth, and thus a premium would be put on getting out quick, and keeping on the move for there would be no "free parking" in the congested area or district. Of course the rates would also have to cover a sort of "time-lock," like a slot machine, on the curb. Man drives into the berth, slips the chain of the time-lock through front wheel and hooks the free end into its proper place in the time-lock which starts the time mechanism, comes back in an hour, wants to go, dial shows amount due, say 50c. puts in money same as in telephone, chain releases, and he can get away. The "perambulating inspector" finding anyone using berth without tying up to the time-lock has the cheater arrested and fined for beating the city out of its revenues, etc. Thus we have it all simplified—the congested area is relieved of the "dead-storage" problem, and the expense of supervising "limited" parking is borne by the man who causes the expense, etc. (You sell the idea to the city authorities and we'll organize a company to build the time-lock devices and we'll either sell them on a royalty basis or rent them for a fixed annual fee, same as slot machines are handled.) Insurance companies ought to like this because it would reduce the stolen car risk, and I'll bet there's many a car owner willing to pay for a place to park.

(No! This isn't the result of "the hot weather," and I own a car, too.) But we both know of men who have made a lot of money out of less worthy ideas than this, and maybe some one will out of this. It has its possibilities.

Seriously, though, something ought to be done to straighten out this parking problem. Yes, it's getting so that the average motorist in a big town is as bad off as Noah's dove, which we are told found no place to park and so returned to the home garage. So if you, in your search for solutions to traffic engineering problems, can use this idea—go ahead.

A. NONYMOUS.

Washington, D. C., Aug. 16.

Using a Bridge to Brace Its Abutments

Sir—Some fifty or sixty years ago William F. Ellis, of Ashland, Mass., widely known in railway engineering circles, was chief engineer of a western road. He once had occasion to change the plans of a road crossing from grade to overhead, which in turn called for changing a near-by river bridge from through to deck construction. The bridge had a span of about 200 ft. One of the resident engineers presented a very low estimate of the cost of this change, and in explanation produced a sketch which showed retaining walls about 20 ft. high, so thin as hardly to carry their own weight. The resident engineer's attention was called to the doubtful strength of the walls, and their relation to the thrust of the embankment. He said in explanation, "The end of the deck bridge will take care of that all right." Mr. Ellis looked at his assistant for a moment rather sternly, and then said, "Young man, I am unfamiliar with your practice out here; but in my part of the country abutments are built to support bridges. Not a bridge can be found carrying its own abutments." X.

Shelter Island, N. Y., July 21.

Highway "Distant" Signals at Crossings

Sir—In Ohio, and elsewhere as far as my observations have been made, the danger signals along the highway have in general corresponded with what in railway signaling is known as the "home" signal. Apparently the idea of placing a variety of danger signals very near the railroad has held too long. The vehicle on the pavement is no longer horsedrawn, and the old crossarm or its nearby assistants do not inform the motor vehicle sufficiently in advance.

My proposition is to place one, two or three series of "distant" signs for the motor driver to read. These may vary with circumstances but where possible the arrangement would be to place one series of three signs, one 500 ft., another 1,000 ft. and the third at 1,500 ft. from the track. Each series should consist of three separate signs with all lettering horizontal, the signs to be placed generally on the right side of the road, or where lights strike them at night; the first sign to read "DANGER"; the second "RAILROAD" (if two railroads or more are parallel or cross the highway near each other this would be varied as "3 RAILROADS"); the third sign to read "1,500 FT." if three series as above indicated were used.

The individual signs should be not closer than 50 and preferably 75 ft. apart (or more) and the sign carrying the distance information should be that distance from the first railroad to be crossed.

I suggest signs having letters 24 in. high and the individual words or phrases to measure 10 ft. long. The signs should therefore measure 36 in. by 12 ft. The character of letters should be plain capitals with from 4 to 5½-in. stroke.

White backgrounds with black letters on wooden signs, made with a slight water-table above and half-round strip on sides and bottom, and supported by two posts of durable wood but light section, would in general be the construction. The signs should be erected so as to clear from 48 to 60 in. above the pavement (clearing ordinary weeds and snowdrifts) but in special places they might be much higher or even lower than the highway, depending upon gradients and positions of the light shafts.

I have recently painted on highways danger signs of the above description with letters 24 in. high and of 5½-in. stroke, but abbreviating the "RAILROAD" to "R.R." or "2 R.R.'S," etc. There is no way of permanently marking these letters on the pavement however, and the zone-marking

white paint discolors to a yellow if placed on tar. For this reason I propose the sign on the side of the road, wholly free from advertising or state-highway marking, and in two or three series as stated above.

The Ohio highway department has painted white strips to correspond with two rails across the highways at certain places. This I believe is good practice but would be better if the strips paralleled, as nearly as practicable, the railway. One would then know in what directions to look for a headlight.

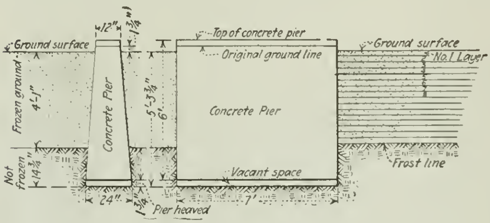
I am offering this plan to meet the grade-crossing menace; it is a "distant" signal to careful and careless alike whether driving at 15 or 50 miles per hour.

It is not intended to replace the home signal or signals, stationary, reflecting, swinging, flashing or bell ringing. I believe, however, that the plan contemplates an inexpensive addition to existing signals at a fair percentage of the grade crossings.

Columbus, Ohio, V. A. EBERLY.
Aug. 16, 1923.

Action of Frost in Heaving Concrete Piers

Sir—Last March we were notified by the manager of our Montreal plant that one of the concrete piers supporting a shaft and hot air duct outside the main motor house had been raised 1¾ in., apparently by frost action. This pier had been constructed during the previous summer. It was 7 ft. long and tapering in section from 2 ft. wide at the base to 1 ft. wide at the top, and set in the ground to a depth of 5 ft. 3¾ in. as shown in the accompanying sketch. As the form of the pier was intended to prevent just such heaving by frost, and as the depth of the bottom was considered to be well below the usual frost penetration, I immediately had an investigation made to determine if possible the cause and to see just what had occurred. The ground in which



SECTIONS THROUGH CONCRETE PIER TO ILLUSTRATE EFFECT OF FROST ACTION

the pier was built is a heavy, tough, sticky clay of a grayish brown color, frequently known as gumbo. At this point it was kept well saturated by the drip from a nearby steam trap which was unable to escape on account of frozen ditches.

In digging down alongside of the pier we found the ground frozen solid until it was almost like sandstone to a depth of 4 ft. 1 in. below the surface. Beyond that point there was no frost and the wet, sticky clay could be scooped out by hand. Underneath the pier we found a vacant space 1¾ in. deep which clearly indicated that the pier had been raised bodily for that distance above its original bed.

The theory that we have to advance is as follows:

Imagine the ground to be laminated, and for the sake of argument we will say each layer of earth is 1 in. thick. As the winter advanced, layer No. 1 at the surface of the ground froze and at the same time it froze to the sides of the pier. As winter advanced still further, layer No. 2 (which was also saturated with water) froze, and, in freezing, it expanded and pushed layer No. 1 up, breaking the bond between layer No. 1 and the sides of the concrete pier. So this action proceeded, until the ground was frozen to a depth of possibly 3 ft. Then a thaw occurred. During the thaw the melting snow on the surface then found its way down between the frozen ground and the sides of the pier. Immediately following the thaw, which only lasted long enough to melt the snow on the surface of the ground, came freezing weather, at which time the water between the frozen ground and the sides of the pier froze solid, and bonded about 3 ft. of frozen earth to the sides of the pier. As the cold weather continued, this freezing action was repeated, but this time when a layer of earth an inch thick would freeze and expand, instead of breaking the bond between the frozen ground above and the sides of the pier, it would lift both the frozen earth above it and also the concrete pier, as the bond between 3 ft. of frozen ground and the concrete pier was greater than the weight of the pier and the frictional resistance of the 1 ft. 3¾ in. of soft clay against the sides of the pier under the frozen ground. As the freezing continued, this action was repeated until the pier was finally lifted 1¾ in. out of the ground.

The fact that the pier did not heave out of the ground until the end of February or March tends to confirm this theory.

One often reads specifications to the effect that all foundations shall extend below frost line. Such a specification is undoubtedly satisfactory in the case of a heated building, but in the case of isolated piers and non-heated buildings I am convinced that such wording of specifications allows for very little protection against heaving.

In view of the fact that I have not been able to find any satisfactory explanation of frost action on foundation piers in textbooks and technical magazines, I am forwarding the results of our investigation and our conclusions in the hope that you will give us your views on the subject.

Montreal, L. DEB. MCCREADY,
June 6, 1923. Chief Engineer,
Canadian Explosives, Ltd.

[In considering this case of frost action on foundation piers, described by Mr. McCready, it should be noted that the pier in question is unusual in that it supported only a light timber framework carrying a 3 15/16-in. shaft and a 10-in. hot air duct inclosed in a light wooden box. Consequently the heaving action of the frost only had to raise a little more weight than the weight of the concrete pier itself. For such piers a spread footing with the top of the spread footing well below frost line, properly reinforced for tension between the body of the pier and the spread footing, would probably prevent heaving. In constructing such piers the surface area exposed to the freezing ground should be reduced to the minimum.—EDITOR.]

A Remedy for Wearing of Earth Shoulders

Sir—A subject of much interest is that of a method of preventing the earth shoulder from washing or wearing away from pavements. Everyone knows the inconvenience and danger to traffic caused by this condition yet its elimination does not seem to the writer to present economic or structural difficulties.

This condition can be eliminated without additional cost above that estimated for the pavement. Suppose it is decided that an 18-ft. pavement will accommodate traffic over a certain route and that the pavement is to be of concrete. If instead of constructing a concrete pavement 18 ft. wide a width of 12 ft. were constructed of concrete in the middle of the roadway, and this flanked on both sides by clay-bound or water-bound macadam of such width as can be built with the money saved by cutting the concrete down to 12 ft., a pavement could be constructed of sufficient width to be safe without costing any more than the standard 18-ft. pavement. The concrete section would accommodate the traffic in a single lane and the macadam sections would be used in meeting and passing.

E. D. FRY,
Columbia, S. C., Resident Engineer, South Carolina
Aug. 23, 1923. Highway Department.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

"Harding Highway" Is the Name Given by the Board of Chosen Freeholders of Salem County, New Jersey, to the Pennsgrove-Malaga road, in commemoration of the late President Harding, who last spring passed over this road enroute from Washington to Atlantic City.

Surveying for a Branch Line of the Canadian National Rys. from Brule, Alta., to Grande Prairie, a distance of 200 miles, has been started. This will give settlers in the Peace River country a direct connection with the Pacific and will tap important coal deposits on the Smoky River, the Bay River and Sheeps Creek.

Upon the Recommendation of its engineering staff, the Federal Power Commission has approved the application of the Pike Rapids Power Co. for a license to develop power at Pike Rapids on the upper Mississippi about 70 miles north of St. Paul and has rejected the conflicting application of the Little Falls Water Power Co. The project will develop approximately 24,000 hp.

Addition of a New 10,000-k.w. turbine unit at the plant of the Oklahoma Power Co., on the Arkansas River, across from Tulsa, at an expense of $600,000, will bring the total capacity of the plant to 30,000 kw., according to Fred W. Insull, president of the Public Service Corp. of Oklahoma. Work on the new installation will start within a few weeks.

Contracts for Two More Hydro-Electric developments in Canda have been awarded. That for the Southern Canada Power Co.'s new 30,000-hp. plant at Hemming's Falls, near Drummondville, Que., has been awarded to the Foundation Co. of Canada, Ltd., and that for the Hollinger Consolidated Gold Mining Co.'s 25,000-hp. plant at Island Portage on the Abitibi River in Northern Ontario to Sir Wm. Arrol, Ltd., of St. Catherine, Ont., for the dam and power house, to the Dominion Engineering Co. for turbines and to the Canadian General Electric Co. for generators.

The Alaskan Engineering Commission, the organization which constructed the government railroad in Alaska and now has charge of its operation, will hereafter be known as the Alaska R.R., according to an announcement of the Department of the Interior. This change will eliminate considerable confusion which now exists due to the similarity of the two names, the Alaskan Engineering Commission and the Alaskan Road Commission; the latter commission being under the supervision of the Secretary of War and charged with the construction and maintenance of wagon roads in Alaska.

Part of Nutley Zoning Ordinance Held Unconstitutional

Following closely on a decision of the New Jersey Supreme Court, by Chief Justice Gummere, that a prohibition of two-family dwellings in the zoning ordinance of Westfield, N. J., is illegal (see *Engineering News-Record*, Aug. 16, p. 281) Judge Katzenbach of the same court has ruled against the portion of the zoning ordinance of Nutley, N. J., under which a building permit for a store in a restricted residence district was refused. In essence, the last-named judge held that the property owner would be deprived of a constitutional property right under an interpretation of the police power which is contrary to the opinion of the judge as to what that power includes.

Toronto Faces Large Expenditure for Improvements

The city of Toronto, Canada, has just been appraised of the fact that during the next few years it must face an outlay of approximately $60,000,000 for special purposes. The information was contained in the annual report of Finance Commissioner George H. Ross. Included in the prospective items of expenditure were: Money to be paid for the street railway which was recently taken over by the corporation; the city's share of the cost of a railway viaduct on the waterfront and the grade separation in the northwest section of the city; consolidation and extension of the municipally-owned light and power system; extensions and new equipment for the transportation system; duplication of the water-works system.

Building 125-Mile Transmission Line in Northern Ontario

Work has been started on the 125-mile transmission line from the new power plant of the Des Quinze Power Co., a subsidiary company of the Northern Canada Power Co., on the Des Quinze River in Quebec to Porcupine, Ont. The power line is to be built with steel towers and with transformer stations at each end and stepping-down stations at the various mining camps in the Porcupine area which it will serve. It is expected that the construction parties will be able to erect ¾ mile of line a day, employing up to 1,000 men on the work. If this is done the transmission line will be completed at about the time that the machinery will be delivered at the new power plant. The estimated cost of the transmission line is $1,500,000.

The initial installation at the Des Quinze River power plant will be two units of 10,000 hp. each. C. F. Goodall, who built upwards of 1,000 miles of transmission line for the Ontario Hydro-Electric Power Commission, is in charge of the work.

Work Assailed for Removal of A. P. Davis

Civil Service Reform Leader Questions Secretary's Right to Replace Reclamation Director

Authority of Secretary of Interior Work to abolish an office in the classified civil service list and to appoint to that office, by a mere change in title, a man lacking in any civil service status, is seriously questioned in a letter from William Dudley Foulke, president of the National Civil Service Reform League, to Dr. Work. The letter, made public Aug. 27, goes into the details of the summary dismissal of A. P. Davis, as director of the Reclamation Service, and the appointment of D. W. Davis as commissioner.

Mr. Foulke suggests that the change was one of political expediency and not the replacement of an engineer by a banker to effect a business administration in the service. After discussing the comparative qualifications of the two men, Mr. Foulke asks:

"Can you wonder that to many it seems that your statement of Aug. 15 that the problems of water users could be 'best handled by a practical business man,' alludes rather to the business of politics than to any other business, and that there is a fear that the public interest will be sacrificed to the demand for men useful to the party, not only among the farmers and water users, but also in the next convention and campaign?

"You once stated to me that 'other things being equal, Republicans should be appointed to places under a Republican Administration.' Are you not now extending that principle so as to make it provide that a serviceable Republican politician should be appointed whether other things are equal or not?"

Resignation or Dismissal?

"Was Mr. Davis's resignation voluntary or requested? Was he not informed by you on June 16 that you had decided to give his place to another man, and did you not then request him to send in his resignation to take effect June 30?

"Did he not, accordingly, write you that in pursuance of your suggestion he so tendered his resigation, and did you not thereupon object to his statement that the resignation had been requested and say that you would prefer that it should appear that it had been initiated by himself and that surely he would not desire to advertise the fact that he had been 'fired'; and did he not answer that he desired the world to know the facts, whatever they were? Did he not afterward write you that he had reconsidered his decision to eliminate those words, concluding that he would thereby be making himself party to a public deception?

"If your reasons for his removal were wholly for the interest of the service and were not political, why did you wish thus to deceive the public?

(continued on p. 363)

Private Capital May Develop Ohio River Power

Though Denied Application for Federal Dam Project, Louisville May Yet Control Private Enterprise

Washington Correspondence

The Federal Power Commission has granted a preliminary permit to the Louisville Hydro-Electric Co. to develop power at the proposed government dam at the falls of the Ohio near Louisville and has rejected the application of the municipality of Louisville for similar rights. This action is the result of the recommendation of the engineering staff of the commission and closes a long argument as to who should develop power at this site—Louisville or private capital.

The engineering report points out that this development is of little value unless it has auxiliary power to supplement it and that the city, in order to make it a paying proposition, would have to build an auxiliary steam plant as well as a complete distributing system, or else would have to take over the property of the Louisville Gas & Electric Co. by condemnation proceedings. In either case the amount of money required would exceed the present bonding capacity of the city of Louisville, and would consequently require an act of the state legislature before the bond limit could be increased.

The engineers further point out that the Louisville Gas & Electric Co. has the necessary distributing system and steam auxiliary. Moreover, the proposed power development is feasible only as an adjunct to navigation development on the Ohio River, and as this navigation development must be started within a year, since it is part of the remaining gap to provide 9-ft. navigation in the Ohio from Pittsburgh down, it would be impossible for the city of Louisville to get through the necessary legislation in time to start the development.

The report still further points out that the city has legal authority to regulate rates and can therefore protect itself, and that whenever it is able and ready to condemn and take over the properties of the Louisville Gas & Electric Co., it can take over this hydro-electric development as well. Therefore, the rejection of the city's application does not deprive the municipality of the right to go into the power business whenever it is ready to do so.

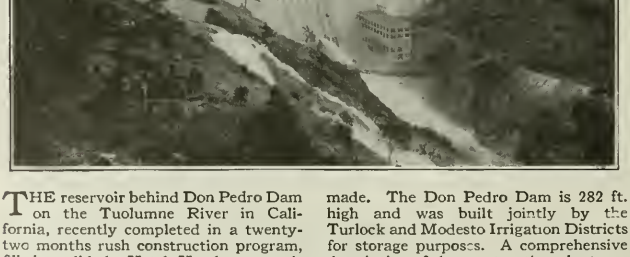
Since the Louisville Gas & Electric Co. did not promptly accept its preliminary permit the Federal Power Commission has advised the mayor of Louisville that it will hold up the execution of the permit until Sept. 6 to afford the municipality an opportunity to present additional arguments in favor of municipal development.

Construction Started on Merced River Dam

All bids on the construction of the Exchequer dam on the Merced River for the Merced Irrigation District have been rejected and the work will be done on the day labor plan by the district under the supervision of Thebo & Anderton, construction engineers of San Francisco. Work has already been started on foundation excavation in the expectation of taking advantage of the next low water season in placing the footings. The dam will be 310 ft. high above the river bed, the total height not being definitely known until the foundation exploration is complete, but it will not greatly exceed the height mentioned because good foundation is known to be near the surface at this point. The construction period is expected to occupy about two years.

The construction of this reservoir will necessitate the relocation of about 17 miles of the Yosemite Valley R.R. and estimates are now being made on grading and other work involved in the railroad relocation.

Don Pedro Reservoir Fills Promptly



THE reservoir behind Don Pedro Dam on the Tuolumne River in California, recently completed in a twenty-two months rush construction program, filled, as did the Hetch-Hetchy reservoir which is farther up the same stream, within a few weeks after closure was made. The Don Pedro Dam is 282 ft. high and was built jointly by the Turlock and Modesto Irrigation Districts for storage purposes. A comprehensive description of the construction plant was published in *Engineering News-Record* June 1, 1922, p. 896.

New Tunnel to Be Built in San Francisco

The San Francisco board of supervisors on Aug. 20 approved the construction of the Eureka Valley tunnel, a vehicular and railway tunnel, 1,634 ft. long, near the Twin Peaks tunnel, which will open up a direct route from Golden Gate Park and the Sunset district to Market St. and the Mission district. The bore is estimated to cost $1,368,107 of which the city has voted to pay 25 per cent, the remainder to be paid by an assessment on benefited property.

A. G. C. Organizes in Denver

A chapter of the Associated General Contractors of America has been effected in Denver Colo. This new concern will be known as the Rocky Mountain branch and it will comprise the states of Colorado, Wyoming and New Mexico. The officers are: Alex Simpson Jr., president; Major W. R. Richards, executive secretary; Maurice Levy, vice-president; Fred C. Dreher, secretary-treasurer. The board of directors: F. J. Kirchhof, C. S. Lambie, Peter Seerie, J. Fred Roberts, J. Everett Young. all of Denver, and Fred Bullen, of Pueblo. Major Richards has had extensive service in railroad, water works and general building construction, and was at one time associated with the J. G. White Engineering Corp., of New York, leaving that concern to enter service during the war.

Headquarters for the Rocky Mountain branch are at the Architects and Builders Exchange building, 1735 Stout Street.

Akron Votes to Transfer Power of City Manager to Mayor

By a majority reported as "exactly 100" in a total vote of "more than 14,000," or "only a small per cent" of those entitled to cast a ballot, the voters of Akron, Ohio, on Aug. 14, adopted a series of charter amendments abolishing the office of "chief administrator" (the local charter designation for city manager) and conferring the duties of the office on the mayor. The charter was adopted Nov. 5, 1918, by a vote of 11.584 to 6,233.

When the charter thus amended went into effect on Jan. 1, 1920, the city council appointed William J. Laub, mayor elect, as city administrator, and the president of the council became mayor. Two years later, after a "bitter fight," a new council displaced Mr. Laub by Homer Campbell. In the September following Mr. Campbell resigned, stating that he was "undesirable to the city political bosses," and P. Tucker was appointed in his place. The salary of the city administrator was $10,000 a year while Mr. Laub was in office and has been $7,500 since. The salary of the mayor has been $3,600 a year but with the transfer of the duties of city administrater to the mayor it will be $7,000. The chief administrator was appointed by the council. He appointed a civil service commission and most of the department heads.

The population of Akron in 1920 was 208,435, as compared with 152,559 for Dayton and 137,634 for Grand Rapids, Mich., the two ranking cities with city managers. On Jan. 1, 1924, the council-manager plan will go into effect at Cleveland, Ohio, the population of which in 1920 was 796,841.

Army Engineers Hear Plan For Bridge Over Hudson

Clearance Height and Safety To Navigation Are Principal Topics Discussed

On Aug. 27 a public hearing was held at New York by a board of Army engineers headed by Col. H. S. Newcomer on the project of the North River Bridge Co. for a suspension bridge across the Hudson from 57th St., New York, to the Weehawken heights. The plan submitted by the company provides a main span of 3,240 ft. between centers of towers and side spans of 1,590 ft. on each bank with a clearance height of 150 ft. on a 500-ft. width, 145 ft. on a 1,500-ft. width, and 135 ft. near the towers. The towers are steel structures enclosed within a masonry protecting shell, resting on piers 200 x 400 ft. seated each on 80-ft. cylinders sunk to rock by open dredging. The superstructure comprises two superimpose eyebar chains on either side of the deck, 160 ft. apart, with trussing of verticals and diagonals between the two chains. The deck is 235 ft. wide and has two levels, the upper for highway and the lower for railway traffic; it is carried on stringers extending between steel plate-girder floorbeams 35 ft. deep by 225 ft. long, built with six rectangular openings through the webs, each long enough to pass two tracks of the twelve railway tracks of the lower level.

Col. Newcomer stated that the hearing was concerned only with matters affecting navigation, including clearance height and safety. Span width was not considered as the pier locations are inside the pierhead lines. In addition to many letters supporting the project several were presented in opposition, including two by engineers, R. S. Buck and W. L. Saunders, the former urging that the traffic of the highway deck would congest the streets of New York and that the structure proposed is of unprecedented character.

Interstate Traffic Discussed

Speakers in support of the bridge projects discussed the needs of traffic between New York and New Jersey in various aspects. Opposition discussion centered on the question of clearance height. Col. Newcomer stated that six or seven steamships would require a clearance height of 225 ft. to pass their masts, and some 30 others would require more than the 150 ft. proposed. Representatives of lines operating large vessels claimed that the location at 57th St. would restrict the use of the new piers for maximum ships at 46th St., and that for the purpose of docking at flood tide the bridge should be a clear distance of a mile above the piers unless its clearance height on the full width were greatly increased. They admitted on question, however, that masts and funnels could be arranged to be lowered when necessary. The 135-ft. precedent set by the permits for the Brooklyn bridge and the new Philadelphia bridge was declared inadequate and hampering by members of the board. Questions of the board were directed repeatedly to the point whether tunnels would meet the traffic needs of the two sides of the river, with generally negative response.

For New York City R. F. Keller presented the views of the Dock Department and A. S. Tuttle, chief engineer, spoke for the Board of Estimate. Plans are under way for new large-size piers at 50th St., Mr. Keller stated, and the northward extension of pier construction is likely to progress farther. The problems of street congestion and proper distribution of the bridge traffic, said Mr. Tuttle, will be considered by the city at a later stage, when detail plans are presented by the company.

It is expected that the decision of the War Department on the application for approval of the plans will not be rendered for several weeks.

Consulting Engineering Organizations Affiliate

George B. Nichols, consulting engineer, 300 Madison Ave., New York City, and The Terrell Croft Engineering Co., of which Terrell Croft is directing engineer, of 6600 Delmar Boulevard, University City, St. Louis, Missouri, have effected an affiliation whereby the experience and resources of each organization will be available to the clients of the other. Nichols will act as the principal for projects east of Illinois, whereas the Croft organization will so act for projects west of that state. The combination will, as have its components in the past, specialize in mechanical and electrical engineering for power and industrial plants, institutions and buildings.

Work Assailed for Removal of A. P. Davis

(*Concluded from p. 361*)

"You say that no diminished construction program is anticipated, but rather an increased and accelerated construction, and that the same chief engineer now is at the head of the work. But if these vast projects are still before you, ought they not still to be under the direction of the experienced man who had begun them—a man who was then offered and is now earning in private employment far greater compensation than that received from a Government which he was patriotically serving to his own pecuniary loss?

"You say you offered him an appointment as consulting engineer. Was not this offer made on condition that he would omit the statement that his resignation as director was requested? And did you not warn him of the consequences to himself if he refused to omit that statement? Why did you do this? Did he not request of you a written statement of the reasons for his removal, and did you not answer that he was not entitled to such a statement under the law?

"You say advice to the farmers was needed regarding the subdivision of large landholding, getting more settlers, securing industrial enterprises, more intensive farming and co-operation in handling and marketing products by men trained along these lines. Is not such service now being rendered by men trained along these lines in the employment of the Department of Agriculture?

"If you were looking for business qualifications, did you appoint a man who had been successful in business? Was the bank of which Governor Davis was the organizer and president markedly successful? Was it not rather to politics that his principal activities have been devoted? Had he not been a candidate for other Federal appointments?"

Pinchot Makes Last Effort To Avert Coal Strike

Unless Compromise Plan Is Adopted, Miners in Anthracite Fields Will Strike Sept. 1.

After having failed to come to any agreement either in the extended Atlantic City conference or in the subsequent conference in New York City attended by members of the U. S. Coal Commission, anthracite operators and miners are still deadlocked on vital controversial issues: the wage schedule that is to replace that which expires Aug. 31, and the checkoff. Unless speedy and effective measures are adopted the country will face a stoppage of all anthracite mining Sept. 1.

Meanwhile, Governor Pinchot, of Pennsylvania, called in as official referee, has been holding for the past three days secret and separate conferences with both miners and operators in the endeavor to get them to agree to some compromise plan which will avert a strike. At the same time he has been employing his own state fact-finding commission presided over by Prof. Clyde C. King, former head of the department of economics of the University of Pennsylvania and now state secretary of that state composed of industrial and economic researchers and writers, to gather data on the economic phases of coal digging and distribution. Upon such data will his decision be based.

Only rumors of the compromise plan in Gov. Pinchot's mind have been heard, the details of the plan having remained secret, but at the time of going to press the proposal is about to be given both contestants. However, it is thought that Gov. Pinchot may suggest an increase in miners' pay of 5 per cent or better, and allow the operators to reject the miners' insistance that they be granted the checkoff.

In a statement issued Aug. 30 the U. S. Coal Commission asserted:

"Should a stoppage of mining occur on Sept. 1, it will accentuate the already panic demand for anthracite and unless the buyer and the retailer representing him learn from past experience, unscrupulous wholesalers will have another opportunity to repeat their speculative activities of last fall and winter on any anthracite coal that may be on the market after Sept. 1, as well as following the resumption of mining. In the absence of any definite regulatory powers over either mine prices or wholesalers margins on the part of the state and federal authorities, the extent of such activities, and the amount of premium added by wholesalers will depend largely upon the willingness of the retailer and the consuming public to pay the prices demanded.

Tentative Value Given C. & N. Ry.

A tentative value of $485,334,029 has been placed on the property of the Chicago & Northwestern Ry. by the Interstate Commerce Commission as of June 30, 1917. Since that date the railroad company has expended $57,820,981 on road and equipment, which brings the total value of the railroad and equipment up to $543,155,010. The company's bonded debt on Dec. 31 last was $287,906,700, and its preferred stock $22,395,120, which leaves a balance of $232,853,190 or about $150 a share on the common stock, of which $145,156,344 is issued.

Random Lines

Add to Definitions

Liquidating Engineers—Second-hand machinery agents (*Engineering News-Record* advertising pages).

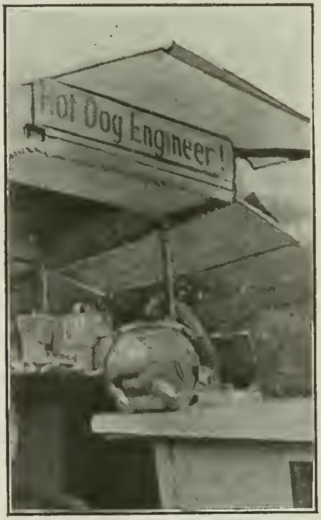
Kitchen Engineering — Free course conducted by domestic science experts from Antioch College as part of sales campaign for kitchen cabinets in a Dayton department store.

Packing Engineering—Department of trade journal "The Barrel and Box" devoted to methods of boxing and crating goods.

Caterpillar Engineers—Gentlemen engaged in driving tractors in clearing land. Reported in the Girard, Cal., *News*. Probably not related to "mosquito engineers" previously noted.

Vocational Engineer — "Character analyst" in Baltimore who picks "right man for right job."

Hot Dog Engineer—The last word in engineering nomenclature. Discovered by W. G. R. as a concessionaire in Fairmount Park in Philadelphia. One member of the profession who believes in advertising himself, ethics or no ethics. See accompanying illustration.



* * *

Sir—With respect to the editorial "An Explanation That Does Not Explain," dealing with the removal of Arthur P. Davis, it is evident that a weak defense of an indefensible action calls for work with a capital W.

A. W. W.

* * *

Maybe They Meant Sand-Chucks

In a book review published in an architectural contemporary appears the following: "It seems strange that the writers of books on foundations neglect to have some practical sections written by experienced digger foremen and superintendents, commonly known as 'ground hogs.'" Doubtless this accounts for the large numbers of men who may be seen each Feb. 2 emerging from excavations all over the land and hunting so diligently for their shadows.

Mud-Laden Water at Omaha Causes Water-Works Trouble

Erosion of a mud bank on the shore of the Missouri River above the intake of the water-works supplying Omaha, Neb., and vicinity, combined with a large accumulation of sediment in the settling reservoirs, both due to high water in the river, gave rise to some alarming press dispatches sent over the country last week. The following details of just what happened and how the emergency was met were sent to *Engineering News-Record* at its request by R. B. Howell, general manager of the Metropolitan Utilities District, under date of August 24:

"The Metropolitan Utilities District has been installing a 50-m.g.d. filtration plant in connection with its sedimentation basins and has also been putting in two additional pumps at the Florence station, increasing the pumping capacity by about two-thirds. This work, which is nearing completion, has necessitated certain pipe connection changes that have interfered with the regular washing of the sedimentation basin. As a consequence, the capacity of the basins for clearing the water was reduced. In this crippled condition the basins were called upon to cope with the present high stage of the river and also with the effect of the erosion of a mud bank on the west side not far above the intake. The resulting quantities of silt introduced into the basins proved the last straw, and the clarifying process broke down. There was but one thing to do in the emergency, and that was to wash the basins. This work has been carried to the point where it is possible to operate the filter plant at a rate high enough to furnish the entire consumption of the city. Now that the turbid water in the mains is being displaced by filtered water, the conditions (as to the quality of the supply) are becoming normal. It is anticipated that all consumers will be receiving an excellent quality of water by Aug. 26."

Illinois Central R.R. Will Start New Line Immediately

Construction work on the new line of the Illinois Central from Edgewood, Ill., to Fulton, Ky., will be started immediately according to the announcement of the senior vice-president of that railroad. The new line will start from Edgewood, Ill., a point about midway between St. Louis and Terre Haute, and will run due south through Illinois to some point on the Ohio River near Metropolis, where it will cross the Ohio and continue south across Kentucky to connect again with the Illinois Central system at Fulton, on the Kentucky-Tennessee border.

This new line has met with considerable opposition from certain interests in Illinois, particularly from Cairo and the surrounding territory, as that territory fears that by the construction of this second line it will no longer be on the main line of the Illinois Central. The Interstate Commerce Commission after hearing all the arguments has granted the Illinois Central permission to build the line. It will have a total length of 166 miles, will shorten the route to New Orleans by 21 miles, and will reduce the grade against coal traffic considerably. The estimated cost is $16,500,000.

European Design Prize to Honor American Engineer

A Lindenthal prize for artistic design has been instituted by the Verein Deutschösterreichischer Ingenieure. It is to be awarded each year to the best design of architectural and engineering character presented at the Behrens school of the Vienna Academy of Arts. The initial award has just been made for the design of a hydro-electric powerhouse. The prize is named after Gustav Lindenthal, engineer of the Hell Gate Arch and the proposed Hudson River suspension bridge, who was born in Austria.

Bankers Plan to Finance New York Port Development

Representatives of sixteen large financial institutions in New York City have held an informal conference with the New York Port Authority and have proposed a scheme of financing the plans for developing the port according to the comprehensive plans of the Port Authority. It is estimated that the plan will require from $100,000,000 to $200,000,000 before it is completed, but this sum will only be required in small amounts as the various units in the plan are developed. The money would be raised by bond issues secured by the actual property of the Port Authority and guaranteed by the states of New York and New Jersey. This plan is very similar to that in use in European ports, such as the Port of London, and provides a very attractive form of investment.

Steps for Large Sewage-Works for Part of New York City

Preliminary steps to acquire the right to use for sewage disposal land on Wards Island northeast of the New York Connecting Ry. have been recommended to the New York Board of Estimate and Apportionment by Arthur S. Tuttle, chief engineer, in accordance with a report of Kenneth Allen, sanitary engineer of the board. The board has concurred in the recommendation. The plan is to get permission from the Commissioner of the Land Office for the transfer of the lease of some fifty acres of land from the State of New York to the City of New York.

In his report on this subject (New York *City Record*, Aug. 15, p. 5386), Mr. Allen in discussing the degree and kind of treatment required, stated:

"The extent of treatment depends upon the steps taken to clean up the rest of the East and Harlem Rivers. The least degree of treatment to be considered would be sedimentation in tanks, but it is probable that some more thorough method, such as that known as the activated sludge process, will be found necessary. With the latest developments in this process 10 m.g.d. may be treated daily on one acre of ground, so that the 202, or at most 232, m.g.d. to be expected in 1960, would require not over 24 acres or about half the area now suggested."

The sewage to be treated on the site in question would come from adjacent areas in Manhattan, The Bronx and possibly Queens. This project is part of a tentative plan to treat as much sewage as local conditions demand.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; Annual Conference, Chicago, Sept. 27-28, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga.; Nov. 12 to 16.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Meeting, Washington, D. C., Nov. 13-15.

The San Francisco Section, Am. Soc. C. E. held an excursion and barbecue on, Saturday afternoon and evening Aug. 11, at Sunol, Calif., as guests of the Spring Valley Water Co. About eighty members and guests made the trip by automobile; inspection was made of work on the Calaveras Dam and on the new reinforced-concrete aqueduct two miles long which is now under construction in Niles Canyon. The barbecue dinner was served near the Sunol water temple, after which there was a short talk by George A. Elliott, chief engineer of the company, on "The Immediate Development and Delivery of an Additional Water Supply for San Francisco Amounting to 24 Million Gallons Daily."

The Engineering Institute of Canada has organized a branch at Kenogami in the Saguenay district, with an initial membership of 51. This branch was inaugurated through the enterprise of the Montreal branch of the institute. Officers at Kenogami were elected as follows: chairman, W. Mitchell; secretary-treasurer, H. B. Pelletier.

Personal Notes

ROBERT GILMOUR, superintendent of Montreal terminal stations of the Canadian National Rys., has been appointed assistant to the general superintendent, Canadian Nationals Rys., office at Montreal.

BRIAN R. PERRY, formerly engineer with P. Lyall & Sons Construction Co., Montreal, has joined the staff of the McKinnon Steel Co., Ltd., of Sherbrooke, P. Q., with offices at Montreal. Mr. Perry is a graduate of McGill University.

U. G. I. CONTRACTING CO. of Philadelphia, a concern engaged in contracting, construction and engineering has filed a copy of its certificate of incorporation with the Secretary of State at Albany, New York, in order to enable it to do business in this state, through A. D. Dudley of 421 South Warren St., Syracuse, N. Y., as its agent.

H. W. GREEN has resigned as sanitary engineer on anti-malaria work with the International Health Board of the Rockefeller Foundation to enter service of the Cleveland Health Council as director of the Bureau of Statistics and Research for the Cuyahoga County Public Health Association. With the Rockefeller Foundation Mr. Green had charge of a demonstration and investigation project in Porto Rico.

PROF. W. K. HATT will resume his duties as professor of civil engineering at Purdue University, Lafayette, Ind., having served two years on the Advisory Board on Highway Research of the National Research Council. He will continue to direct the affairs of the Advisory Board for the present.

R. W. HEBARD & CO., INC. have been employed by the city of Limon, principal Atlantic port of the Republic of Costa Rica, to prepare plans for general sanitation of that city.

JAMES E. MILLER, of Chicago, has been appointed trade commissioner of the Department of Commerce at Calcutta, India. Mr. Miller was formerly a consulting engineer with the General Engineering and Management Corp. of New York City, and prior to that was engaged with the Westinghouse Electric & Manufacturing Co. in engineering construction and sales in the United States, Canada, England, France, Russia and South America.

ABRAHAM LEVIN announces the organization of the Technical Service & Engineering Co., himself as manager, in Huntington Park, Calif., for the practice of civil and industrial engineering, especially the designing of buildings for industrial plants. Mr. Levin was formerly connected with the Rider-Connolly Manufacturing Co. of Pittsburgh, Pa., and the Virginia Bridge & Iron Co., Roanoke, Va.

FRANK T. MILLER, Greensboro, N. C., has been appointed chief engineer of the proposed Appalachian & Western North Carolina R.R., which is being sponsored by the state.

W. R. WORLEY, formerly an insurance man, of The Dalles, Ore., has been appointed city manager of Warrenton, Ore., to succeed Mrs. R. E. Barrett, who has resigned on account of ill health.

FREDERICK WILLIAMS, civil engineer and surveyor, formerly assistant engineer of the New Jersey Board of Commerce and Navigation, announces the opening of an office at 336 Main St., East Orange, N. J., for general practice.

CHARLES W. MCKAY, former president and general manager of McKay & Sherman, and more recently head of C. W. McKay and Associates, valuation engineers, has been made manager of the valuation division of Roberts-Pettijohn-Wood Corp., engineers and appraisers, of Chicago.

WILLIAM H. FLAHERTY, formerly located with the Gulf Wrecking Co. at Mobile, Ala., is now a consulting engineer and contractor with office at 44 Whitehall St., New York City.

J. C. MANLEY for some years city engineer of Tacoma, Wash., has resigned, effective Sent. 1, on account of ill health.

J. ALBERT HOLMES, consulting engineer, Boston, Mass., has been selected to make an investigation of and report on flood conditions at Chickasha, Okla., and as consulting engineer on the design and construction of an earth dam at Asheville, N. C.

MCCALL-MOORE ENGINEERING CO., Waco, Texas, a partnership which has existed since 1912, will be dissolved Sept. 1, 1923, and each of the partners will remain in Waco and conduct a business along the same line, Mr. McCall under the firm name of the McCall Engineering Co., and Mr. Moore under the firm name of Bart Moore Construction Co.

HARTIGAN-PROUDFOOT CO. has been incorporated to do a general contracting and construction work at East Chicago, Illinois. Alfred G. Proudfoot, Augustus F. Hartigan and Walter E. Kasten are directors of the company.

RICHARD W. SCHMIDT, formerly a field engineer with the Roxana Petroleum Co., has been made assistant civil engineer in the sewer department of the St. Louis, Mo., board of public service.

WALTER H. FRICK, formerly architect with the West Penn Power Co., has become an assistant civil engineer with the Pressed Steel Car Co., Pittsburgh, Pa.

PROF. L. S. SMITH, professor of engineering at the University of Wisconsin, Madison, has been engaged as city planner for the city of Waukesha, Wis.

HARRISON BROBERG has resigned from the Kansas Highway Commission and has accepted a position as highway engineer with the U. S. Bureau of Public Roads in construction work in the Phoenix, Arizona, district.

GEORGE A. CRANE has been made chief estimator for the Aberthaw Co. in its main office at Boston. Mr. Crane was for five years manager of the Detroit and Montreal offices of the George A. Fuller Co.

GEORGE F. RUSSELL, superintendent of public utilities, Seattle, Wash., has been appointed superintendent of the water department, to fill the vacancy caused by the death of L. B. Youngs.

CLIFFORD A. BETTS, resident engineer on transmountain division surveys for the Denver Municipal Water Commission, has been made office engineer for the Moffat Tunnel Commission, Denver.

CLARENCE F. POST has been named purchasing agent of the Western Pacific R.R., succeeding the late William T. Jacobs, whose assistant he was. Mr. Post has been with the Western Pacific since 1916. He went to the Pacific Coast seventeen years ago as a representative of the St. Paul and Tacoma Lumber Co., and later was with the Grand Trunk Pacific R.R. at Prince Rupert, Canada.

GEORGE PERRINE, construction engineer for Rodgers & Hagerty, Inc., general contractors, New York City, is

now engaged on the construction of the New York approach of the vehicular tunnel, for which this firm has the contract. Mr. Perrine's engineering estimating and construction experience includes elevated railway and subway work in Baltimore, Washington and New York City, and charge of construction of the Cathedral of St. John the Divine in New York City.

E. J. TERRILL has been appointed division engineer of the Southwest division of the Kansas State Highway Commission with headquarters at Dodge City, Kan. Mr. Terrill was formerly resident engineer on federal-aid projects in Montgomery County.

JAMES E. BARLOW, city manager of New London, Conn., since Nov. 1, 1921, has resigned. Lack of support in the enforcement of the liquor laws is reported to be the cause of the resignation. Mr. Barlow was principal assistant city engineer of Cincinnati under H. M. Waite and went to Dayton, Ohio, early in 1914, to become director of public service under Mr. Waite as city manager. When Mr. Waite resigned in 1918 to enter the army as lieutenant-colonel, Mr. Barlow became city manager of Dayton.

C. R. RANKIN, assistant city engineer of San Francisco, who has been resident engineer on the recently completed O'Shaughnessy Dam on the Hetch Hetchy project, has been put in charge, for the city, of the construction of the 24 m.g.d. conduit that will be used for the present by the Spring Valley Water Co. to bring an additional water supply into San Francisco.

ROBERT S. SUMNER, civil engineer, with offices in the United States National Bank Building, Denver, has been appointed a member of the Denver Water Commission, relieving FINLAY L. MACFARLAND. Mr. Sumner is a member of the American Society of Civil Engineers. PETER SERIE, local contractor, has also been appointed a member of the commission, filling the vacancy caused by the death of JOHN C. SKINNER.

CHARLES A. HOWLAND has been appointed on the technical staff of the Philadelphia Bureau of Municipal Research to fill the position left vacant by the resignation of J. W. Follin. Since 1920 Mr. Howland has been estimating and construction engineer on water supply, sewerage and paving improvements for the Benham Engineering Co., Kansas City. Previous to that, since graduation from Cornell University, he was inspection engineer and then assistant sanitary engineer for the New York State Department of Health, this service, however, having been interrupted by service in France during the war with the 102nd Engineers.

LIEUT.-COL. FRANCIS A. POPE, Corps of Engineers, recently arrived at San Francisco from the Philippines, has been ordered to Norfolk, Va., for duty. Lieut.-Col. Pope was, during the war, first in command of the 301st Engineers and division engineer of the 76th Division, and in 1918 in command of the 315th Engineers and division engineer of the 90th Division. Since the war he has served at Duluth on river and harbor improvements and in the Philippines.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

To Draw for Exhibit Space at Good Roads Show Soon

Announcement will soon be made of the date for drawings for exhibit space at the annual Good Roads Show, to be held in the Coliseum, Chicago, Jan. 14-19, in connection with the convention of the American Road Builders' Association. As announced in this journal Aug. 16, p. 284, Charles M. Upham, state highway engineer of North Carolina, has been appointed manager of the convention and show and will be granted a leave of absence by the State Highway Commission of North Carolina in order to devote his time to completing arrangements for the Chicago convention and exhibit of road-building equipment and materials. Mr. Upham will open an office in Chicago well in advance of the convention date. Mr. Upham will report directly to the executive committee of the American Road Builders' Association. With the approval of that committee he will appoint several committees to handle various features of the two big events of the year in the highway industry.

President Frank Page has received from S. F. Beatty, president of the Highway Industries Exhibitors' Association assurances of that body's co-operation in making the 1924 Good Roads Show a success.

All inquiries regarding the convention and show should be addressed to the home office of the American Road Builders' Association at 37 West 39th St., New York City, until the announcement of the location of the temporary Chicago office has been made.

Barnes Cites Production Records of American Industry

Julius H. Barnes, president of the Chamber of Commerce of the United States, in an address Aug. 22 before the National Association of Insurance Agents, cited ten production records that have been established in industry during the last few months. They are: largest pig iron production; largest cotton consumption; largest steel ingot production; largest crude oil production; largest automobile and truck production; largest residential construction; largest production of locomotives; largest volume of mail-order sales; largest volume of retail sales; largest volume of railroad car loadings.

Mr. Barnes also made several significant comparisons of changes that have taken place in the United States since the pre-war year of 1913. The more important comparisons are:

"The population of the United States has increased 14,000,000 people, with their enlarged requirements.

"The annual national income has increased from 34 billion, to 50 billion dollars.

"The aggregate savings deposits have increased from 6 billion to 14 billion dollars.

"The deposits in national banks have increased from 6 billion to 17 billion."

Ten Thousandth Mixer Order Shipped by Koehring Co.

Mixer order No. 10,000, a 14-E paver, was completed and shipped Aug. 1 by the Koehring Co., Milwaukee, to the Julian C. Field Co. in Texas. The 10,000 concrete mixers have been sold by the company during the period of 16 years that it has been engaged in the production of this type of construction equipment.

Early Shipments Urged to Prevent Freight Car Shortage

Intimation of a threatened freight car shortage this fall has been given by the Public Relations section of the American Railway Association in an advisory circular just issued to trade organizations urging manufacturers to increase their efforts to expedite the movement of freight before the usual heavier shipments of the fall begin.

"The fact that there is no appreciable car shortage today should not serve as a basis for lessening the efforts to move as much as possible before the fall period," says the railway association's warning to shippers and consumers. "The volume of traffic now being handled is far in excess of that tonnage which the Car Service Division originally anticipated would be offered the railroads. To avoid car shortage this fall shippers and consumers must continue and augment during the next thirty days their efforts to level off the peak of shipments during the coming fall."

HEAVY CAR LOADINGS

The American Railway Association reports that the railroads are now moving the greatest volume of freight in the history of the country. This is being done practically without car shortage, due to increased efficiency of operations, installation of new and better facilities, active co-operation of industry and agriculture in promoting the most efficient use of transportation facilities and in moving a substantial tonnage in anticipation of future requirements.

"From the best economic analysis of business conditions which we are able to obtain," says the railway association, "the measure of the large railroad tonnage being offered is due not only to a general increase in business activity, but also to the efforts which have been put forth in some industries to stock in advance in anticipation of future needs. Notwithstanding this progress, inventories throughout the country are not extra large, and all indications seem to point to continued business activity and heavy car loadings.

"The railroads are vitally interested in discharging their responsibilities this year in the most adequate manner possible, but to accomplish this end, and minimize car shortage during the peak fall movement, nothing should be left undone at this time to move the tonnages of those commodities which can be properly stocked by consumers during the next thirty days to meet their

fall and winter requirements. This is especially true of coal, lumber, sand, gravel and other building materials, and those commodities the need of which has already been set out in definite future programs."

Paving Brick Production in July

Steady production of vitrified paving brick during July is reported by the National Paving Brick Manufacturers Association, Cleveland. The July statistical report covering 68 per cent of the normal tonnage capacity of the industry, shows production 30,529,000 and shipments 27,092,000 brick as compared with a June production of 31,105,000 and June shipments of 27,251,000. Stocks on hand at the end of July were 78,835,000 brick, as against 75,398,000 at the beginning of the month.

July shipments were made into thirty states and Canada, with Ohio leading in consumption followed by Illinois, Texas, Iowa and Pennsylvania in the order named.

Automobile Production

The Department of Commerce announces July production of automobiles, based on figures received by the Bureau of the Census and covering approximately 90 passenger-car and 80 truck manufacturers each month as follows:

AUTOMOBILE PRODUCTION
(Number of Machines)

	Passenger Cars		Trucks	
	1923	1922	1923	1922
January....	223,706	81,693	19,398	9,416
February...	254,650	109,171	21,817	13,195
March.....	319,638	152,959	34,681	19,761
April.......	344,474	197,216	37,527	22,342
May.......	350,180	232,431	*43,013	23,788
June.......	*337,143	263,027	*40,616	25,984
July.......	297,104	224,770	29,998	21,837

* Revised.

American Designs Copied Abroad

That American manufacturers need proper protection in foreign countries for their designs, patents, trademarks and copyrights is emphasized by the Department of Commerce in the following statement:

The superiority of American machinery is generally recognized in foreign countries, and in a great many instances designs have been copied and the business so handled as to work to the great disadvantage of American manufacturers. In some instances foreign interests send to this country inquiries for equipment and stipulate that detailed working drawings must be furnished with proposals—endeavoring, through one subterfuge or another, to secure full particulars of the working details. Very often it develops that this is done to facilitate their own work in producing copies.

The matter is referred to because the Bureau of Foreign and Domestic Commerce has been in receipt of further reports showing how foreign manufacturers of machinery have succeeded in securing detailed drawings enabling them to produce copies of American types of machinery. It is therefore suggested that, when foreign inquirers call for the furnishing of detailed drawings, the matter be taken up with the Bureau of Foreign and Domestic Commerce, Washington, D. C., as there is a fair probability that, through co-operation between this government agency and the manufacturers, a way will be found to meet the requirements of the situation, and at the same time overcome the risk of furnishing working drawings to a foreign competitor.

Discuss Asphalt Paving Practice at Denver Conference

By Roy J. Randall
Office Engineer, State Highway Department, Denver, Colo.

DISCUSSION at a conference on asphalt paving held at Denver, Colo., Aug. 21 and 22, and participated in by highway engineers, contractors, and producers of asphalt, was notable in the diverse opinion expressed. Many of the points brought out in certain papers were contradicted in others, the effect being to leave one at a loss as to what was considered correct procedure.

A state highway engineer said that the use of asphalt was particularly suited for paving in his state on account of the wide variety of mineral aggregates to be found locally. While these aggregates differ considerably in composition, size and quality, they can all be used with asphalt for paving with satisfactory results by changing the specifications for the mix to suit each locality. He called attention to the fact that few of these local materials, which were found to be suitable for asphalt paving, were suitable for concrete.

In contrast with this paper, another speaker made the statement that the largest single cause of failure in asphalt paving was due to unsuitable mineral aggregates. While the last paper did not entirely disagree with the first one, it emphasized the necessity of using no local material for asphalt paving unless tests had shown that material to be adequate for first-class work.

Allowable Vehicle Loads

Another point upon which there seemed to be a wide diversity of opinion was the allowable loads on highway vehicular traffic. One speaker asserted that no limit should be placed on any load on highways, and that engineers could design roadways to accommodate any load, and accomplish this result with comparative ease. Later at the conference another speaker vehemently attacked the position of engineers who were designing pavements and structures for loads of from 15 to 20 tons. He stated that, in his opinion, a load from 10 to 12 tons should be the maximum allowed on any public highway.

A large number of the speakers materially digressed from the subjects assigned to them and wandered into the field of comparison between the rigid and semi-rigid types of pavement. Some rather broad statements were made concerning the "sinful waste of public funds" entailed by those officials who continue to pave with concrete.

The writer somewhat regrets that more time at the conference was not employed in the discussions of the speakers concerning the weak points in asphalt pavement—how they might be corrected, and points which should be carefully watched in laying asphalt pavement. However, many valuable examples of special construction work were given during the progress of the conference, such as the laying of asphalt pavement between street-railway tracks and on bridge floors.

Among the speakers were J. E. Pennybacker, of the Asphalt Association, Roy M. Green, Western Laboratories, E. P. Allen, Standard Oil Co. of Indiana, C. P. Jensen, Fresno, Calif., J. A. Griffin, Los Angeles and S. H. Diggs, Midwest Oil Co.

Business Notes

H. D. Conkey & Co., Mendota, Ill., manufacturers of cranes and industrial cars, announce the appointment of the Florandin Equipment Co. as New York sales agents. The latter organization, in addition to handling the distribution of Conco cranes in the New York district, is agent for the hoists manufactured by American Engineering Co.

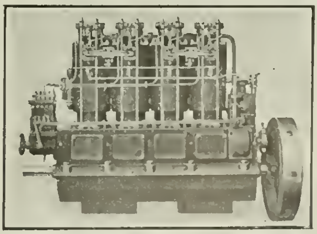
Link-Belt Co., Chicago, announces a reduction in the price of its Cub portable belt loader from $700 to $550. The machine is equipped with a two or three phase, 60-cycle motor, and fitted with raising or lowering mechanism.

Dr. Thomas Addison has retired at his own request as Pacific Coast manager of the General Electric Co. and will be succeeded by J. A. Cranston, formerly Northwestern manager. Dr. Addison has been with the company for 33 years, and has held his present position since 1892. He was born in Courtland, Mich., and was graduated from Bellevue Medical College with the class of 1877. In 1885 he forsook his profession of medicine to take employment with the United States Electrical Co. of Chicago, and in 1888 accepted a position as apparatus salesman with the Thomson-Houston Co. at that city. When the western branch of the company was reorganized in 1890 he was selected to go to San Francisco as local manager. Two years later he became Pacific Coast manager of the General Electric Co.

Equipment and Materials

Heavy Oil Engine Designed for Low Operating Costs

Economical operation, due to the use of low-priced fuels of the semi-Diesel type, kerosene or Pacific Coast distillate, together with operating flexibility, lightness of weight and bulk comparable with a gasoline engine, are among the advantages claimed by the Automatic Machine Co., Bridgeport, Conn., for its four-cylinder heavy-oil engine manu-

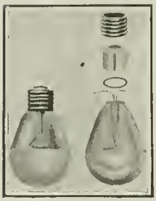


factured in sizes with a power range from 19 to 150 hp. This motor, its manufacturer claims, is particularly adapted to the operation of heavy construction equipment, such as steam shovels, locomotive cranes, hoists and other material-handling plant or may be employed as a separate portable power plant for the operation of electric generators, conveyors and other types of machinery.

The feature of the equipment is its light weight compared with other types of oil engine, amounting to about 50 lb. per horsepower. As to fuel consumption, tests indicate that about $\frac{1}{2}$ lb. of oil is required per horsepower-hour. The engine operates at from 450 to 525 r.p.m., the same speed as the company's heavy-duty gasoline engine. The motor is equipped with a standard electric starter and a gear pump insures the constant flow of lubricating oil to all internal working parts. For ignition a jump spark is used instead of hot bulbs. For operation there is a moderate compression, which, however, is high enough to insure good fuel economy and at the same time low enough to prevent frequent repairs to the engine. A ball type of governor, driven by a pair of spiral gears, automatically adjusts the power to the load. The cylinders are water-cooled. Through the entire range from no load to full load the speed is controlled by the movement of the throttle, there being no other valves or levers to be regulated. With the exception of its height the dimensions of the heavy-oil engine are the same as the company's gasoline engine so that the two types of machines are interchangeable on the same foundation.

Theft-Proof Electric Bulb

To prevent theft of electric bulbs on construction work and in industrial buildings, hotels and schools, a special design of lamp which fits any standard socket has been developed and placed on the market by Lester Kulp, 143 West Austin Ave., Chicago. The main parts of the bulb, which is without guards, locks, keys or springs, are shown in the accompanying illustration. One contact is at the top, just as in an ordinary lamp, and the other through a brass ring fastened at the bottom of a porcelain plug. This plug has a groove which is filled with plaster of paris, lightly holding the brass shell in place. After the lamp is screwed into the socket an extra turn breaks the plaster of paris so that the lamp can turn freely in the shell and at the same time maintain electrical contact. The shell, however, cannot be turned in the socket. The shell is spun over the ring and screws up so close to the socket that fingers or tools cannot grasp it. The bulbs are made in standard sizes and can be removed for replacement when burned out.



An All-Year-Round Explosive

A new non-freezing exposive named "Ammite" has been announced by the Atlas Powder Co., Wilmington, Delaware. In addition to its non-freezing properties the manufacturers claim for it all the advantages of dynamite in strength, water resistance, sensitiveness and stability. The explosive is made in six grades, 75, 60, 50, 40, 35 and 30 per cent. These are claimed to be sufficient to meet practically every requirement of blasting in mines, quarries, clay pits or construction work, either above or below ground.

Wheeled Scraper and Leveler Built in Three Sizes

Designed for tractor operation, the Hanford wheeled scraper and leveler is being built in three sizes, 1, 2, and 4 cu.yd., by the Yuba Products Co., San

Francisco. The bowl is mounted on an axle carrying two wheels in such a way that when moving into position or traveling it does not touch the ground, but when dropped into the loading position by the movement of a lever only the forward $\frac{1}{2}$ in. of the blade is in contact with the earth, thus eliminating drag and reducing the amount of power required for hauling. A lever release provides for dumping, and during this operation the bowl swings into a vertical position and rolls upward in trunnions placed on either side. Dumping is controlled by a check chain on the bowl which may be set at any desired length to provide for spreading the dirt or dumping in one pile. Power from the tractor accomplishes the dumping operation.

The smallest sized scraper, with a bowl 5 ft. wide, is a one-man outfit in which the levers are handled from the driver's seat on the tractor. The other two sizes, with 6-ft. and 7-ft. scrapers, require two operators, one driving the tractor and the other on a platform behind the scraper controlling the filling and dumping of the bowl.

New ¾-Yd. Shovel Has Rope Thrust

A new ¾-yd. gasoline rope-thrust revolving shovel, known as the 20-B and embodying the same features as the company's 30-B machine which has been on the market for the past year, has just been announced by the Bucyrus Co., South Milwaukee, Wis. The feature of this machine is the patented rope-thrust arrangement which not only does away with the necessity of en-

gines, gears, clutches, chains or complicated shafting on the boom, but at the same time gives the shovel a drive behind the thrust which is claimed to be more powerful than it is possible to obtain with a steam shovel of the same size, since the whole power of the main engine is behind it.

The shovel is driven by a single, slow-speed gasoline engine. The motions of the dipper handle are controlled by a small drum on a shaft under the boom, which shaft has keyed to it pinions for engaging with the racks on the handle. The drum is turned either way by two ropes wound around this drum in opposite directions, both ropes leading to drums in the main machinery.

This shovel may also be had with high lift or extra high lift booms, or with dragline, clamshell excavator or crane attachments. The control, according to the manufacturer, is exceedingly simple, and the machinery is arranged with convenience of the operator in mind. Whatever clutches are necessary are sufficiently large to obviate the danger of burning. The caterpillars and frame in general are the same as on the 20-B steam machine.

Publications from the Construction Industry

Test Road Results—PORTLAND CEMENT ASSOCIATION has published a 16-p. pamphlet consisting largely of pictures, with explanatory text, of the results of the traffic tests conducted by the Illinois State Highway Department on the Bates experimental road.

Cold Patch—TEXAS CO., New York, is distributing a 24-p. pocket-size booklet on the use of Texaco cold patch for repairing roads and streets. The text gives the proper proportion of stone and asphalt to be used and describes the preparation of the worn area of the pavement, the mixing and curing of the repair material and the construction of the patch.

Track Drainage—W. S. DICKEY CLAY MFG. CO., Kansas City, Mo., in a 59-p. illustrated pamphlet, sets forth in detail the uses of vitrified clay products for the drainage of railway track. A number of typical installation photographs are shown and there are drawings showing drainage details for a variety of special conditions.

Air Filters—MIDWEST AIR FILTERS, INC., New York, have just published a 49-p. illustrated pamphlet entitled "Dust Problems and Their Solution," showing the application of air filtration to a variety of industrial uses. The filters are essentially shallow steel boxes with perforated sheet metal covers and are filled with filter materials covered with a thin film of viscose fluid. Among the uses suggested for the air filter are in connection with heating and ventilating installations, cleansing air for use in sewage works of the activated studge type, food and food product plants, paint shops, paper mills, textile mills, hotels and restaurants.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

July Industrial Movements Shown by Government Figures

The Department of Commerce announces the following figures covering industrial and commercial movements in July:

Iron and Steel

Pig-iron production in July totaled 3,680,000 tons as against 3,668,000 tons in June and 2,405,000 tons in July a year ago.

Steel-ingot production, allowing for companies not reporting, amounted to 3,516,000 tons as compared with 3,749,000 tons in June and 2,953,000 tons in July, 1922.

Unfilled steel orders at the end of July amounted to 5,911,000 tons as compared with 6,386,000 at the end of the preceding month and 5,776,000 tons on July 31, 1922. Prices of iron and steel declined during the month.

Locomotive shipments by the principal manufacturers amounted to 239 as against 232 in June and 128 in July, 1922. Unfilled orders on the books of these manufacturers on July 31 called for the delivery of 1,738 locomotives as compared with 1,958 on June 30 and 811 on July 31, 1922.

Building Materials

The index of the cost of building materials entering into the construction of a six-room brick house, at 217 for July on a 1913 base, compares with 215 for June and 184 for July a year ago. For a six-room frame house the index for July is 214 as compared with 212 for June and 181 for July, 1922.

Contracts awarded for all classes of construction in 27 Northeastern states amounted to $274,225,000 as compared with $323,559,000 in June and $350,081,000 for July a year ago.

The production of Douglas fir in July totaled 461,532,000 ft. as against 567,626,000 in June and 476,199,000 in July, 1922. Prices of lumber and building materials declined during the month while new orders for flooring, both oak and maple, increased in July over the preceding month.

Cement Production

Production of cement totaled 12,620,000 bbl. as compared with 12,382,000 bbl. in June and 11,557,000 bbl. in July a year ago. Stocks at the end of July amounted to 8,076,000 bbl. as compared with 8,433,000 bbl. on July 31, 1922.

The total employment in 1,428 representative United States factories amounted to 2,041,250 on July 31 as compared with 2,040,827 at the end of June and 1,729,826 on July 31, 1922.

Wholesale prices in general declined, the Department of Labor index for 404 commodities being 151 as compared with 153 for June and 155 for July, 1922. The cost of living index, based on July, 1914, as 100, stood at 162 for July, as compared with 160 for June and 156 for July a year ago. The index of unfilled orders for basic commodities compiled by the Department of Commerce stood at 68 on Aug. 1, based on 1920 as 100, as against 77 on July 1 and 66 on Aug. 1, 1922.

Structural-Steel Sales

The Department of Commerce has just announced July sales of fabricated structural steel, based on figures received by the Bureau of the Census. Total sales of 113,331 tons were reported for July by firms with a capacity of 224,640 tons per month.

Tonnage booked each month by 175 identical firms, with a capacity of 229,575 tons per month, is shown below, together with the per cent of shop capacity represented by these bookings. For comparative purposes, the figures are also prorated to obtain an estimated total for the United States on a capacity of 250,000 tons per month.

1922	Actual Tonnage Booked	Per Cent of Capacity	Computed Total Bookings
April.....	200,588	87	217,500
May......	184,638	81	202,500
June.....	168,498	73	182,500
July...	157,631	69	172,500
August...	156,011	68	170,000
September.	146,146	64	160,000
October....	132,450	58	145,000
November..	111,794	49	122,500
December..	138,024	60	150,000
1923			
January...	172,415	75	187,500
February...	183,938	80	200,000
March.....	218,997	95	237,500
April.......	185,335*	81	202,500
May.......	131,291*	57	142,500
June.......	116,609**	51	127,500
July.......	113,331***	50	125,000

* Reported by 174 firms with a capacity of 229,375 tons.

** Reported by 170 firms with a capacity of 228,160 tons.

*** Reported by 156 firms with a capacity of 224,640 tons.

Apprenticeship Courses Planned for N. Y. Building Trades

Registration will begin next month for the apprenticeship courses in the building trades in New York, as a result of co-operative effort between the Board of Education and the Apprenticeship Commission of the New York Building Congress. Through the medium of seventy night classes to be held in ten schools, an effort will be made to relieve the shortage in skilled labor by the training of young men as bricklayers, carpenters, sheet metal workers and painters.

It is understood that the bricklayers' union and the Mason Builders Association have promised their help in developing and carrying on a comprehensive apprenticeship program in the bricklaying industry. Similar movements are under way in Boston, Philadelphia, Cleveland and other cities, according to Fred F. Moran, managing director of the Apprenticeship Commission of the New York Building Congress. For the New York courses an enrollment of about 2,000 apprentices is expected.

The movement to develop apprentices by co-operation of employer, labor union and the public school system, according to Mr. Moran, is growing rapidly. It is said that employers who were formerly reluctant to take on boys to learn a trade, or who dispensed with them after a few months' trial, are now pledged to support the apprenticeship program. Recent conditions in the building industry have indicated the desirability of a steady, normal supply of apprentices to replace vacancies in particular trades. Building congresses are functioning in various cities to stabilize the industry by developing an adequate supply of skilled labor and providing steady work.

Report on Surplus Freight Cars

The railroads of the United States on Aug. 14 had 78,404 surplus freight cars in good repair and immediately available for service if needed, according to reports filed Aug. 25 by the carriers with the Car Service Division of the American Railway Association. This was an increase of 4,236 over the number of such cars on Aug. 7.

Of the total number, 56,948 were surplus box cars in good repair, an increase of 1,582 within a week, while there also was an increase within the same period of 200 in the number of surplus coal cars, which brought the total number for that class of equipment up to 6,293.

The reported car shortage on Aug. 14 amounted to 8,315 cars, a reduction of 1,834 compared with the total on Aug. 7. Shortage in box cars amounted to 2,329, a decrease of 833 within a week, while the shortage in coal cars totaled 4,193, a reduction of 704 under the reported shortage on Aug. 7. Reports showed practically no shortage in other classes of equipment.

Much Building Planned in Britain

Since Jan. 1, Trade Commissioner A. V. Dye reports to the U. S. Department of Commerce, the British Department of Labor has gathered statistics showing the estimated cost of building plans approved from 142 localities in the United Kingdom.

During the first six months of this year building permits in these 142 localities, comprising about one-third of the population of the United Kingdom, amounted to £20,346,700. In June, however, the estimated cost of such building plans approved was £3,861,700, as compared with the average for the previous five months of £3,300,000 per month.

Building is, so far, limited to dwelling houses and large office buildings and construction or re-modeling of general stores, of which there has been a considerable amount noticeable in London and the larger cities. Dwelling houses are limited to two classes of construction: Houses which are built by owners for their own occupancy, and houses which are built by large corporations, such as coal mining companies, to house their employees. In both cases these houses are built without regard to the economic rent derived from the expenditure, as it does not yet pay to build houses to rent. That building and construction in Britain is improving is also indicated by labor conditions in that industry, which showed an improvement in June. The number of unemployed in building and construction has dropped from 182,123 on Jan. 22, to 114,243 on June 25.

Weekly Freight Loading Shows Slight Decrease

Loading of revenue freight for the week ended Aug. 11, according to the Car Service Division of the American Railway Association, totaled 973,162 cars, a decrease of 59,968 cars under the week of Aug. 4, due to the observance

of President Harding's funeral. It was, however, an increase of 130,472 cars over the corresponding week of last year as well as 164,893 cars over the same week of 1921.

While the loading of revenue freight during the week of Aug. 11 for the country as a whole increased 15.5 per cent over the corresponding week last year, the largest increase was 19.2 per cent in the Eastern district, which includes the Allegheny and Pocahontas districts, partially due to decreased coal loading last year on account of the miners' strike.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 115 to 127, are the following:

Temple, Milwaukee, Wis., to Raulf Co., $1,500,000.

Hotel, New York, N. Y., to Lynch Constr. Co., $1,500,000.

Apartment, Long Beach, Calif., to Scofield Eng. Co., Los Angeles, $1,470,000.

Hotel and apartment, Long Beach, Calif., to Scofield Eng. Co., Los Angeles, $1,000,000.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 115 to 127, are the following:

Canal, Port Colborne, Ont., for Dominion Dept. Rys. and Canals, Ottawa, $10,000,000.

Pipe line, Portland, Ore., Bull Run Reservoir, $2,500,000.

Infirmary, Louisville, Ky., for St. Joseph's Infirmary, $1,500,000.

Fill, Erie Canal, Cities of Albany and Watervliet, N. Y., $500,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the the issue of Aug. 2; the next, on Sept. 6.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb.	$3.64	$4.00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.00
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.25	5.40	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.80	3.20	3.45	3.85	3.65	4.10	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	52%	45%	47%	53-5%	36%	33.2@42.2%	+35%	47.43
Cast-iron pipe, 6 in. and over, ton	62.30	−54.00	63.00	60.20	60.50	69.00	62.00	−62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.70@2.80	3.00	2.25	2.20	2.50	2.84	2.63	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	1.89	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.83	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	63.00	40.00	52.25	56.50	42.50@43.75	42.75	41.00	28.00	70.00
Lime, finishing, hydrated, ton	18.20	22.50	22.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	2.35	1.50	1.50	2.70	2.10	2.80	10.00
Common brick, delivered, 1,000	23.65	12.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	.115	.0724	.0816	.065	.....	.11	1.15
Hollow partition tile 4x12x12, per block	.1573	.102	.115	.....	..	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.98	−1.00	1.14	1.12	−1.02	1.25	−1.16	.86	1.26
Common Labor:									
Common labor, union, hour	.75	.35	....	...	..	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	82½	.50@.55	.35@.50	.50	.50@.62½	.35@.40

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.68). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in., $119.

Changes Since Last Week

In keeping with the general unevenness that has characterized the market during the last few weeks, this week's line-up shows an improvement in steel and non-ferrous metals, and depression in cast-iron pipe and linseed oil. Higher production costs, consequent to a shorter working day at the steel mills, have resulted in a solidification of the mill base at around $2.50 per 100 lb. for shapes and plates, and $2.40 for bars.

A buying movement has developed in steel rails, wire and tin plate, while greater activity is reported in steel pipe.

Seattle warehouses report a reduction of five points in black steel pipe discounts and a severe drop in cast-iron pipe prices. Atlanta also quotes a reduction of $2 per ton in c.-i. pipe.

Warehouse prices, generally, have shown little change during the week, especially in lime, lumber, clay products and concreting materials. Linseed oil, however, dropped 2c. in San Francisco and Minneapolis and 8c. per gal. in Atlanta.

Despite the fact that the brick manufacturing season is nearing its close and that a coal shortage is also threatened, the price of brick at New York docks is a trifle easier at $20 per M., wholesale, as against $21, recently. Common brick has been quoted at its present level, in this market, throughout the first half of the current year.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—James H. McGraw, President

Engineering News-Record

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, *Editor*
Frank C. Wight, *Managing Editor*

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Another Earthquake Disaster

AS WE go to press the first news comes of another mighty, historic earthquake in Japan. Such reports as have filtered out of the almost isolated country are sufficient to establish the appalling magnitude of the disaster, though their details are confused and hardly credible. The rumors of the destruction of numerous modern steel-frame buildings clash sharply with all that has been learned from prior earthquake experience, and for the present at least must be discounted. But earthquake visitation is fantastically erratic, and the years during which its effects have been studied are short indeed, so that it is by no means impossible that the details of a new disaster may give the lie to past conclusions. However its full facts may develop, the present catastrophe is great enough to dispel any belief that earthquakes are growing less frequent and less terrible. Modern civilization has to reckon with them fully as much as did earlier ages.

The Coal Commission's Duty

SEPTEMBER first has come and with it the anthracite coal strike. In spite of all the elaborate preparations made to prevent a repetition of last year's strike—the formation of a federal coal commission and the interposition of the Governor of Pennsylvania—the Juggernaut car of the coal industry proceeds on its appointed way. It is hardly to be believed that the "little group of wilful men" on both sides of the table will really defy the American people another year, but if they do they must take the consequences of drastic action in the coming congress. One thing is incumbent now on the coal commission. That body presumably knows more about the coal business than any other group of unprejudiced men. The people at large know nothing about the rights of the controversy, but they are entitled to a frank statement from that commission as to who is responsible for the present conflict. One might wade through the volumes of testimony and statistics prepared by the commission and come to some conclusion but it is not a fair thing to ask. The commission knows, or ought to know, whether the operators are making too much, whether the middleman is a profiteer and whether wages and working conditions are unfair to the workmen. The commission is obligated by the situation to state definitely where the guilt of this outrageous strike lies.

Recognition of Mexico

NEGOTIATIONS looking to a renewal of diplomatic relations between this country and Mexico have been under way for some time and last week word came from Washington announcing the full recognition of the present Mexican government beginning Sept. 1. This event will have an important influence on prospective engineering development in Mexico. Some projects that have not yet been financed may now be regarded in a more favorable light, American interests can expect better protection from their own government and, with American recognition, the Mexican government itself can be expected to look more favorably on development in Mexico backed by American capital. The recent start of construction to complete the gap in the railroad along the west coast will help conditions greatly; with direct rail connection through to Mexico City the danger of banditry in the heretofore isolated west will be lessened and there will be a means of transportation that will facilitate development. Perhaps the first and most attractive field for developments are in the oil and mineral resources of Mexico. These require but little exploitation. However, as soon as capital, particularly American capital, gains confidence, assurance of protection and an insight into the wealth, the extent and the variety of Mexican resources thus far practically untouched, there will certainly ensue an era of prosperity in which American engineers should have a generous share.

Light on Cement Prices

STATE authorities who are considering the construction of cement mills to reduce what they consider the high cost of cement will do well to study the figures on the profits of eleven of the large companies in the East submitted by Professor H. P. Willis, of Columbia University, and noted in the news pages of this issue. Doubtless Professor Willis will gladly furnish the full data on which he has based the figures that are given here, so that the state can check them for those items of investment and operation which should be of so much importance in any computation on the cost of state cement production. If private companies, with their wealth of expert aid and of experience, are unable to average more than 7.3 per cent earnings on their investment, there is certainly no reason why any state should consider prices so exorbitant as to enter into competition with them.

Shaded Topographical Maps

IF NEW methods of bringing out topographic relief on contour maps are successfully developed and brought into use, in pursuance of the present attempts of the Geological Survey, as outlined in this issue, the utility of what is sometimes spoken as the map of the United States will be increased in an almost sensational degree. Of the wealth of information contained in the contour map as now published, only a small part is readily available for use. For most kinds of topography the contour system beclouds and conceals rather than reveals the features of the country, and any general understanding of the lay of the land can be worked out only by previous detail study. This condition is a fatal bar to useful application of the map in a great number of cases where it would otherwise prove of value. Engineers, as well as other map users, have long felt the

desirability of some more plastic method of showing relief, preferably to be combined with contours in order not to sacrifice the numerical definiteness which these give. We believe that this feeling has grown decidedly in recent years, and that engineers in particular are anxious to have an improved system applied to the existing maps at the earliest possible moment. In selecting the best system and working out its details, however, the government authorities should be supported and guided by the opinion of map users. It is suggested that those who have definite opinions on the subject based on experience with topographic maps make their views available without delay, to assure the most rapid forwarding of the development of an improved system.

An Irregular Standard

LAST month we commented editorially on the extremes to which the enthusiasm for standardization can be carried. A minor, though illuminating, example has just come to notice. In this month's *Harper's*, in an excellent article on the railway problem, there is some preliminary comment on the establishment of the standard gage, in which the author by implication deplores the irregularity of the 4 ft. 8½ in. standard and is especially concerned over what he is pleased to call that "absurd one-half inch." This is characteristic of the craze for standards. It is assumed that there is some magically saving grace in even figures, that millions of dollars a year and thousands of useless brain throbs would be saved by an even 4-ft. or 5-ft. gage—all of which is just as absurd as that one-half inch is claimed to be. Fifty six and one-half inches is just as easy to remember and just as easy to measure as five feet, as every engineer knows and while one may be curious to know how the standard gage was arrived at certainly no railway man would go to any great trouble to change it to an even figure.

Not All Profits

TRAFFIC through the Panama Canal is increasing in surprising volume. In the nine years of its operation, which were completed last month, the paid tolls, which are a fair measure of traffic, amounted to $76,000,000. Of this amount $17,000,000 or 22 per cent were in the latest fiscal year. In the latest month the tolls were somewhat over $2,000,000, as against the average monthly for the nine-year operation of about $700,000. Taking these figures as a text, Governor Morrow, of the Canal Zone, who recently arrived in this country on his annual trip to Washington, has been extensively quoted in the daily press as stating that the Canal is now paying better than 3 per cent on its investment. This is hardly a fair statement, whether Governor Morrow said it or not. The government now has invested in Panama, according to the latest figures, upwards of $450,000,000, of which $400,000,000 can be probably charged to the Canal itself, the other $50,000,000 being bookkeeping liabilities which probably have compensating money assets. This extends back over a period of nearly twenty years. On even so low a rate as 3 per cent the investment has piled up in an average of ten years about $120,000,000 interest charges which in any private business would have to be accounted for in figuring profits. It is highly gratifying to everyone who favored the construction of the canal that it is now bringing in, clear of expenses, an income of approximately $500,000 a month. Even were the financial return not so great the value of the Canal would be unquestioned. It cannot be fairly said, however, that it is bringing in a profit on the investment except on the basis that all such government expenditures have their own type of accounting which does not come in the same realm of mathematics as that of private business.

Highway Accidents at Railway Crossings

EXAGGERATED importance is likely to be attributed to the railway crossing as a cause of highway accidents unless one holds his perspective true. Horror is aroused by their deadliness and by the complete demolition which usually results. A contributing reason perhaps is the fact that so few automobile accidents are due to other faults of road structure. Crossing accident figures are undoubtedly impressive. The Interstate Commerce Commission for the last quarter of 1922 reports 517 deaths and 1,710 other casualties due to this cause. This is a condition that obviously calls for change. Quite as obviously the only certain and complete remedy is grade crossing elimination. Eventually we must come to this perfect cure. Always its adoption should be urged. Always also, it has to be remembered, it is an enormous physical and financial task which cannot soon be accomplished and it is a primary duty meanwhile to undertake palliative measures. Our railway crossings are yet far from being properly protected by signals and barriers. Careless driving which is the major cause of all highway accidents has scarcely begun to be curbed. Statistics are not plentiful but all that can be found agree very closely. In Iowa in 1922 there were 6,513 highway accidents which involved casualties, and of these only 4¾ per cent were at grade crossings of railways. Referring to the total figure the state highway commission bulletin concludes that "reckless and careless driving would seem to be the cause of 90 per cent." In Wisconsin in eight months of 1922 there were 1,069 accidents of which 6½ per cent were at railway crossings. Again something over 70 per cent of all were due to careless driving. In every way the task of curbing reckless and careless driving is more imminent than that of producing accident-proof road structure including even the deadly railway crossing.

New York Garbage and Jersey Beaches

COMPLAINTS of New Jersey sea coast towns that their beaches are strewn with the garbage and refuse of New York City bring to mind the fact that it is now some five or six years since our largest American city returned to the primitive means of dumping its garbage and refuse at sea. In doing this it abandoned an engineering plan the main features of which were worked out by the late Col. George E. Waring, after extended studies by a staff of specialists—a plan also which in the main has been recommended for New York by other engineers after careful investigation. Not only that: the contractor whose garbage reduction plant in New York Harbor Mayor Hylan caused to be shut down was under agreement to pay the city for every ton of garbage the city delivered to the plant, while since the change the city has been paying for barging the garbage many miles farther to be dumped at sea, whence, according to the Jersey shore cities, it floats inshore to become a nuisance and to lessen the summer crowds on which the residents of these towns live.

Upon the controversy as to whether the beach litter comes from the city scows or seagoing vessels, we cannot undertake to pronounce. The fact of general engineering interest is that the largest city in the two Americas has for a half dozen years allowed its refuse disposal problem, and the refuse itself Jerseyites claim, to drift, while at the same time paying out large sums annually for dumping garbage containing grease and fertilizer base for the recovery of which a contractor was under agreement to pay the city. We are well aware that the contractor was in financial straits; that the plant was ordered closed because of allegations of nuisance; that the contractor did not contest the order —perhaps because the plant was losing money; and that the war garbage reduction, like pig feeding and incineration, has had its ups and downs—mostly downs. Notwithstanding all this, the city's action appears to have been grounded on pre-election controversies and promises and on political reprisals rather than on engineering considerations.

The present situation is accompanied with the usual wild statements about the relation of garbage disposal to the public health. Thus, Governor Silzer of New Jersey, according to a reporter's story in the Newark *News*, has "traced the appearance of a form of intestinal grip to germs in the garbage dumped from New York City." Can it be that Jerseyites are eating garbage these summer days? Worse than this—because it is an editorial utterance, and editors are supposed to show knowledge and judgment—the New York *Times*, after discussing sympathetically the Jersey coast allegations against New York garbage, turns to what it regards as New York's laxness in sewage disposal and closes with saying that the city is "apparently willing to continue its old makeshift system until some calamity, such as an epidemic directly traceable to pollution [of salt water, be it noted] shakes the authorities out of their apathy."

It is just this sort of tilting at men of straw indulged in to arouse public opinion to the need for better garbage or sewage disposal that is largely responsible for such apathy as exists. The cry of "wolf, wolf" soon fails to alarm. Some ill-informed and unthinking people may be roused to momentary excitement over "epidemics," threatened by a dead cat in the street, garbage on a bank of snow in the dead of winter, watermelon rinds on a beach, "sewage slick" in a harbor, or offensive sights and odors in dock slips or alongshore; but the underlying commonsense of the people at large and the experience of communities as well discounts such alarmist outcries. The taxpaying public and city authorities responsible for it will spend money to insure the purity of their water supply and, as enlightenment progresses, of the milk they drink, because they have experienced to their sorrow that impure water causes typhoid and contaminated milk results in typhoid, infant mortality, tuberculosis, and other ills; but subconsciously, at least, they know that garbage and sewage, once these wastes are well clear of their homes, will, as a rule, produce nothing worse than bad sights and smells—barring the pollution of public water supplies, which is now generally well guarded against by one means or another. When the smells are bad enough, or a community becomes unusually sensitive or supersensitive to them it will, on that account but not because of real and well grounded health fears, appropriate money for improved means of sewage and garbage disposal.

New York today, to return from the general to the particular, is spending large sums for a primitive means of garbage and refuse disposal; but it is only fair to add that under existing conditions affecting both the incineration and reduction of garbage it is conceivable, until competent engineering studies demonstrate the facts one way or the other, that New York's refuse might be towed so far out to sea as to insure its never or rarely returning to shore, at less than the net cost of reduction or the cost of incineration, though for the latter there is little promise of revenue in the light of all American experience and of British experience of recent years. It is also only fair to the New York authorities to say that progress is being made on a systematic plan for sewage disposal.

Garbage and refuse disposal problems are more than ever for engineers to solve and for politicians to let alone, except as the latter choose from possible engineering methods the one most likely to meet the demands of an intelligent public opinion rather than of political expedience or revenge.

More to Come on Earth Dams

THE Apishapa Dam, the failure of which was noted in *Engineering News-Record* last week, bids fair to become a celebrated case in dam engineering. Earth dams of such height and volume are always an interesting problem, because their design and construction continue to be more empirical than in other types of dams, and failure is important in the development of the art of their design because by failure alone can there be absolute assurance that something went wrong. To discover just what that something is is the difficult sequel of all such dam failures.

In the Apishapa case this is the outstanding fact at present. There are so many inconsistencies and contradictions in the various reports that have come in to *Engineering News-Record* that it has been decided to postpone publication of any of them until next week, or a future time when a fair degree of consistency in the reports can be assured. Two important details, however, may be noted for future reference. The first is the diametric opposition as to the desirability of early filling of the reservoir behind dry fill earth dams and the second is the historical significance of the protests of the designing and constructing engineer during the construction of the dam.

One observer writing in claims that to leave dry such a dam in the arid west is to invite failure by sudden filling of the reservoir. The designer, on the contrary, stipulated in his preliminary reports that the reservoir should not be filled for some years, during which time the dam was to be allowed to settle and densify. Here is obvious contradiction that needs explanation and it is on a point which is most pertinent to the design of the dry emergency dam such as built at Dayton and planned at Pueblo.

The designer's ungranted plea for additional height and section, with his subsequent disclaimer of responsibility in case of failure, has a dramatic element not usually associated with the prosaic business of dam building. Whether or not the failure was due to matters he wanted corrected remains to be seen, but he is at least entitled to his day in court. His interpretation and the full reports on the failure should be important contributions to the art of earth dam building.

A Bascule Bridge of New Type and Its Construction

Varying Effective Length of Hanger Link Maintains Balance—Bull-Wheel and Worm-Gear Operation—Toe Locks Eliminated—Creosoted Lumber Framed and Bored at Mill

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Consulting Engineer, New York
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SEVERAL unusual features distinguish a new bascule highway bridge at Mystic, Conn., completed last year. It is the first bridge of a newly developed type, in which the counterweight rotates through a considerably smaller angle than the span. At Mystic the counterweight rotates through an arc of only 69 deg. while the span is traversing a full right angle. This is accomplished by means of a double-pivoted short link forming part of the hanger link, and a stop on the moving-leaf girders which changes the effective length of the hanger link during the motion. The small angle of rotation of the counterweights permits of their being placed symmetrically about the center lines of the balance beams without interference with the tower, and keeps girder, tower, balance beam and counterweight all in the same plane, obviating the necessity of carrying loads transversely.

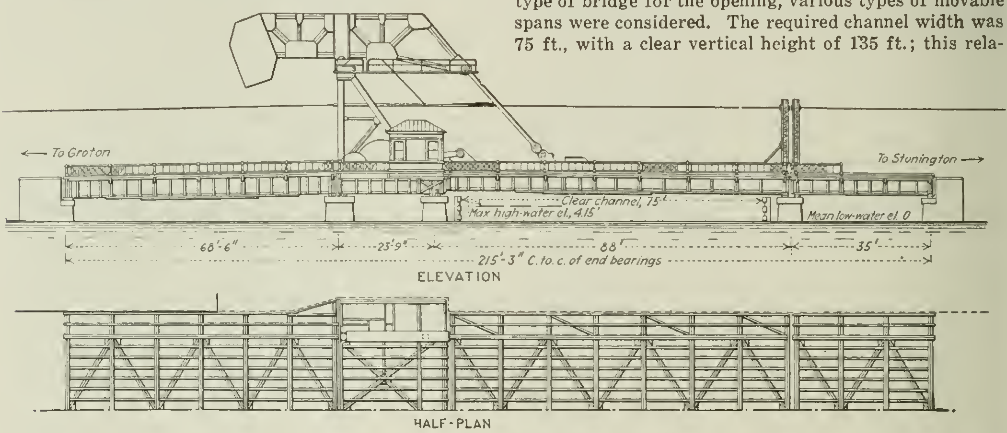


FIG. 1—GENERAL PROFILE AND PLAN OF NEW BROWN BASCULE HIGHWAY BRIDGE AT MYSTIC, CONN.

A bull-wheel method of operation is used, which incidentally locks the span in its closed position. Worm gears are successfully employed, eliminating the noise of high-speed spur gearing. Special details were introduced to permit the concrete sidewalks and wood-block roadway paving to be raised with safety to the vertical position. The counterweights were poured in their high position with a small under-support. Framing and boring of the creosoted lumber at the mill was used with success.

General Description—The completed bridge consists of four through plate-girder spans; the main or movable span of 84 ft. 8 in., a tower span of 23 ft., and two simple approach spans. (Fig. 1 shows profile and plan of bridge.) The bridge is on the New York and Boston Post Road and carries traffic of large volume and heavy weight, including motor trucks and a single-track interurban trolley line, together with considerable pedestrian traffic. To meet the traffic needs, a roadway width of 33 ft. in the clear was provided, with a single trolley track in the center. The roadway is paved with creosoted wood block. The sidewalks are 5 ft. wide and are paved with a 3-in. reinforced-concrete slab. (Fig. 2 shows a cross-section of the movable span.)

Selection of Type—In the selection of the particular type of bridge for the opening, various types of movable spans were considered. The required channel width was 75 ft., with a clear vertical height of 135 ft.; this relatively great height of channel clearance compared to the length of span excluded the vertical lift. The extreme width of the bridge, practically 50 ft. over all, would require a swing span at least 210 ft. center to center of end wedges if the bridge were made symmetrical with both arms of equal length. However, as buildings at both ends of the bridge extended up to and in some corners in front of the abutments, and a symmetrical swing span would have extended about 25 ft. over the west abutment, a bobtail swing would have been required, which in turn was prohibited by the location of the center pier and the channel.

The elimination of the swing and vertical-lift types necessitated the use of some kind of a bascule, and after careful consideration and comparative estimates it was decided to adopt the Brown "balance-beam" type. There are several advantages of this type over the older forms of bascule, and as the bridge at Mystic is the first of its kind to be built a short description of the method of balance is of interest.

The movable span is counterbalanced by two concrete weights placed on the center lines of the main girders and carried by balance beams in the form of trusses which rest on trunnions at the tops of the tower bents. These trusses are about 60 ft. long over all, and their forward ends are connected with the plate girders of

the moving span by hanger links or suspenders consisting of eyebars and short links having double sets of pivots at the span end. (See Fig. 3.) Butt blocks or stops are suitably placed on the upper flanges of the movable-span girders to make contact with the short links at the proper time during motion, and thus change the point of rotation of the eyebar hangers from one set of pivots to the other. This system of multiple pivots is the important distinguishing feature of the new Brown type.

Fig. 4 is a diagram showing the action of the pivots and butt blocks as the span rotates through its 90 deg. of motion. Between positions I and II of the span (see Fig. 4), or for about the first 38 deg. of motion, the hangers rotate about the primary pivots A. The butt blocks then make contact with butt castings on the short links, preventing their further rotation about pivot A, as shown in position II. From this position throughout the remainder of the opening, the eyebars rotate about the pivots B, on the ends of the short links.

It will be noted in Fig. 4 that in the closed position of the span, when its center of gravity is horizontally in front of its trunnion, the center of gravity of the counterweight is well above the level of the balance-beam trunnion, and that in the open or 90-deg. position, when the span is vertical, the counterweights are considerably back of the vertical tower legs and entirely clear them; that is, the span has rotated 90 deg. while the total angular motion of the counterweight is only 69 deg. Throughout the entire motion no attempt is made to keep the lever arms or the angular motions of the span and of the counterweights about their respective trunnions equal or similar in any way, the balance being maintained entirely by selection of the pivotal points A and B so as to reduce and increase the respective lever arms of the hanger links about the balance beam and the span trunnions in proportion as the moments of the counterweights and the span vary about their respective trunnions.

There are several advantages with these two pivotal points of rotation. The counterweights, not having to pass between the tower legs, can be built centrally over and integral with the balance-beam trusses; thus all the stressed members from girders to counterweights are maintained in the same plane, saving a considerable amount of steel usually required for lateral transfer of forces or of counterweight loads. The counterweights being in two sections entirely disconnected, no

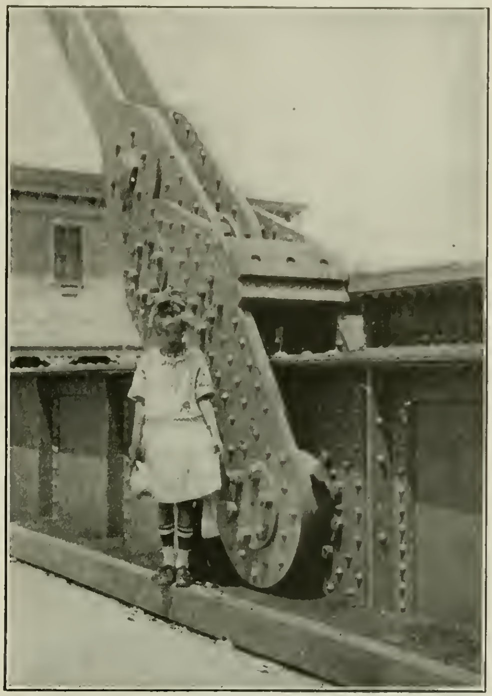


FIG. 3—SHORT LINK AT BASE OF MAIN EYEBAR HANGER

This link in conjunction with the butt-block on the girder, in the foreground, changes the leverage of the counterweight as the span rises.

rigid bracing is required between the balance beams. Light bracing only is required, which though rigidly providing against lateral overturning of the beams yet allows a slight flexibility of motion in the planes of the trusses and thus provides against the possibility of binding of trunnions or pins and against inequality of stress in the hangers due to the usual slight inaccuracies in lengths of members and in lining up of trunnions in the field.

Again, there is great latitude in the choice of the positions of the points A and B while retaining the practical balance throughout the motion. In the Mystic

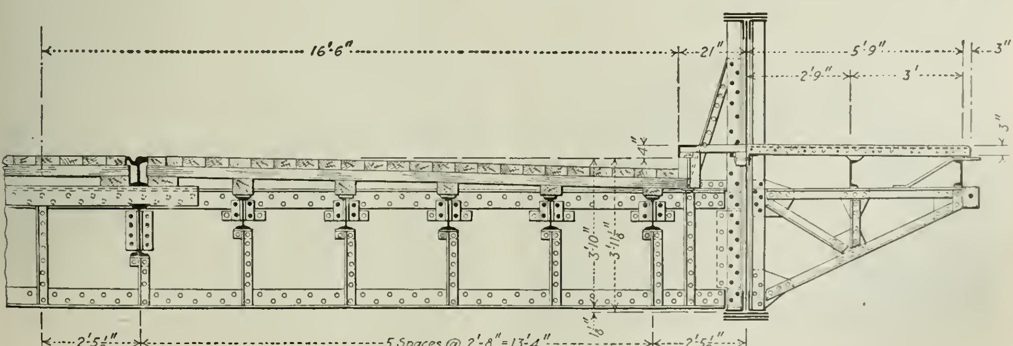


FIG. 2—HALF CROSS-SECTION OF BASCULE SPAN

design point A was so chosen as to provide an unbalance when closed, tending to hold the bridge well down on its toe bearings, which in combination with the locking function of the bull-wheel avoided the necessity of toe locks. This positive reaction at the toe end is 1,000 lb. per girder. Point B, on the other hand, was placed slightly higher than the theoretical position required. This increases the backward or downward pull of the hanger around the span trunnion (see Fig. 4), offering a resistance to the further opening of the bridge as it approaches the 90-deg. position. The resistance increases rapidly if the span passes the vertical, thus providing a safety factor against the span being blown or operated backward against the tower.

A further advantage is the adjustability of point B by shimming in the butt block to obtain nicety of balance or to compensate for a change in dead load of the floor.

Power Equipment and Machinery—On the Mystic bridge the main source of power is three-phase 60-cycle alternating current delivered at 2,200 volts to the bridge site, where it is transformed to 220 volts. Operation is by two 36-hp. motors of the induction type, one on each side of the tower span, placed on unit frames with worm-gear units of a ratio of 20 to 1. By the use of worm-gear units the operating machinery was made so compact

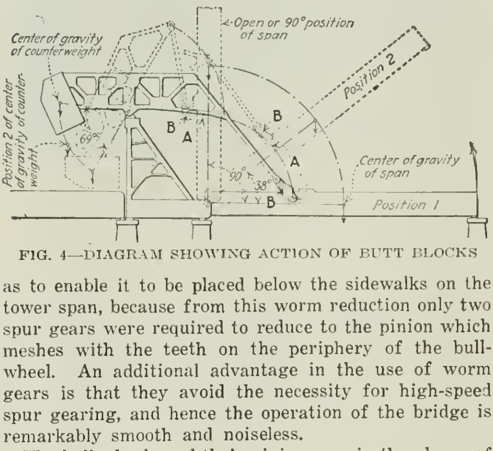


FIG. 4—DIAGRAM SHOWING ACTION OF BUTT BLOCKS

as to enable it to be placed below the sidewalks on the tower span, because from this worm reduction only two spur gears were required to reduce to the pinion which meshes with the teeth on the periphery of the bull-wheel. An additional advantage in the use of worm gears is that they avoid the necessity for high-speed spur gearing, and hence the operation of the bridge is remarkably smooth and noiseless.

The bull-wheels and their pinions are in the planes of the tower bents, and the forward ends of the bull-wheels are connected by links or "connecting rods," which straddle the front legs of the tower, to operating pivots on the main bascule girders. The lengths and

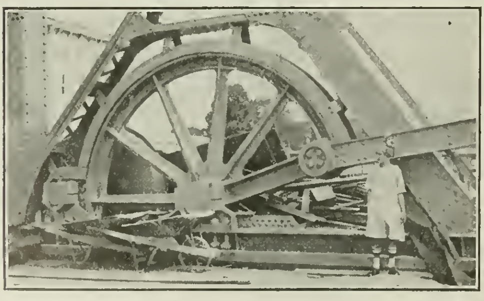


FIG. 5—BULL-WHEEL

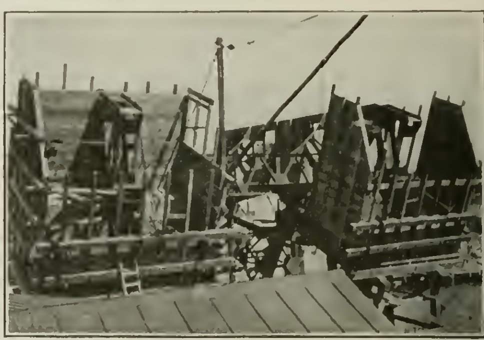


FIG. 6—FORMS FOR COUNTERWEIGHTS

positions of these links are so adjusted that when the bridge is in its closed position they are practically on dead center with the axles of the bull-wheels, thus locking the bridge in this position (see Fig. 5). This bull-wheel lock in combination with the unbalance of the span, already described, enables toe locks to be dispensed with. The bull-wheels also provide greatly increased leverage at the two extreme positions of the span. As the operating links approach the dead-center position at the extreme ends of the run, the combined leverage of the machinery approaches infinity and the speed of the span approaches zero. This permits very gentle seating of the span with motors running at constant speed. In fact if, through inadvertence on the part of the operator, the motors should continue to run after the span is seated, the links will pass the dead-center position and open the bridge, instead of stalling or short-circuiting the motors. Likewise in open position, when the span offers the greatest wind-sail area, the operating links have reached the other point of increased leverage, which condition combined with the automatically increased unbalance of the span makes it an impossibility for the span to be overturned against the tower, regardless of the wind velocity.

The two independent machinery reductions on each side of the bridge are connected by the usual transverse shaft. The motor shafts are equipped with solenoid brakes, and in addition emergency air-brakes are provided on each end of the tranverse shaft. Either set of brakes may be used independently. The usual emergency hand operation is also provided.

Erection—On account of the extreme simplicity of the structure no particular problems were encountered in the erection with the exception of the placing of the concrete counterweights. The original design had been made with the idea of erecting the bridge in open position, for which purpose the approach span at the rear of the tower had been designed with a view to supporting the forms and the counterweights while the latter were being poured in their lowest position, with the center of the counterweight 9 ft. from the center of the pier. But it was found much simpler to lay the concrete sidewalks and wood block paving with the span horizontal so that the decision was later reached to erect the entire span in the closed position.

The counterweights therefore had to be built in their upper position, in which they were a horizontal distance of 24 ft. from the pier and about 32 ft. above the roadway. The approach-span girders were not sufficiently

strong to support the entire weight in this position with the additional framework required. The solution of the difficulty was to carry the greater part of the load from the balance beams.

This was accomplished by putting up light staging on the approach span, sufficient to carry the weight of the forms and also the weight of a 2-ft. bottom slab of concrete; then, before pouring this bottom slab, wire guys or tie ropes were attached to the top of the balance beams and brought out through the bottom of the forms. After the bottom slab had set, the remainder of the concrete was poured. Fig. 6 shows the counterweight forms.

The requirement that the span must open to 90 deg. necessitated considerable care in the laying of the wood-block paving and the concrete sidewalks. Each individual block on the lift span was separately nailed to the sub-planking with a wire nail through the center of the block. In addition, horizontal angles about 10 ft. apart were laid on both roadway and sidewalks, to act as shelf angles supporting independent 10-ft. sections of the wood-block paving and concrete when the span is in the open position.

A special feature in connection with the field work was the boring and framing of nearly all of the creosoted lumber at the mill, although cutting and boring before cresoting was not required by the specifications. Steel erectors are averse to handling creosoted lumber, and it was therefore decided to relieve them of a large portion of this work. The spiking pieces, curb guards, ties and other miscellaneous lumber were framed and bored before creosoting, so that very little field work was necessary, the principal part being the boring where steelwork or other bored lumber was used as a templet. The lumber was given marks at the mill similar to shipping marks on steelwork. The erection department was well pleased with this method of handling the lumber, as it saved considerable expense and time besides relieving the erectors of an uncongenial task.

Conclusion—The total weight of steel in the bridge is about 400 tons; the weight of the moving leaf complete is about 200 tons. The concrete counterweights weigh 400 tons, while the total weight of the moving parts is about 650 tons.

The bascule and tower spans were designed by Thomas E. Brown & Son, consulting engineers, for Waddell & Son, who were consulting engineers to the state highway department for this portion of the work. The approach spans and the substructure were designed by the state highway department, L. G. Sumner, chief draftsman. The substructure work was done by the J. E. Fitzgerald Co; the structural steel superstructure and machinery were fabricated and erected by the American Bridge Co.; and the concrete counterweights were placed by the C. A. Sibley Co. The bridge was built for the state of Connecticut under direction of Chas. J. Bennett, formerly highway commissioner, R. L. Saunders, formerly deputy commissioner, A. W. Bushell, district engineer, and A. R. Collier (now state supervisor of bridges), resident engineer.

FIG. 7—MYSTIC BASCULE PARTLY OPEN

Camp Site Sanitation in Wisconsin

Due to the thousands of tourists who camp out in free sites maintained by cities as one of the summer attractions for patronage, attention has been given in Wisconsin to safeguard public health and insure comfort for the patrons. In a recent bulletin issued by the State Board of Health the following essentials in campsite sanitation are noted:

(1) Provide a safe water supply such as wells or springs protected from pollution. Have the water analyzed before the season opens.

(2) Adequate sanitary toilet facilities should be maintained.

(3) Provide garbage and refuse receivers and a daily disposal. If there are no containers, bury or burn the waste.

(4) Maintain clean premises and equipment.

(5) Enforce rules conspicuously posted governing use of grounds.

(6) Eliminate fleas and vermin by every means available.

(7) Employ a caretaker and give him authority to enforce sanitary regulations.

It is encouraging, say the health officials, to note that the municipalities boosting campsites are shaping their plans toward the observance of these rules and in not a few places have these ends been achieved.

Syracuse Garbage Reduction Works Reopened

The Syracuse garbage reduction works, which were shut down for some months, were reopened in the latter part of June, after having been remodeled. The works are being operated under a five-year lease made after the city had advertised for bids. The contract, which included also a certain amount of remodeling, was awarded to the C. O. Bartlett & Snow Co., Cleveland, Ohio, which organized the Cobwell Reduction Co., a New York corporation, to carry out the terms of the contract. The city pays the company $30,000 a year to cover both operation and amortization of the cost of remodeling the plant, the capacity of which was increased to 125 tons per day or more than double the original capacity of the plant as built by the city. In the plant as it now stands, the garbage is first shredded and then fed to the dehydrators, both operations being mechanical. The dehydrators are of indirect-direct heat type. They reduce the free moisture content to about 30 per cent. In the dehydrators the remaining moisture is eliminated, the material is broken down under low temperature and the grease extracted, all this work being done as a continuous process within the closed receptacle. After the process thus outlined is completed, the remaining solid material is screened and then conveyed to storage.

Iron Removal and Softening Plant, Benton Harbor, Mich.

Preliminary Experiments Indicated Use of Lime for Reduction of Iron Carbonates—Softening Added to Process

NOVEL features of the iron removal plant at Benton Harbor, Mich., comprise mixing chambers equipped with stirring devices and so arranged that a portion of the water delivered to the plant may be over-treated with lime before being mixed with the remaining portion. The stirring devices themselves in the mixing chambers are not entirely new as these were probably first used on a municipal plant by Philip Burgess at Owensboro, Ky. Over-treating a portion of the water was suggested by the experience at the Grand Rapids filter plant. The combination of the arrangement and equipment, however, is believed to be rather unusual. Another feature, first suggested by C. P. Hoover, is the use of a Dorr thickener in the sedimentation basins. This clarifier has two functions: (1) It removes the

FIG. 1—IRON REMOVAL AND SOFTENER PLANT

bulk of the sludge continuously so as to reduce the number of times that the sedimentation basins must be emptied and cleaned. The peculiarities of the locality are such that this operation involves pumping out the lower portions of the sedimentation basins, an operation which is costly, time consuming and troublesome. (2) Means are provided for returning a portion of the settled sludge to the raw water so as to promote rapid reaction and precipitation of the lime with the bicarbonates in the water.

The plant has a nominal capacity of 2 m.g.d. Under this rating the mixing chambers have a retention period of 50 minutes, the Dorr clarifier 1 hr., and the sedimentation basins 8 hr. A clear water storage of 700,000 gal. is provided.

Hitherto the city obtained its public water supply from wells in the sand and gravel beds bordering the St. Joseph River. The yield of these wells was not sufficient to meet maximum summer demands. Moreover, the water contains some 2 p.p.m. of iron which caused very objectionable staining of plumbing fixtures and also favored the growth of crenothrix in the mains. The water carries about 250 p.p.m. of hardness, all in the form of carbonates of calcium and magnesium. The magnesium content is high, about 23 parts per million.

The city authorities decided to utilize the St. Joseph River as a source of water supply, as being the most certain in point of quantity and the most economical. It was proposed to render the water of good sanitary quality by purification. Lake Michigan water would have been preferable because it is generally materially softer than the river water, but the distance to Lake Michigan rendered this project unduly expensive.

The principal objection to the river water is its warmth in the summer time and there is also a sentimental objection to its sanitary quality even if it is not delivered into the mains until passed through a filter plant. To obtain the advantages of both the well water and the river water it was decided to build a plant which could be utilized to remove the iron from the ground water or purify the river water. Preliminary experiments that were conducted with a view to determining the best design and proportions for a plant for removing the iron from the ground water revealed the necessity of using lime to precipitate the iron. This suggested the desirability of softening the water, as the hardness is in the form of carbonates in both river and well water. Accordingly, the functions of the plant were enlarged to include partial softening—partly for economy and partly because it was believed that if the water is reduced in hardness to a Lake Michigan water standard, it would prove satisfactory to all concerned.

The experimental plant comprised the usual component parts of a rapid sand filter plant; coagulant preparation and feed devices, mixing chamber, sedimentation basins and rapid sand filters. In addition, a 10-ft. gravel filter or adsorption tower, a lime saturator and an aerator were included. One set of experiments without chemicals of any sort indicated that aeration and 4⅔ hr. of sedimentation had no material effect on the removal of the iron. However, the iron was taken out almost completely in the sand filter. This method of treatment was regarded as objectionable since accumulations of iron and crenothrix growth in the filter may be anticipated which would tend to unfit the filter for the treatment of the river water.

Another series of experiments with alum as a coagulant was unsatisfactory. The sedimentation basins failed to take out any material amount of iron and it was found practically impossible to obtain a good alum floc. The mechanical filter, as in preceding experiments, removed the major portion of the iron.

Experiments with the use of lime developed what the engineers regard as a satisfactory method for removing the iron. After the application of lime the sedimentation basins were able to reduce the iron from 1 to 0.2 or 0.3 p.p.m., which was carried to somewhat less than 0.1 p.p.m. by the mechanical filter.

FIG. 2—DORR THICKENER FOR SLUDGE REMOVAL
Continuous instead of intermittent removal of sludge is obtained in the water purification plant by adapting sewage apparatus to the water purification process.

FIG. 3—MIXING CHAMBERS OF 1-HR. DETENTION PERIOD
Four units with motor-driven stirrers. In background at left are three chemical dry-feeders.

Further experiments were conducted to determine the efficacy of back treatment with alum to prevent incrustation of sand grains. It was observed in the experiments that whenever there were normal carbonates in the effluent from the sedimentation basins a reduction in alkalinity took place during the passage of the water through the filter.

The adsorption tower was found to reduce the iron to 0.3 or 0.4 p.p.m., with rates up to 250 m.g.d. per acre. The tower experiments were not pursued to a finality, as it was found feasible to remove the iron with ordinary devices included in a rapid sand filter. They may, however, prove of value elsewhere especially if some satisfactory means can be devised for cleansing.

Both experimental work and subsequent design and construction of the combined filter and softener were carried out under the direction of Pearse, Greeley & Hansen, consulting engineers, Chicago.

Observations on the Failure of Structural Materials

Japanese Tests Point to Influence of Internal Friction and Indicate a Constant Angle of Friction

BY GEORGE PAASWELL
Consulting Engineer, New York City

THE PHENOMENA attendant upon failure of structural units are usually dismissed by the engineer with the thought that, being without the province of elastic law, they can have no bearing upon elastic stress distribution. As a matter of fact, it is now becoming recognized that tests to destruction serve to show more than mere maximum loads. A recent paper by Chidô Sunatani (in "Technology Reports of the Tohoku Imperial University, Sendai, Japan," Vol. III, No. 1, 1922) serves to illustrate the fact that the study of the failure of stressed bodies may modify accepted notions of elastic behavior and limit permissible stresses to certain ratios of the fundamental shear and tension stresses.

Engineers are beginning to recognize that, however complicated the applied stress distributions, impending failure is controlled by the elementary shear or tension stresses on planes determined by the maximum-stress theory of ordinary elastic law. Failure tests aid in indicating how such surfaces of maximum stress may be located. Thus cylinder tests for compression on concrete illustrate shear failure, not compression failure, and the permissible compression stress is really the permissible shear stress from the applied load.

When does a body fail? There are three theoretical criteria upon which failure is assumed to depend. Failure is believed to occur either (1) when the applied load reaches a certain value, the criterion of maximum stress; (2) when the elongation in the direction of the load reaches a certain amount, the criterion of maximum strain; or (3) when the maximum shear due to the load reaches a certain value, the criterion of maximum shear. According to the first two, failure surfaces should be normal to the applied load; according to the third, failure surfaces should make an angle of about 45 deg. with the load axis, depending somewhat on the nature of the material (brittle or ductile).

As a matter of fact, tests verify none of these deductions. Mr. Sunatani has conducted a series of torsion, tensile and compressive tests, and has found failure surfaces that seem to depend upon an angle of internal friction ϕ. Previous investigators (Mohr, Hartmann, etc.) have recognized the possibility of internal friction in elastic structures, and the appearance of Lüder lines in a tension specimen of ductile material is explained on a frictional theory. It is questionable whether such internal friction assumes an important rôle within the yield point; but at or near failure, Sunatani demonstrates quite clearly, internal friction does play an important rôle.

Two types of failure are distinguished: a sliding failure, such as occurs in brittle material under compression, and a tensile failure, such as a brittle material would suffer under simple tension. The failure of a ductile material under tension exhibits some of each type of failure, the outer shell of the specimen yielding to a sliding failure, the inner core to a tension failure.

For the case of sliding failure, the determination of the maximum stress is made upon the basis of a shearing resistance in the failure plane (the usual tangential component of stress) and the frictional resistance (which is the product of the internal friction coefficient k, or $\tan\phi$ and the normal stress on this plane). Determining the plane upon which this composite stress becomes a maximum, the author finds that for simple tension, sliding occurs along a plane making an angle of $45° - \frac{1}{2}\phi$ with the axis of the tension load. and the shearing stress, R, bears the following relation to the applied unit stress, t:

$$R = \frac{1 + \sin\phi}{2\cos\phi} t$$

If the applied loading is compressive, the numerator of the equation takes the form $1 - \sin\phi$. For a torsion load, where f_s, the torsional shear, is obtained from

$$f_s = \frac{3M + a\frac{dM}{da}}{2\pi r^3}$$

(M is twisting moment, a is angle of twist, and r the radius of the member), the limiting shear of sliding failure is

$$R = f_s/\cos\phi$$

Here f_s and t are stresses that may be computed from usual tests, the former by means of the equation just given, the latter by taking the quotient of the applied load and the area of the section. Since the controlling shearing stress R is the same for either case, the angle ϕ may be obtained from

$$\sin\phi = 2\frac{f_s}{t} - 1$$

With the ratio of the unit stresses as obtained by tests upon the same material for torsion and for compression, the author finds that the shear stress is about 0.7 of the tension stress, which gives a value for ϕ of approximately 20 deg. Measurements of the angle of the fracture planes of wrought iron, mild steel, brass and copper, indicated with experimental exactness that this is a correct value of the angle.

In similar fashion the author derived an expression for maximum tension on a plane, the resistance of the plane being controlled by the normal tension stress as indicated by usual elastic theory, and a tangential frictional component, the product of the internal friction coefficient k and the shear stress. This formula indicates failure surfaces making angles of $\frac{1}{2}\phi$ with the horizontal. Tests upon brittle specimens, such as plaster, chalk and cast-iron, again gave a value of the internal friction angle of 20 deg. That this angle appears constant leads the author to state that "the effect of the normal component of stress on the shearing resistance is equal to that of the tangential component of stress on a tensile resistance."

From these observations, the resistance of a material to failure is a function of the internal angle of friction, so that for a ductile material subjected to a tensile stress the shearing stress occurring on a plane of maximum stress must be less than 0.7 of the applied unit stress of tension. Ductility or brittleness may be defined by a characteristic type of failure, a ductile material starting to fail by shear, a brittle material starting to fail by tension, both under tensile loading. This distinction is a novel one, and the author follows it up by the statement that, as the ratio of the composite shearing strength to the composite tensile strength is greater or less than 0.7, the material is to be regarded as brittle or ductile.

As to the ratio between the composite compressive and tensile strength, the formulas give

$$f_c = \frac{1 + \sin\phi}{1 - \sin\phi} f_t$$

With the angle of internal friction 20 deg., the compressive strength should be approximately twice the tensile strength. Experiments made to verify this ratio were not conclusive, however. The author ascribes this to flexural stresses in the compressive specimen. Offhand the conclusion that the compressive resistance is twice the tensile resistance appears preposterous. It may be, however, in view of the fact that so little is really known of true compression failures, that the ratio is correct and that more careful experimentation may confirm it.

The above ratio is identical with the one Rankine obtained for granular materials. It is possible, therefore, that soils, possessing quasi-elastic properties, have angles of internal friction constant and independent of the soil constituents.

Summing up the author's work, it appears that the angle of internal friction is constant for all elastic solids, having a value in the neighborhood of 20 deg., and that in consequence the failure type and the corresponding weak planes of that type may be predicted with reasonable accuracy, once their classification as brittle or ductile materials is determined. As an indirect conclusion, the mechanics of failure appears to be amenable to elastic theory and there is hope that more detailed attention will be paid to the characteristics of fracture rather than mere ascertainment of the breaking load.

Reservoir Loses 84% of Storage Capacity in Nine Years

Measurements of Silt Behind Old and New Austin Dams in 1900 and 1922—Stream Flow Has Ranged From 160,000 to 9 Sec.-Ft.

By T. U. Taylor
Dean of Engineering, University of Texas, Austin, Texas

MEASUREMENTS made in each case by the writer show that the silting up of the reservoir formed by the new dam across the Colorado River at Austin, Texas, decreased the storage capacity by 83.84 per cent in the nine years ending in the summer of 1922, compared with a decrease of 62 per cent behind the first dam in the four years ending May, 1897, and 52 per cent for the 6¾ years from May, 1893, to January, 1900. The amount of water stored behind the old dam in the 2¾ years between the 1897 and 1900 measurements increased due to the flushing out of silt, notably by a flood which caused a 9.8-ft. depth of water over the crest of the old dam in June, 1899. It should be noted that the river cross-sections on which capacities for 1893 are based were taken in 1893. Details of the author's measurements are given below, together with notes on various Colorado River floods and on the minimum floods on record. [For the earlier measurements, reference may be made to an article by Prof. Taylor on "The Silting Up of Lake McDonald and the Leaks in the Austin Dam," *Engineering News*, Feb. 22, 1900, p. 135. The article is accompanied by a tabular and graphical presentation of the depth of silting at twenty stations, as measured in 1900, a map of the Colorado River and a curve and formula, the latter with derivation, showing rate of silting worked out in terms of depth on 1 sq.mi. Water flowed over the crest of the old dam for the first time in May, 1893. The dam was destroyed by flood on April 7, 1900.—Editor.]

Silting of New Lake at Austin—The contract for the present Austin dam was let in 1911 and the dam was partly filled by the summer of 1913. In September, 1913, the lake was filled with water up to the present spillway, which is 51 ft. above the toe of the old dam—the datum usually adopted. The dam, which has not yet been accepted by the city of Austin, has been in the hands of a receiver, Guy A. Collett, since 1916. In 1918 Mr. Collett, with the consent of the federal authorities, sold the water in the lake to the rice growers in the lower countries for the purpose of irrigating thousands of acres of rice on both sides of the Colorado River. This drained the lake.

In September, 1922, the writer cross-sectioned the lake at the old stations and found the results as shown by the accompanying table and diagram. In brief, the water storage capacity of the lake in 1922 was only a sixth of what it was in 1913. Making use of the author's formula for rate of silting in terms of depth on a base of 1 sq.mi. (for derivation, see *Engineering News*, Feb. 22, 1900, p. 135), in which $h(1 - x)^n$ = depth of water after n years, we have $h = 52.87$, and depth of water $= 8.53$. Hence $52.87\ (1 - x)^9 = 8.53$ or $(1 - x)^9 = 0.1616$. Hence $x = 0.1834$. That is, on an equal base, 18.34 per cent of silt was deposited each year on the average.

Historic Floods at Austin—The biggest floods of which we have knowledge are those of 1843, 1852, 1869,

1870, 1900 and 1913. The discharge of these floods has been estimated but no reliable measurements of any of them were made except of 1900. The following notes on these floods will be confined chiefly to that of 1869, although brief comments on some of the other floods and some general comparisons will be given.

Flood of 1869—The flood of 1869 is referred to by old settlers in Texas as the greatest in the history of the Colorado River. The writer has gone to considerable trouble to find accurate data in regard to this flood and submits herewith extracts from the diary of E. C. Bartholomew who has been a resident of Austin since 1867.

Wednesday, July 7, 1869: The Colorado River is tremendously high and causes great excitement. The people living on the bank are nearly all moving, and many houses are under water. Monroe Swisher's house across the river floated off, as well as other houses of an inferior class. Fields of cotton and corn on the river bottoms are covered with water, and the loss is immense. It has rained steadily since last Saturday night (July 3, 1869) until today. The river rose into the Davis large mill (Zilker ice house) on the bank of the river.

Saturday, July 17, 1869: We received the first Northern mail this morning in 13 days. The flood prevented the running of stages.

Capt. W. C. Walsh, another old resident whose home in 1869 was between Barton Creek and the Colorado River, states that the heavy rains began at 4 p.m. on June 27, 1869, and continued until about 3 a.m. of June 28, when the back water in Barton Creek was approximately 30 ft. deep. The rains continued through June 29 and 30, light showers alternating with heavy downpours. Rain began falling again on Saturday, July 3, and continued until the morning of July 7, when the maximum flood occurred. On the morning of July 7 the water was about 6 ft. deep at the gateway that leads to the present Barton Springs park.

The flood of 1869 is regarded as the biggest flood that ever occurred in the Colorado River, but E. C. Bartholomew distinctly questions whether the flood of 1869 was greater than the flood of April 7, 1900, that broke the Austin dam. There was a ferry across the Colorado River at the foot of Congress Ave., where the present reinforced-concrete bridge exists. Old settlers unite in stating that there was a high bluff from the present concrete bridge to the railroad bridge of the International & Great Northern Ry. This bluff was composed largely of alluvial deposits and was nearly as high as the present north bank. The flood of 1869 cut down this high bank on the south side, and eroded the plateau south of the bank for many feet.

Thus, the flood of 1869 and the flood of 1900 were passing through channels whose cross-sections were entirely different and there is no basis of comparison.

Flood of 1870—Quoting again from the diary of E. C. Bartholomew, this time under date of Monday, Oct. 17:

It rained hard all night, and when I arose this morning the river was up nearly as high as it was one year ago last July. The water carried off the pontoon bridge, and has caused great destruction on plantations below.

Studies at Webbersville of 1869 and Other Floods—Because the flood of 1869 changed the cross-section of the river at Austin, the writer made a special investigation of the floods at Webbersville on the Colorado, eighteen miles below Austin. At this place, the cross-section has remained practically constant. The village of Webbersville is situated on the north bank of the Colorado River, and the old settlers there were in all the floods since 1868, and the writer is able to make the following definite report:

RESULTS OF SILT SURVEY BEHIND NEW DAM AT AUSTIN, TEXAS SEPTEMBER, 1922

Station and Distance from Dam Name	Miles	Depth of Silt as Measured in Feet Mean 1913	Mean 1922	Maximum 1913	Maximum 1923
Dam....	0.0	36.10	14 44	60	19.00
Bee Creek....	0.2	36.57	11 33	60	16.00
Mormon	1 2	29 91	6 13	57	12 20
Dry Creek....	3 0	30.00	3 70	47	6.80
Bull Creek....	4.0	29 43	3.60	38	6.40
Ennis....	5 6	32.25	4 21	38	7.00
Devils	7 0	31.08	5 54	38	6.80
Ogarita ...	7 8	27.29	4.89	36	6.30
McNeill......	9.3	26 83	4 70	31	6.20
Scotts....	10.4	22.00	5 22	31	8.00
St. Monica...	13.7	19.62	2.80	21	5.20

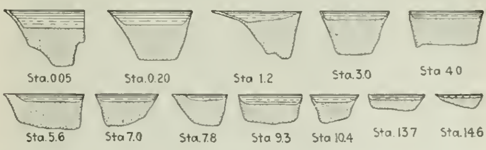
	Cubic Yards	Acre-Feet	Feet Depth on a Square-Mile Basi
Volume of water in 1913...	54,591,680	33,745	52 87
Volume of water in 1922...	8,805,280	5,456	8.53

Ratio of water volumes, 1922 to 1913 = 0.1616 or 16.16 per cent; or in the nine years from 1913 to 1922 Austin Lake has filled 83.84 per cent of its 1913 volume leaving a water volume only one-sixth that of 1913.

The flood of 1869 flooded Webbersville to a depth of 9 ft. and covered the farms to the foot hills, on the north, a distance of 1 to 1½ miles. The flood of 1870 was 3 ft. deep in Webbersville, and, therefore, 6 ft. below the flood of 1869. The flood of 1900, that washed away the Austin dam, did not get out of the banks of the river at Webbersville on the north side. The flood of December, 1913, was about 1 ft. higher than the flood of 1900. Therefore, in order of magnitude, the floods stand: 1869, 1870, 1913, 1900, 1899. The writer was unable to get any data in regard to the floods of 1843 and 1852.

During the flood of 1869 all the creeks between Austin and Webbersville were at flood stages, and therefore added their volume to that that passed Austin. However, the flood of 1870 came like a thief in the night, reaching Webbersville and overflowing farm lands while the farmers were working their fields. The 1870 flood came from the upper reaches of the Colorado River.

Flood of 1899—Although no reliable measurements of any of the floods were made, except that of 1900, calculations can be made for the flood of June, 1899. The old Austin dam had a rounded crest 1,091 ft. long, and we could apply Francis's weir formula to the calculation of the discharge. The coefficient in the Francis weir formula is 3.33 but it is a well-known fact that this increases as the depth increases and the writer is of the opinion that in the case of the Austin dam this coefficient was nearer 4 than 3.33. A coefficient of 4 in the Francis weir formula will give a discharge of 160,000 sec.-ft. for the flood of April 7, 1900. It is to be recalled that this flood was produced almost entirely by the rains that fell in the Canyon section, between Marble Falls and Austin. The heavy rains



RELATIVE DEPTHS OF SILT AND WATER BEHIND AUSTIN DAM IN SEPTEMBER, 1922

The stations are given in miles above the dam. See table for depths in feet.

began at 6 p.m. on April 6, 1900, and continued for about twelve hours steadily. At 11:20 a.m., April 7, 1900, the old Austin dam cracked, and soon portions of it were washed away.

Low Flows of Colorado—In 1910 and 1918 the Colorado River reached its very lowest flows of recorded history. In 1910 the writer measured the flow at the dam from Aug. 15 to Sept. 28 and found it to be only 21 sec.-ft. In 1918, after the water had been drawn from the lake, the whole flow of the river plowed a narrow furrow through the silt above the dam, and the channel was so narrow that it was easy to hop across it at one jump. At this time the whole discharge of the Colorado River was only 9 sec.-ft. immediately above the dam, the flow being confined to a channel about 4 ft. wide in the silt.

Shaded Topographic Maps Are Developed by Geological Survey

WITH THE RECENT production of a shaded topographic road map of the region of Washington, D. C., the United States Geological Survey has made a further step in attempts to improve the legibility of its regular topographic maps by the use of shading. A section of the Washington map is reproduced herewith, reduced to one-half the scale of the published map (Fig. 1). An example of a different style of representation, a combined contour line and shaded map, is also shown (Fig. 2).

For a number of years the survey has been experimenting with various types of shading for showing relief both by itself and in connection with contours. The combination of shading and contouring, as exemplified for the Monument Spring section in Fig. 2 herewith, is considered to be well adapted to use for regular engineering purposes. A number of sheets in West Virginia and Pennsylvania are in course of preparation, and it is intended to publish them in the near future as a means of securing an expression from users of topographic maps as to the value of this method of showing relief. If opinion is favorable, other maps in various parts of the United States will be produced as demand requires. The extent of the work necessarily will depend on funds available. The same remarks apply to the method of representation used for the Washington road map, in which surface contours are not considered necessary.

FIG. 1—PART OF SHADED ROAD MAP OF WASHINGTON AND VICINITY

One-half actual size. A greenish gray was used for the topographic shading, red for through roads (heavy lines), black for minor roads (fine lines), and blue for water.

The Monument Spring map was prepared under the supervision of J. H. Renshawe, of the Survey, an experienced topographic engineer and also an artist. The shading is so applied as to produce the effect of a sculptured relief model under oblique illumination. The aim of the artist was to bring out the character and individuality of the different topographic features, so far as the limitations of the scale would permit. The map further embodies an attempt to express differences in altitude by gradation of the shading tint, dark tints being employed for low lands and lighter tints for high lands. The use of hard lines was avoided, and a soft mellow effect was sought, so as to bring out the outstanding features in correct proportion, to enable the map reader to visualize the country at a glance.

FIG. 2—CONTOURS AND SHADING COMBINED

Part of Monument Spring quadrangle, Brewster County, Tex., reproduced one-half original size. The contours are in brown as on the ordinary topographic maps of the U. S. Geological Survey. A brown stipple is used for the topographic shading, which is so applied as to give the effect of shadow under illumination from the upper left.

Where standard topographic contoured maps exist, the work involved in preparing the shaded copy for combining with the contouring is not costly. The shaded copy can be prepared in a few days by a trained cartographic artist at an expense of approximately $70 for a standard topographic sheet, and the additional cost of mechanical reproduction would not exceed $75 a sheet for the ordinary editions.

The Washington area was selected for the purpose of bringing the question of shaded road maps for regions near large cities to the attention of road users. No additional field work is involved in producing the shaded map, and no great additional cost in applying the shading and in printing. It is expected that the result will prove to meet the requirements of tourists and automobile users far better than the ordinary road maps without relief.

Where the topographic survey of a state has been completed and published maps exist, a shaded relief map on the scale 1 : 500,000 will be prepared. The best example of a shaded map of a state that has been completely topographically mapped is that of Ohio, and the results obtained by Mr. Renshawe on this map may be considered as a standard of what can be expected for other states as rapidly as the topographic surveys are completed.

Expressions of opinion concerning these two types of shaded maps are desired by the director of the U. S. Geological Survey.

Reclaimed Rubber Tires to Be Tested

An order for fifty tires made with various amounts of reclaimed rubber in the tread has been placed with one of the rubber companies by the U. S. Bureau of Standards. These tires, when completed, will be tested in the laboratory and also on trucks of the post office department on four different types of road, to determine the relative wear resistance of the different compounds.

Inadequate Design Causes Failure of Concrete Swimming Pool

Structure at Midland Beach Resort, Costing $63,000, Damaged Through Collapse of Sidewall When First Filled

LACK OF adequate engineering design was apparently behind the failure, on July 3, of a reinforced-concrete swimming tank at Midland Beach, near New York City, built by the owners of the resort, and scheduled to have had its opening on July 4. The tank had been constructed hastily and was being filled with water for the first time when about half of one of the side walls pushed out, shearing off along the line where the side wall joined the floor slab. Property damage sustained through flooding was estimated at several thousand dollars.

The tank was built upon filled marsh land and was supported on timber piling. The structure, of rectangular shape with semi-circular ends, has a length of 200 ft. and a width of 83 ft. It was to provide for a water depth of 3 ft. at the shallow end, with the bottom sloping to provide a 11-ft. depth at the deep end. Concrete slab and side walls are about 12 in. thick.

Inspection of the tank after failure would indicate that the greatest structural weakness lay in the lack of buttressing or counterforts to resist the heavy pressure of water exerted by a filled tank. As the photographs indicate, the structure is built in such fashion that the side walls merely rested on the slab, an attempt having been made to tie slab and walls together by bent ⅜-in. deformed bars. There appeared little uniformity in the spacing of the bars. When the side wall fractured it failed along the top of the slab, the slab under the inside half of the wall being left clean after failure.

FIG. 3—CLOSE-UP OF REINFORCEMENT

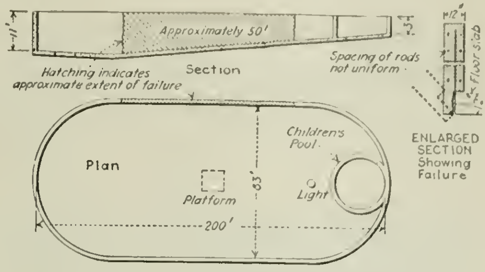


FIG. 1—PLAN OF POOL AND SECTION OF WALL

Lack of adequate design was also apparent in the failure to provide expansion joints. There was no provision for expansion longitudinally though laterally several straight cracks clear across the slab were apparent.

FIG. 2—VIEW OF COLLAPSED PORTION

FIG. 4—REINFORCING CLEANED OF CONCRETE

The concrete used in the construction of the pool seemed to be run from bank run gravel and sand and no effort seems to have been made either to accurately measure it or exercise care in running the batches.

Competent advice was sought when the project was first proposed and a preliminary sketch was submitted by a reputable architectural and engineering office, but the owners for some reason did not retain the original designs although the layout was followed to a considerable extent.

The pool was built by the Midland Beach Co., at a cost of $63,000, James C. Hinchcliffe of Paterson, N. J., representing the owners. It is practically a dead loss as there are indications of failure in other parts of the construction.

Interchange in Formulas

An error in checking the formulas in the article "Trapezoidal Portal and Eccentric Heel Joint of Truss," by Camillo Weiss, printed on page 339 of the issue of August 30, interchanged the formula for moments M_A and M_B in two cases. The formulas for M_A and M_B below the middle of the first column, and the corresponding simplified formulas near the top of the second column, should have the right hand expressions interchanged, or they can be made to read correctly by writing M_B for M_A and vice versa. The formulas as still further simplified near the middle of the second column are given correctly in the printed text.

Two Precast Concrete Bridges on Lackawanna R.R.

One Carrying Railroad at Millburn, N. J., Made Up of Heavy Slabs Replaced Under Traffic Lighter Steel Structure—Other 48-Ft. Footbridge Over Three-Track Right-of-Way

By M. Hirschthal
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In THE design of railroad structures replacing those in use the main consideration is to cause a minimum disturbance of traffic. This factor frequently far outbalances economy in the design of the structure itself, for the difference in the cost of track work or temporary construction for two different types of design may constitute a large percentage of the total cost of construction. To eliminate interference with traffic and yet obviate the necessity of temporary construction, precast reinforced-concrete members have often been designed but with limitation as to spans, loads, and type of structures. Methods to extend these limitations to the point of almost removing them have recently been used with highly satisfactory results on the Lackawanna R.R. in two interesting examples of precast reinforced-concrete bridge work. The two structures to be described are the extremes of bridge work, the one a railroad bridge to withstand locomotive loadings as an undercrossing, the other an overhead footbridge.

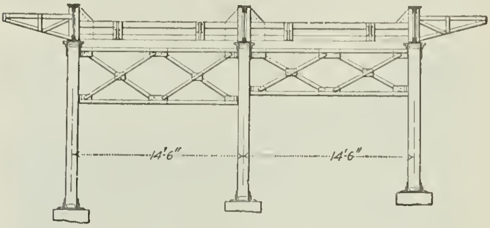


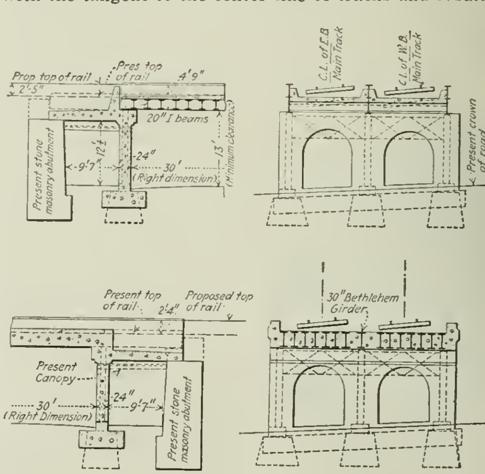
FIG. 1—SECTION THROUGH STEEL BRIDGE REPLACED AT MILLBURN, N. J.

Millburn Undercrossing Requirements—The undercrossing is a replacement of a structural steel bridge at Main St., Millburn, N J., on the main line of the Morris & Essex Division, subject to the heavy suburban traffic between Morristown and Hoboken. In 1894 this structural steel bridge, an unusual type, was built to provide for two tracks and station platforms, the latter by means of brackets cantilevered from the fascia girders which were each spaced 14 ft. 6 in. c. to c. from the center girder. All of these were through girders supported on steel columns (braced by latticed struts) along the curb lines and masonry abutments along the street lines. The floor beams, spaced 5 ft. 11 in. c. to c. were supported on the lower flanges of the girders while the stringers consisting of two channels back to back were framed into the floorbeams at different levels to take care of the superelevation required for the 4 deg. curvature of track compensated. The ties were placed on the stringers to form an open floor leaving the roadway span unprotected. The sidewalks, however, were protected by wooden canopies spanning from the abutment to a channel connected with the columns. Fig. 1 shows the old structure.

Some ten years later the station was moved about a thousand feet further east, dispensing with the platforms and permitting the removal of the brackets, thus reducing the loads on the girders, which were then being overstressed by the increase in locomotive loadings. These loadings however continued to increase and it became necessary to replace the structure by one more modern to meet future requirements. In 1921 plans were prepared for such a structure. The first type to be considered was one similar to that to be replaced, with the exception that the sidewalk spans were to be of concrete and the main bridge floor solid, as in the section in Fig. 2. The girders were to be supported on concrete arched piers encasing the then present columns, which construction also carried the sidewalk slab and necessitated the through girder construction over the roadway only. This scheme was discarded for one which dispensed with the use of the through girders, consisting of a floor of 30-in. Bethlehem girder beams spanning the roadway and spaced about 2 ft. centers, filled solid with concrete to form a 36-in. solid floor (Fig. 3).

Type Selected—The final variation was the substitution of reinforcing steel for the Bethlehem girders, which could only be accomplished for that thickness of slab by the use of compressive reinforcement, thus making the structure a reinforced-concrete bridge. The substitution reduced the weight of the slabs sufficiently for the handling of larger units as precast slabs.

The clear roadway span which is maintained in the present design is 30 ft. measured at right angles to the center line of street which makes an angle of 79 deg. with the tangent to the center line of tracks and result-



FIGS. 2 AND 3—TWO STUDIES OF PROPOSED NEW BRIDGE, BOTH REJECTED

Both designs incase old steel supports in concrete. Fig. 2 shows new steel girder bridge with 20-in. floorbeams and solid concrete floor, with reinforced-concrete spans over sidewalks. Fig. 3 substitutes solid concrete main span, of Bethlehem beams incased in concrete.

ing in a skew span of 30 ft. 7 in. The track centers are also maintained at 14 ft. 6 in., requiring two 7 ft. 3-in. slabs to carry the load of one track (Fig. 4).

The various portions of the structure were designed to carry an E-65 engine loading. For this condition of loading a slab simply supported, reinforced for tension and shear only, would have required a depth of 49 in. for the roadway span. Since the depth was limited to 36 in. the deficiency in the compressive resistance of the concrete for the latter depth was compensated for by the use of compressive reinforcement in the upper plane of the slab, with the required additional tensile reinforcement in the lower. Twenty-four 1¼-in. square bars were required for compression and twenty-five for tension to resist the maximum moment at the center of span. After the quarter-point of the span was passed, the steel was reduced to take the moment at that point. Two lifting loops of 1¼-in. round rods were imbedded at each end of the slab for handling both in loading on the cars and for setting in place. To provide for the maximum shearing stresses seven of the tension bars were bent up near the supports and stirrups of ¾-in. rounds were spaced as shown. The parapet slabs for the main span are of sufficient depth to require no compressive reinforcement to resist moments due to the load they were designed for. The parapet slabs for the sidewalk spans were precast as a convenience in construction.

The piers were designed to take the maximum live-load reaction together with that of the dead-load and impact, the arched girders being reinforced both by the strut angles and reinforcing bars to transfer their loads to the concrete columns encasing the old ones of steel. The masonry footings were found to be sufficiently strong to carry the new loads, except that those at the ends were increased to provide for future third tracking. The pier is so designed that an addition can be made to accommodate the installation of a third track,

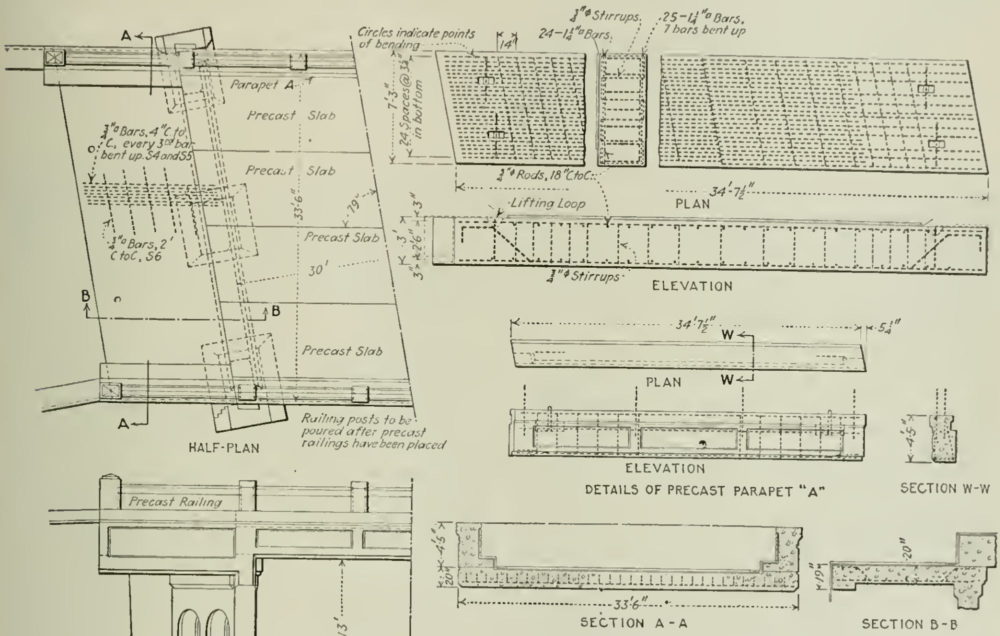


FIG. 4—ADOPTED DESIGN FOR MILLBURN BRIDGE

Consists of concrete encasement for old steel supports; precast concrete floor slabs and parapets.

for which purpose the parapet slab unit may be moved, two additional track slabs set in position and the parapet unit replaced at the new face. The sidewalk slabs could again be poured in place, with the pier extension.

Casting Methods—The precast units were cast in the yard of the shops at Kingsland, N. J., which is on the Boonton Branch. The forms were erected on a platform, the reinforcing steel was secured in position and the 1:2:4 machine-mixed gravel concrete poured. Two sets of forms were used and one track slab and one main parapet slab were poured in one operation. The concrete was cured in the open air and flushed twice a day for two weeks. All the slabs were treated in this manner and were cured at least thirty days before they were loaded on the cars for shipment to their destination. The weight of one track slab is 57 tons.

In order to expedite the completion of the work the precast slabs while still in the yard were waterproofed and a protection coat was provided to within lapping distance of each edge, the cloth extending a lap beyond the edge and being bent back pending erection, after which the cloth was bent back into position and the protection coat placed. The waterproofing for all the work consists of two plies of asphalt-saturated cotton cloth laid in asphalt and protected by 2¾-in. thicknesses of asphalt mastic.

The piers and sidewalk slabs however were poured

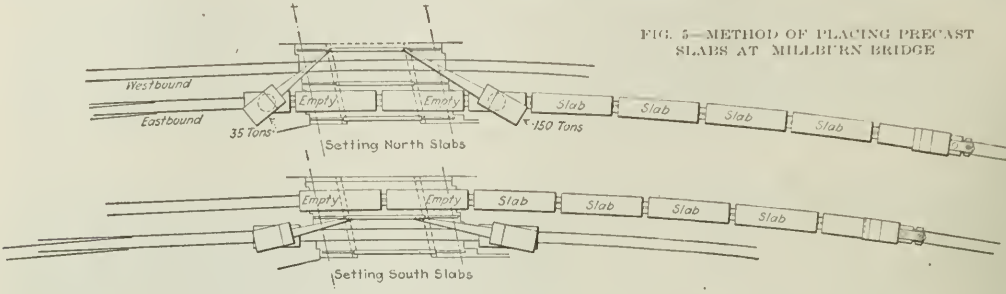


FIG. 5—METHOD OF PLACING PRECAST SLABS AT MILLBURN BRIDGE

in place without disturbing traffic either of the railroad or of the thoroughfare. The masonry of the abutments was removed to a point below the proposed level of the bottom of the sidewalk slab, the structural steel girders were blocked up a few inches to clear the sidewalk slabs, while the struts on the south half of the bridge, being too low, were cut off and replaced at the higher elevation as shown in Fig. 4. The forms were then built around the columns and struts as well as for the sidewalk slabs, the reinforcement placed in position and the concrete poured, each pier with its adjacent sidewalk slab comprising one operation, without interfering with traffic. These were allowed to cure for a month before the precast units were placed in position.

Erecting Millburn Bridge—The process of erection of these slabs was as follows: The precast units were loaded on flat cars at Kingsland, N. J., and transported to the site of the work at Millburn, N. J. It was planned to complete this erection and the raising of the track between the passage of the westbound train at 11:33 p.m. Sunday, and that of the eastbound at 4:11 Monday morning, or within a little more than four and one-half hours. It was decided to install the westbound track first because of the superelevation, therefore this track was cut east and west of the limits of the bridge while a work train was located on the eastbound track, as shown in Fig. 5. The work train consisted of the cars on which the slabs were loaded, a 150-ton wrecking crane, empty cars and a 35-ton crane. The floorbeams of the westbound track were cut free from the center girder, and, together with their fascia girders, each sidewalk span was lifted by the respective cranes into the empty cars which were then drilled out of the way

FIG. 6—THE FINISHED PRECAST CONCRETE BRIDGE AT MILLBURN

and replaced by two other empty cars, with the cranes located on either side so that together they could lift the main span (fascia girder and floor beams) and load it onto the cars. The smaller crane was then drilled into the switch while the remainder of the train was manipulated so that the wrecker was located east of the cars containing the track slabs, after which the smaller crane was again shifted into position west of the cars, enabling both cranes to handle the units which were then placed in position clear of the center girder and tracks blocked up to new level 2 ft. 6 in. above the old.

It then became necessary to raise and ballast the track for a total distance of 1,800 ft. on both sides of the bridge, precluding the possibility of completing the eastbound track side of the bridge that night. The tracks at the bridge were then blocked up to permit of the completion of the waterproofing. Two nights later the work was resumed. The eastbound track was cut at both ends of the bridge, the wrecker located on the east end and the crane on the west while the train was so located that the empty cars were on the newly set span of the westbound track. The cranes then lifted the old steel sidewalk spans into the empty cars which were drilled out of the way, replaced by the other two empty cars into which was loaded the main steel span and these also were drilled out of the way. The cars containing the slabs were then located in position and the slabs, handled by the two cranes, were set in place and all of them aligned, the track was graded and ballasted on both sides of the bridge at which they were blocked up, traffic was resumed on both tracks and the waterproofing completed between trains. After all this the ballast was placed. The bush-hammering was then completed and a concrete balustrade cast in place, resulting in a structure as pleasing as one built in place.

East Orange Footbridge—The other example is a footbridge to replace one of structural steel, for Maple Ave., East Orange, in connection with the East Orange improvement described in *Engineering News-Record*, Nov. 9, 1922, p. 778.

This bridge consists of piers cast in place on top of the continuous retaining walls, which were built in connection with the depression at this point, the girders together with the slab spanning between them constituting the precast section. The stairways leading from the bridge at either end, like the piers, were built in place.

The piers carrying the footbridge are supported on the retaining walls and held in place by means of five 1-in. square bars imbedded in both walls and piers for a length of 3 ft. 6 in. in each, or about 40 diameters. The piers are 1 ft. 9 in. thick and somewhat more than

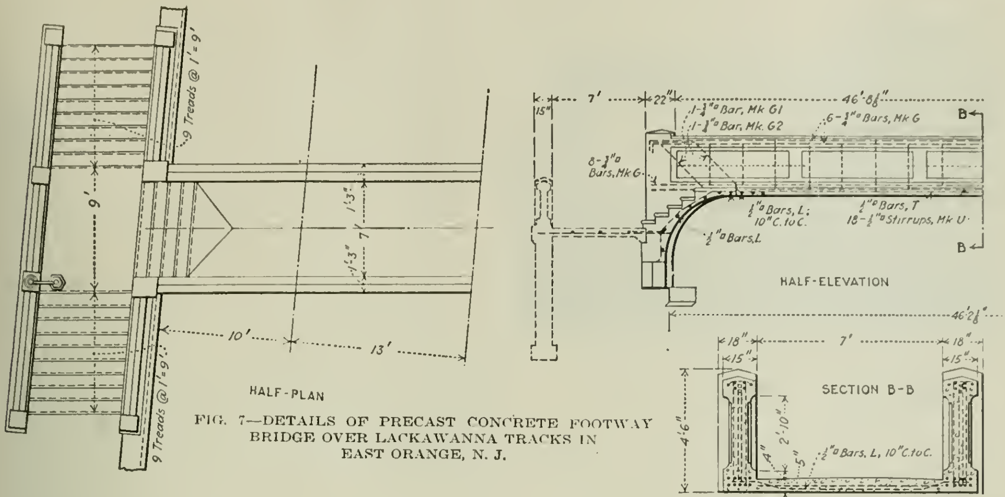


FIG. 7—DETAILS OF PRECAST CONCRETE FOOTWAY BRIDGE OVER LACKAWANNA TRACKS IN EAST ORANGE, N. J.

8 ft. high above the walls. These piers were poured more than a month before the footbridge was placed.

The interesting portion of the work is of course the precast section, which the writer believes to be the first instance of a complete reinforced-concrete bridge precast and erected on previously prepared piers. This footbridge is a single span of 46 ft. 8 in. over three tracks, the center lines of bridge and tracks forming an angle of 84 deg. 59 min. with each other, or very nearly a right crossing. It is of the slab and girder type, the slab being supported at the bottom flanges of the girders, which are located at the respective fascias and are somewhat ornamented for architectural effect. The clear passageway is 7 ft. wide, making an out-to-out width of 10 ft. at the end posts or 9 ft. 6 in. at other points. The fascia girders act as balustrades or railings and have a width of 1 ft. 3 in. both at top and bottom while the web between these flanges is only 9 in. thick except for the 1½-in. panel indentations. The floor slab is 6 in. thick along the center line or crown with a pitch of 1 in. to either side for drainage, which is further facilitated by a 2-in. camber resulting in a pitch toward the stairs at either end. Side clearances for the tracks below permit curving the soffit of the slab to a 4 ft. 10 in. radius at the junction, with the supports providing a curved corbel, thus permitting the introduction of the stair construction several feet before the supports are reached. The precast section therefore includes five risers of the stairway at either end.

The fascia girders 4 ft. 3 in. high result in 3 ft. 9 in. depth of railing, but this does not provide the required compressive resistance for the span, necessitating the use of compressive steel reinforcement, consisting of six ¾-in. square bars as shown in the cross-section. The

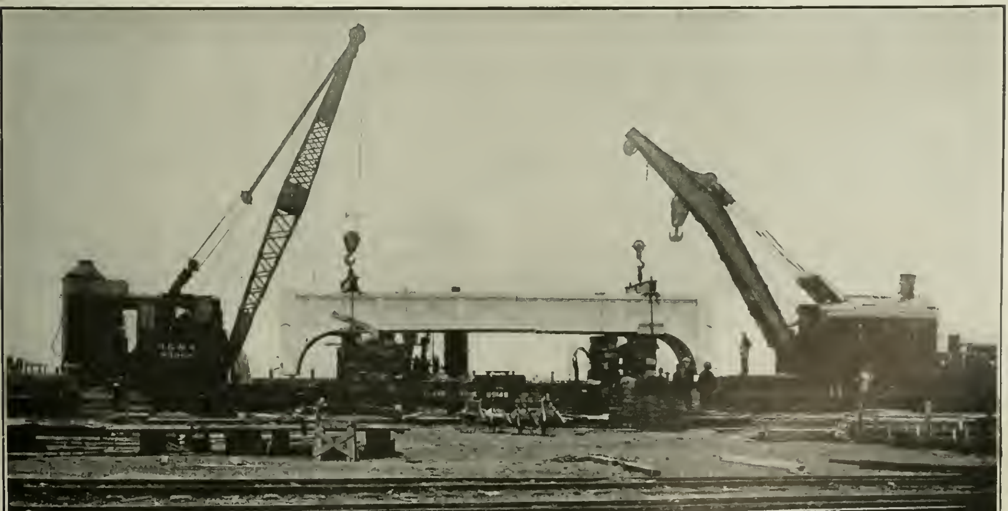


FIG. 8—LIFTING THE 57-TON CONCRETE BRIDGE IN THE CASTING YARD

FIG. 9—THE MAPLE AVE. PRECAST BRIDGE IN PLACE
The supporting piers have been built up from the retaining walls alongside the cut; the approach stairways have not been put in position.

tensile reinforcement consists of ten ⅞-in square bars two of which are bent up to resist diagonal tension in addition to the vertical stirrups of ½-in. square section spaced 2 ft. 6 in. on centers throughout the length of the girders.

This footbridge was also cast in the yard adjoining the Kingsland shops. The forms were erected on a platform, reinforcement was set in place and concrete of 1:2:4 proportion with broken stone as the coarse aggregate was poured, of course, in one operation (the volume amounting to less than 30 cu.yd). After the forms had been removed and concrete sufficiently hardened the panels formed by the indentations were bush-hammered, and the bridge was ready for transportation to the site of the work.

To insure against any damage to the bridge in the various operations incident to final erection and to facilitate handling, a combination of spreader and cradle was devised, to encircle the structure at points adjacent to the curved sections near each end. Each of these cradles consisted of a pair of 15-in. I-beams side by side, both under the soffit of the slab and above the tops of the girders. They projected beyond the structure sufficiently to permit bolting them together at both top and bottom flanges by plates 1 in. thick and 15 in. square at each end. At the center of this spreader there was provided a pin of 3⅞ in. diameter held in place at the underside of the I-beams by means of a 1-in. plate bent to the radius of the pin, the flat portions being bolted securely to the two I-beams. This pin was connected with a 3-in. eyebolt ending in a loop to engage the hook of the crane. Fig. 8 shows these details quite plainly.

In preparation for setting the bridge on the flat car used for this purpose, a timber grillage was built near each end to a height sufficient to keep the curved ends off the floor of the car. Two cranes, one at each end of the bridge, each engaged a lifting loop, raised the bridge from its platform and set it on the flat car in proper position. The train including the cranes then moved to East Orange via the Bergen Hill Tunnel at Jersey City. The bridge was set on its supports by the two cranes, in the same way it was loaded on the cars in the hour between 1 and 2 a.m. after the last westbound suburban train had passed.

In the design of both these structures the unit stresses, similar to all other work on the line, were 650 lb. per square inch for concrete in compression, 16,000 lb. per square inch for steel in tension and 100 lb. for adhesion between steel and concrete; the stress in the compressive reinforcement is of course much below ordinary allowable limits, being fifteen times that of the concrete at the section of its embedment or in the neighborhood of 7,500 lb. per square inch. The weight of the precast bridge is 57 tons.

Oregon Short Line R.R. Improves Idaho Division

Relocation, Grade Reduction and Double Tracking for Tonnage Trains—Pusher Sections Reduced—Construction Work

DOUBLE TRACKING and grade reduction on pusher grades of the Oregon Short Line R.R. near Glenns Ferry, Idaho, are being carried out to effect material improvements in operating conditions on the two freight districts of the Idaho Division, extending between Pocatello, Idaho, and Huntington, Ore., a distance of 326 miles. Except for the two pusher sections of 2 and 1.72 per cent grade these districts have very favorable grades. The work includes a 26-mile stretch of double tracking between King Hill and Reverse, two sections of relocation of the second track and the improvement of the freight yard and engine terminal at Glenns Ferry, which is the intermediate district point. Between Pocatello and Huntington the line is equipped with block signals.

From the general and detail plans and profiles, Figs. 1 and 2, it will be seen that Glenns Ferry, the district terminal for freight runs, lies in a deep sag in the grade line. From it the maximum ascending grades are 1.72 per cent eastbound and 2 per cent westbound. Elsewhere on the division the ruling grades are 0.5 per cent except for about 102 miles between Glenns Ferry and Minidoka, where the ruling grade is 0.65 per cent for eastbound traffic on both the main line and the North Side branch (see Fig. 1). All permanent improvements on the division are being made to conform to these ruling grades.

Grade Reduction—For several years the limitations imposed by the heavy grades east and west of Glenns Ferry, involving the use of pusher engines, have hampered the handling of traffic and the difficulty has been increased by lack of adequate yard facilities at this freight district point. As a result, the capacity of the single-track main line has been overtaxed during seasons of heavy business.

Extensive surveys for relocation have shown that to reduce these heavy grades to the ruling grades elsewhere on the two districts would involve prohibitive cost of construction. It has been determined therefore to retain the short pusher sections from King Hill to Ticeska on the east and from Hammett to Reverse on the west (see Fig. 2) but to reduce their grades to such an extent as to facilitate the handling of standard tonnage trains.

At present, the ruling grade eastbound from King Hill east to Ticeska is 1.72 per cent, but the second track will be constructed in part on a new location with a maximum grade of 1.5 per cent at a cost no greater than that of double tracking on the present location. The diversion will be about a mile in length and at a maximum distance of 450 ft. from the present main line. This

improvement will not involve any material increase in distance. With this reduced grade the standard 2,200-ton train load can be handled eastward from Glenns Ferry to Minidoka (ruling grade 0.65 per cent) with the assistance of a pusher engine of the same tractive effort as the road engine between King Hill and Ticeska, a distance of only six miles. At Minidoka trains may be filled out to the 2,600-ton standard rating for the ruling grade of 0.5 per cent eastbound to Pocatello, the branch line feeders from the south into Minidoka furnishing ample tonnage for this purpose.

Relocation and Double Tracking—Since prohibitive cost also prevents the reduction of the westbound maximum grade of 2 per cent to the ruling grade of 0.5 per cent, extensive surveys were made to determine the best location for a new westbound second track on a grade which would fit in with the use of pusher engines. These surveys resulted in developing a line which has a maximum grade of 1.45 per cent, shortens the distance by two miles, has a maximum curve of 3 deg. instead of 5 deg. and saves 54 deg. of total curvature. The saving in distance was secured by taking advantage of the slack grade between Hammett and Reverse and starting the ascent about one mile west of Hammett. This location was adopted for a new double-track section, with abandonment of the original line.

Heavy grading is involved by this new double-track diversion, although it has no bridges and except for one 10-ft. arch span the culverts are light. Owing to the cost of earthwork this improvement was not undertaken until the increasing traffic warranted the expense. Some of the grading quantities are noted on the profile, Fig. 3. In spite of the additional cost of constructing the second track on the new location, it is estimated that this improvement will result in high economy in operating expenses due to the saving in distance, the saving in first cost and operating expenses of interlocking plants and the preservation of right-hand operation of trains on double track. All towns and business in the district involved can be served as well by the new line as the old line.

With the completion of the work described above, in addition to the 15½ miles of double tracking between King Hill and Bliss, and the ballasting and laying of heavy rail on the North Side Branch (Fig. 1), the Oregon Short Line R.R. will have a continuous second track from Minidoka to Reverse, 123 miles. On the new work and in relaying the present track, 100-lb. rails of the A.R.A. section are used, with gravel ballast 15 in. deep under the ties.

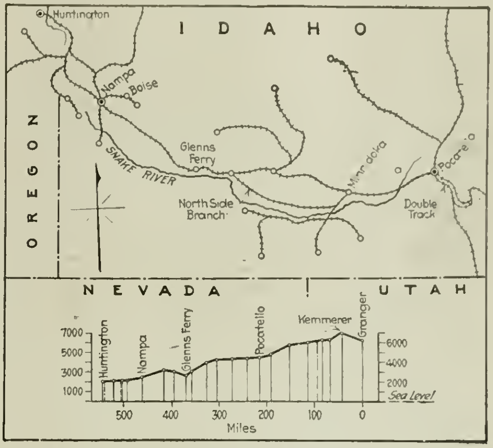


FIG. 1—OREGON SHORT LINE R.R. IN IDAHO

Double tracking now under way covers the stretch between King Hill and Reverse, 26 miles. Work was started in June, 1922, on the section between King Hill and Hammett, and in November on the section between Hammett and Reverse. About eight miles from King Hill to Glenns Ferry was put in operation on Nov. 16 and the next stretch to Hammett was put in operation on Dec. 30, 1922. Since the line change between Hammett and Reverse, nine miles, involves heavy grading, this portion probably will not be completed until near the end of 1923.

Freight Yards and Engine Terminal—Two tandem freight yards for eastbound and westbound movements have been laid out at Glenns Ferry and between them is the engine terminal. At this point the two main tracks were laid on opposite sides of the 200-ft. right-

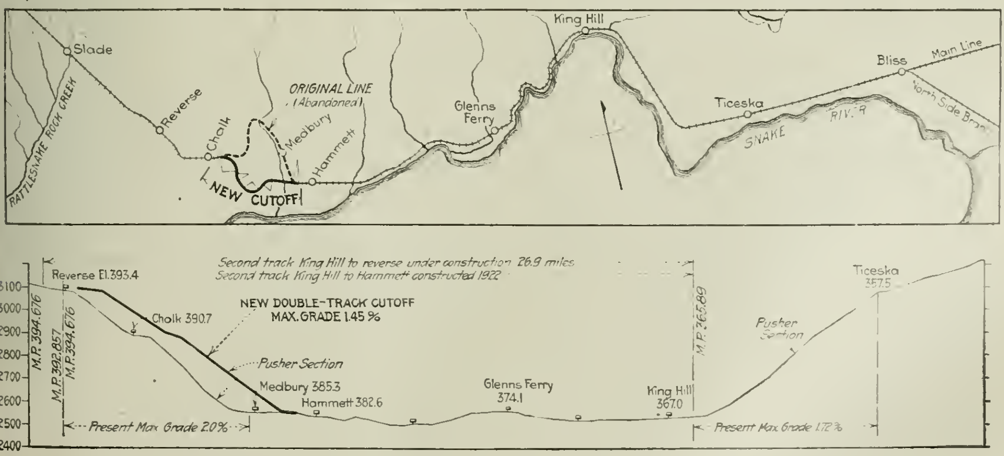


FIG. 2—DOUBLE TRACKING AND GRADE REDUCTION BETWEEN KING HILL AND REVERSE

of-way in order to permit ample development for the yard tracks and locomotive facilities. Daily freight traffic at this point averages 35 trains inbound and 35 outbound. Many of these are run through as solid trains, except for the change of engines and crews and the switching out of occasional bad-order cars. These yards are arranged for flat switching. In the ladder tracks No. 9 frogs are used, but the turnouts from main tracks have No. 10 frogs.

At the engine terminal a 100-ft. truss turntable serves a 17-stall roundhouse of brick and concrete. The ashpit is of the depressed-track type, with ashes shoveled by hand from the pit into cars on the depressed track. A new coaling station is to be built, having a bin of 650 tons storage capacity.

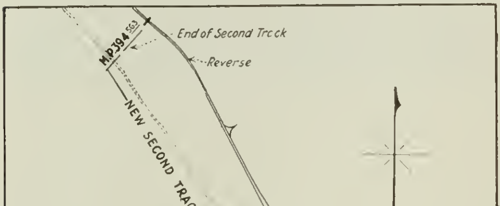
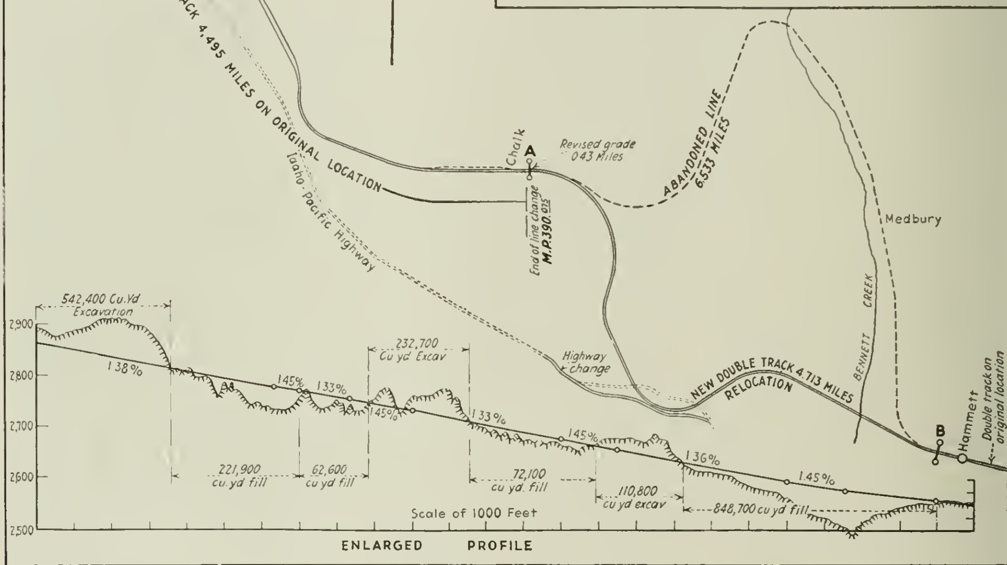



FIG. 3—PLAN AND PROFILE OF RELOCATION ON IDAHO DIVISION

Construction Methods and Plant—On this improvement work the grading outfit included five steam shovels with 2½-yd. buckets and one dragline excavator with 5-yd. bucket and 50-ft. boom. Teams and fresno scrapers were used also on the lighter portions of the work. Dump wagons served the dragline machine, which was used in one large cut. Both standard-gage and narrow-gage equipment served the steam shovels in cuts and in borrow pit excavation. Standard-gage side-dump cars of 12 cu.yd. capacity were used, while the 3-ft. gage equipment comprised 12-ton locomotives handling trains of ten 3- and 4-yd. dump cars. The haul was from 1,000 ft. to 18,000 ft. but on account of the heavy traffic on the existing single-track main line it was necessary to handle practically all construction operations without use of the main track. Fills were made by dumping from framed trestles having a maximum length of ½ mile and a maximum height of 50 ft.

On the four-mile diversion west of Hammett (see Fig. 3), the total yardage will be about 1,204,000 cu.yd., averaging 300,000 cu.yd. per mile in embankment. All of this material will be hauled from cuts, with the exception of about 300,000 cu.yd. from borrow pits. In the first mile west of Hammett a heavy fill of 848,700 cu.yd. will be built with material from cuts, a large part of this coming from one cut 3½ miles distant. The embankment will be about 3,500 ft. long with a maximum height of 75 ft.

For handling packed sand in horizontal strata, which is the material encountered between Hammett and Chalk Siding, the contractor's price for excavation covers all grading and placing without classification or allowance for haul. Other grading between Chalk Siding and Reverse will be done under the Oregon Short Line R.R. specifications, which provide classification for earth, loose rock, solid rock and lava rock, with 400 ft. free haul. Fills are required to be made with 10 per cent of the cross-section added for shrinkage.

Grading is being done by the Utah Construction Co., Ogden, Utah, and the new buildings for the engine terminal are being built by C. I. Anderson, Salt Lake City. The moving of stations and other small buildings at King Hill and Glenns Ferry was done by A. D. Moodie, Portland, Ore. All track and bridge work is being done by railway forces. A labor shortage from July 1 to Nov. 1 slowed up progress.

This improvement work is being carried out under the direction of R. L. Huntley, chief engineer of the Union Pacific System, and W. R. Armstrong, assistant chief engineer in charge of the Oregon Short Line R.R., with J. P. Elliott as assistant engineer in resident charge of the work.

An Interview

With HENRY H. WILSON
Managing Partner, Winston & Co., Muncy, Pa.

Overlooked Items in Estimating Road Work

By C. S. HILL
Associate Editor Engineering News-Record

Factors Affecting Costs Whose Neglect or Improper Evaluation in Estimating Turn Theoretical Profits Into Practical Losses

WHEN ESTIMATES are too low it is usually because either (1) all the items of cost are not considered or (2) some or all of the costs are not correctly evaluated or because both errors are committed. There probably never will be found a way of determining beforehand all the contingencies that affect cost, and there is even less chance of making a uniform and always correct appraisal of the sum that every contingency adds to cost. There must be always some guessing in setting prices for construction but that does not warrant wild and free speculation.

Qualifications for making correct estimates cannot be transmitted by gift. Neither is it possible to reduce estimating practice to a code. Judgment is a leading qualification which cannot be passed on by word, and conditions vary too much to be capable of expression in standard forms. Without, them, presuming to present a complete method of estimating—there being no such thing—it is possible to name some, perhaps a majority, of the factors influencing costs which are frequently overlooked in making estimates.

If a contractor would avoid overlooking important items entering into a bid, he must exercise, in its preparation, the same degree of industry and intelligence that he is willing and expects to exercise after the contract is awarded him. He should not overlook the fact that in estimating, "A little learning is a dangerous thing." It is unwise to accept the judgment of scantily experienced people on matters of vital concern in connection with his estimate. Also it is unwise to place too much reliance on the infallibility of the estimate made by the engineer in charge of the work, or, perhaps, any reliance at all on the estimates sometimes tendered by interested vendors. It is also well to avoid being influenced by figures which may have been submitted by other bidders on similar work at previous lettings. Costs of other contractors may be determined by factors one is incapable of measuring, with the information at his disposal; or possibly incapable of duplicating even under similar conditions, with his organization. A conservative policy to follow in estimating is to be unmindful of others who may be bidding and thereby avoid any possibility of allowing oneself to be influenced by what another may bid.

General Factors—An important consideration frequently overlooked by bidders is the adding of a percentage to their bids to cover the probability of having to assume many elements of risk and uncertainty, such as Acts of God, delays and suspensions of work by owners, unusual increase or decrease in contract quantities, absence of means for legal redress for inequities or arbitrary decisions. By the unilateral form of contract under which one is generally compelled to bid, the contractor may be penalized for one or all of the above contingencies. So long as this form of contract persists, it is imperative that bidders should protect themselves by adding to their estimated costs a proper percentage to cover probable occurrence of the above factors. No conservative business concern should assume risks without underwriting them. In one state, it was estimated in recent years, by a committee of representative contractors and engineers, that at least 15 per cent should be added to estimated costs to cover risks embraced in the form of contract in use.

Another general factor which should not be overlooked is, a decision in advance of bidding as to proper sequence of operations and the most satisfactory and economical equipment for performing them. Such a study may have great influence in reducing the volume of labor required or in increasing the amount of machinery.

With the heavy advances in freight rates, in recent years, and the constantly increasing tendency to substitute machinery for labor in road building, freight on plant has become a formidable item of expense on almost every road contract. With a scarcity of labor and the resulting unrest in its ranks, losses due to transportation advanced often assume serious proportions and should be carefully approximated. The total cost of such items as leases, rentals, camps, warehouses, traveling expenses, legal expenses, demurrage charges, telephone and telegraph bills, compensation, fire and public liability insurance and interest charges, is impressive and none of these items should be overlooked. In estimating interest charges, thought should be given to probability of delay in payment either on monthly or final estimates and also to whether or not allowances will be made for materials stocked on the work.

With the increasing size of road contracts and the growing practice of letting contracts throughout the year, increasing volumes of work have to be carried over the winter into a second season. The additional cost is an important estimate item. Again, in using previous costs, consideration must be given to whether these costs were achieved under the direction of a more competent superintendent and a more efficient organization than is likely to be available for the work in hand. Other items which have to be considered are soil and topography, right-of-way, and structural obstacles in their relation to wet weather, transportation and the probable duration of the working season for the locality.

The probable character and ability of engineers and inspectors should not be overlooked. In a particular state highway department, one will often find considerable variation in this matter and a consequent reaction on costs. If there are many engineering complications on a contract, one may encounter considerable delay and expense if the engineer is inexperienced, procrastinating or too busily engaged with other contracts to give one's problems prompt and conclusive attention.

It is well, first, last and always, to remember that there is as much in conditions as there is in prices. Successful estimating is as often the result of one's skill as a phophet as it is a matter of his industry.

Labor—A common oversight in estimating is the careful appraisal *for the period of operation* of the supply of labor and, as determined by this supply, the trend of wages. Last year road contractors who put in early-season bids, underestimated the season's average rate of wages. One wonders if they have not done so again this year. It is true indeed that wages and labor supply are hard to foretell, but the wise bidder will make some attempt at a valuation of both.

Some of the questions to which answers need to be secured are: Is there a local supply of labor? Is this supply normally consumed later in the season? Will there be other local construction operations to compete? Is the labor resident or transient? Are there nearby large cities to draft labor, to reflect quickly wage changes, to magnify union influences and to encourage unsteadiness and turnover? Are there living accommodations for imported labor? Finally the general market for construction labor has to be taken into account. It is to be noted again that it is the *average* wage rate for the period of the operation that the estimator needs to know.

Experience and training are other factors in the labor problem by which costs are affected and, therefore, prices must be determined. Is the work to be done with an old experienced organization, or by a new organization created for the operation? The latter circumstance will increase the labor cost by a material percentage, particularly in the early stages of the work, (1) because the untrained crew will be longer in getting the outfit ready and squared to estimate-earning work and (2) because it will turn out smaller volumes until it becomes trained.

It should be borne in mind that, in a rising labor market, labor costs always increase in greater proportion than do wages, due to decreased efficiency of production. Tables kept by one contractor last year showed that, for every 10 per cent increase in wages, there was an increase of 16 per cent in the labor cost of production. It will be immediately apparent that this is a factor of vital significance to estimators and failure properly to evaluate it has made unprofitable many contracts taken on an apparently profitable basis. An additional factor, difficult of even approximation and, oftentimes, entirely overlooked, is the expense resulting from labor turnover in those years when there is a scarcity of labor and an almost constant necessity of breaking in "green" men in place of experienced ones. While hard to estimate, this may be a prolific source of expense. On one road contract last year, where the average working force was less than 100 men, more than 800 men were actually employed during the working season. Indirect or overhead labor, such as superintendence, office force, unloading, repairing, setting up, moving and removing equipment, is an item of expense easily underestimated, particularly where there is any possibility of failure to complete work withing the time estimated.

Transportation—The old habit of expecting railway transportation to be adquate has, in the last few years, been pretty well beaten out of contractors. Embargoes, car shortages, strikes and other influences of general operation curtailing railway service are being discounted. Local drawbacks are more commonly overlooked. This is unfortunate because these are the ones which it is most within the power of the contractor to appraise and overcome.

Some of the contingencies in transportation to be regarded are whether service is by a main or secondary or branch line; what the frequency and time of train movements are; whether the direction of light train movements is that in which job shipments will come; whether the local car and general freight-handling facilities are good; what additional sidings, unloading spaces and car moving equipment will be required; what the road conditions are to and from unloading points and railway distances to supply points.

Train movements are of vital concern. Carload shipments must be by regular trains and the frequency of these and when they come in determine arrangements which have to be made for receiving shipments. Generally secondary line service is best if the freight originates on the line; main lines are more apt to be crowded with higher classification freight which will receive preference, and branch lines have fewer available trains. Also generally better service is had if the shipments are in the same direction as light freight movement. The local carload freight handling facilities determine what the contractor will have to provide in the way of sidings and how much shunting and shifting he will have to do. Generally lack of means of handling shipments increases both the cost of receiving service and the inevitable demurrage charges.

Roads are another factor in transportation costs that frequently are overlooked with disastrous consequences. Not only the roads for getting materials to the operations of construction but roads to and about the unloading yards and even to the town and railway station where supplies are got and small shipments arrive have to be considered for all conditions of weather and with the loads to be hauled in mind. Underestimated costs properly to maintain roads serving the job have cut the paper profits of many a highway contract.

Materials—Taking the lowest bid for materials as a basis for estimating without knowing whether the dealer or producer can deliver as fast in the amounts wanted as is required and whether the material is of a quality that will be accepted by the inspector is a common error. Quality and regular delivery are the paramount considerations and the price should be fixed on this basis. On materials not bought on contract, a price has to be estimated with due regard for the probable trend of the market. Other items are the cost of storing, shifting and rehandling materials, and waste incident to these operations as well as to damage and accidental loss which cannot be avoided. Failure to provide waste insurance in the estimated prices of materials cuts into profits. It is pertinent to note here that adverse railroad conditions in recent years have strikingly demonstrated that stocking and rehandling large quantities of materials is less expensive than delays often resulting from lack of materials. Liberal allowance should always be made for stockpiling and rehandling expense which average experience indicates to be necessary for an uninterrupted flow of paving material to the job at all times.

Supplies—Proper consideration is not often given to the cost of supplies. Individually the items may be insignificant but the total always runs into a considerable sum. An item easily overlooked here is the cost of repair parts and shop work for machinery, which will vary greatly according to age and condition of equipment. Besides the actual prices paid and the amounts

required, there are freight and express charges and delivery expense for all supplies. The cost of handling numerous small quantities and articles is a larger amount than one imagines until the figures are totalled. Any contractor will do well to prepare lists of supplies, for particuar types of roads, using previous job records, and work out approximate figures for shipping and handling costs. Going over such details and figures, when an estimate is being made up, will often save an under-allowance for supplies.

Plant and Tools—It appears to be a natural habit to underestimate these items of expense. Extra gangs, changes in plans and misjudgment in co-ordinating operations are contingencies that must be anticipated and all of which add to the stock of equipment and tools required. As an example, the failure of a planned water supply may require additional development, pumping outfit and pipe line. Plant depreciation is one of the most troublesome items for the estimator and one on which there is room for considerable divergency of view. Where a contractor has been forced to make large purchases and immediately encounters a falling market, it accumulates added significance. Under these conditions, the first cost of a heavy plant investment might drop 33⅓ per cent during one season's operations. Assuming such a condition, the owner would be faced with a loss of one-third the value of his equipment, plus the depreciation upon the remaining two-thirds. Under these conditions, and under the small margin of profit on which highway work is bid, an otherwise profitable commitment might be thus turned into an unprofitable one.

Excavation Costs—Failure to study all excavation involved, in the field, and work out in advance of bidding an approximate classification of materials to be handled in grading foundations, ditches, borrow pits, shoulders, dressing slopes, refilling rock-breakage in cuts, etc., as well as the relative cost of each type of work is common. Because of the difficulty and expense necessary properly to keep such costs, we find not only contractors' records, but the actual technical literature in existence on this particular subject, very barren. After all care and skill have been exhausted, however, we are still forced to admit that any estimate upon road excavation will, doubtless, vary more widely proportionately from the actual costs experienced than the estimate upon any other item in a highway contract. Under these conditions, one might think that contractors would proceed with more caution and be less inclined to flirt with the danger line, in bidding on this item, than on any other item of a contract, but no such impression can be justified by the history of costs in recent years.

It is quite common not to estimate even approximately on the amount of fence moving, sod clearing, scarifying and other items which may be included in the excavation price, not to approximate average length of haul or overhaul on excavation and borrow, not to recognize that, on most road construction in cuts, it is impracticable not to excavate the shoulders of the road and then replace them without payment for either operation.

Other Contract Item Costs—In the same category with these oversights in estimating excavation is the common failure, in bidding on masonry work, to recognize the great variation in the unit costs of labor and other expenses, as between bridges, walls and other heavy masonry and pipe head walls, curbing, gutters, etc. Such items as head walls, bridge parapets, curbing and gutters will be comparatively much more expensive than other heavier types of masonry, not only in labor but also in waste of material. As an instance of this, on a road built in 1920, the cost of rubbing down head walls, with labor at $4.50 per day, was found to be 30c. per cubic yard of concrete.

In fixing prices on varying sizes of curbing, gutters, etc., many bidders apparently fail to recognize the basic fact that the smaller the volume of concrete, or other material, per linear foot, the greater will be the unit cost of handling and placing a cubic yard; of handling forms, finishing, protecting, moving equipment; of ratio of material waste. The same is true of excavation prices in that they sometimes appear to indicate a premise that excavation for tile drain, curbing and other small items can be done as cheaply as grading where quantities are large.

The cost of materials for pavements is usually a large part of the cost of a modern highway, hence the importance of adding to one's bid an ample percentage to cover waste and the labor expense in handling that waste. In some instances, highway departments and inspectors still insist upon the right to reject materials after unloading from railroad cars, without compensation to the contractor even though the burden may properly rest upon the material producer. As producers almost invariably refuse to accept responsibility for paving material condemned after unloading, it is proper to add a percentage for protection against this contingency where it is likely to be encountered. In some localities, it is essential for a bidder to protect himself against arbitrary decisions as to proportions of paving and other materials. In one state, in recent years, it was estimated that an arbitrary decision requiring contractors to give compacted measure on cement and accept loose, unshaken measure on aggregates, cost the contractors over $100,000 in a single working season. Recognition of this hardship was refused and no legal means of redress was possible under the form of contract in vogue.

Care should be exercised not to overlook figuring shrinkage as between loose measure and solid measure in the construction of sub-base, broken stone base and other foundation courses.

Conclusion—In conclusion, it may be said that there is no "royal road" either to the best estimating or to preventing the disappearance of paper profits. To the close student of the subject, however, this fundamental thought should always suggest itself: *No matter how many uncertainties may enter into the preparation of an estimate, the moment you eliminate or neutralize one of these uncertainties by careful analysis and study, you are correspondingly closer to the actual result than if you guessed at them all.* As has been said before, no scheme will ever be devised or charts drawn so that a novice can make highway estimates. By the same token, nothing will ever be promulgated or known which will entirely eliminate the disappearance of paper profits. However, through use of brains, intelligent interpretation and application of previous costs, as well as a study and knowledge of conditions influencing costs, risks can be greatly minimized and a much more accurate and conservative result obtained than is possible by any other human method. Aptitude in estimating for all items of expense concerned in a job, will have to be built on experience and study in the actual conduct of construction.

Building Construction Courses in Engineering Schools

Details of the Thompson-Starrett Foundation at Yale and Union and of Proposed Similar Courses in England

SOME WEEKS ago it was announced that there were to be established at Yale University and Union College courses in building construction financed partly by a benefaction to be known as the Thompson-Starrett Foundation. The full details of these courses have not been worked out but there is given below a preliminary statement regarding each. The information about Yale is from Dean C. H. Warren, of the Sheffield Scientific School, and that about Union from Prof. F. P. McKibben. As a matter of collateral interest there is also presented an extract from a recent "London Letter" in the *Journal* of the American Institute of Architects, which notes the formation of somewhat similar courses in England.

Yale University Course—Through the generosity of Louis J. and Mary E. Horowitz, a very substantial sum of money has been placed at the disposal of the university to be used for defraying the expense connected with the establishment of a course which may serve to prepare young men for entering on a professional career in the field of building construction. To accompany his gift for the establishment of the course, Mr. Horowitz offers two very substantial prizes to assist worthy and capable young men in securing practical experience for a period of two years after graduation.

The receipt of this gift is of such recent date that the university authorities have not as yet had an opportunity to work out fully the details of the course. As outlined in a preliminary way, it is proposed, in accordance with Mr. Horowitz's wishes, to make the course in every way equivalent to the other engineering courses, with the expectation that graduates of the course will be prepared to enter upon work in the construction of modern buildings from a thoroughly scientific and engineering standpoint.

The course will be given under the auspices of the Sheffield Scientific School and will be associated with the Department of Civil Engineering. The study of architectural design will be in the hands of the Department of Architecture in the School of Fine Arts, and it is expected that students in architecture will be given the opportunity of electing special subjects in the course in building construction.

The work of the first two years will be substantially that of the other engineering courses. Students will enter the course from the freshman year and will in the sophomore year pursue the same fundamental subjects, such as mathematics, physics, and drawing, as do the other engineering students. In their junior year they will pursue courses in building design, stresses, structures, materials, economics, and accounting. This will be followed in the senior year by more advanced work in design and by such subjects as mechanical equipment of buildings, specifications and contracts, estimates, business law, and insurance. In this year they will also devote a substantial amount of time to a full year course in building construction in which they will be instructed in the application of the knowledge and principles which they have learned during the earlier years of the course. During the vacations between undergraduate years practical work under supervision will be recommended or required.

The university is prepared to admit students to the first three years of the course. As it will be necessary to secure some men with a wide experience in actual building construction and otherwise competent to give the more specialized work of the senior year, it will probably not be possible to admit students to the senior year at the opening of the university in the fall.

It is the belief of the faculty at Yale that work in building construction will add a very important field to the university's educational program, and they are confident that it will develop into one of their strongest and most useful engineering courses. They also believe that the location of a course of this character in an engineering school closely affiliated with a strong architectural department argues well for the successful development of the course.

Union College Course—The president of the Thompson-Starrett Co., L. J. Horowitz, of New York, has also established a trust fund the income from which is to be used in part to provide training in building construction at Union College. A new four years' course or option in civil engineering has been authorized at Union with a view of affording as broad training in general engineering as possible in four years and at the same time offering therewith specialized work in the design, construction and estimating of buildings. A new professor will be appointed to teach the work in building construction and estimating.

From the graduating class two students are to be chosen each year to enter the Thompson-Starrett organization under the Foundation and remain two years, after which time they become a part of the company's regular force.

At Union the freshman and sophomore years will be exactly the same as now given to civil and electrical engineers—these two courses being identical for the first two years. The junior year will be similar to the regular course in civil engineering except that it will include work in building construction.

The work of the senior year will be as follows:

First Term		*Second Term*	
Mechanical Equipment of Buildings	2	Reinforced Concrete	4
Structural Engineering and Design	6	Structures and Design	4
Business Law	3	Contracts and Specifications	3
Building Construction	3	Building Construction	3
Heat Engineering	3	Heat Engineering	3
Finance and Banking	3	Business Administration	3

The figures in the above table represent the number of exercises per week. Students who satisfactorily complete this course will receive the degree of B.S. in civil engineering.

Proposals in England—"Definite proposals appear to be on the tapis for the foundation in England of a School for Builders to provide for future builders, equal facilities to those enjoyed by intending architects.

"The school would be financed by the Federation of Builders, and would provide the equivalent of a university education with a sort of Master Builder's degree instead of the usual pass or honors degree in law, history, etc.

"The advantages of such a scheme are patent. The organization of a contractor's business is a very com-

plex one and there is no reason why the sons of master builders should not receive a full scientific school training both in theory and the elements of practice. This training would be completed by fuller practical work.

"From the architect's point of view the scheme offers the promise of a better standard of education in the building trade and consequently enhanced understanding between the trade and the profession. Limited collaboration with the big architectural schools would increase the advantages of education on both sides, and would incidentally make possible the conservation of many of the finer traditions of building which are being gradually lost with the spread of commercial building. A revival of the spirit of the craftsman in the operative would not be beyond the range of possibilities, and might counteract the tendency toward mechanical repetition in design. The site for the proposed school is still undetermined, but it is to be hoped that it will not be too far removed from the large architectural schools of the metropolis."

Hydro-Electric Plant with Head of Over One Mile

High-Head, Low-Flow Swiss Plant—Special Steel Penstock 15,200 Ft. Long—Unusual Design of Pelton Wheels

By Fred A. Noetzli
Chief Engineer, Bissell & Sinnicks, San Francisco, Calif.

A HYDRO-ELECTRIC power plant of 12,000 hp., operating under a head of practically one mile (1,650 meters), and having a single penstock of less than 2 ft. diameter, was recently constructed and successfully put in operation in Switzerland. The water utilized in this development is drawn from the little lake of Fully which is located in the westerly part of the Swiss Alps at an altitude of about 7,000 ft. above sea level.

FIG. 2—METHOD OF MOUNTING RUNNER BUCKETS
One bucket is placed on top of the runner to show its construction.

The lake is tapped by a tunnel and pipe line about 100 ft. below normal water level. The penstock extends from the intake at the lake bottom for a distance of approximately three miles down to the valley of the Rhone River. Fig. 1 shows the power house and the penstock location. Lake Fully is located behind the far mountain range through which the penstock pipe is carried in a tunnel.

Storage Increased by Pumping—The natural storage capacity of the lake, which is very small, was increased by the construction of an arched masonry dam 40 ft. high. The useful storage above the intake tunnel is 2,600 acre-ft. Due to the high head this represents a stored energy of 10,000,000 kw.-hr. The power plant is used as a reserve for a low-head plant and is operated intermittently. This makes it possible to increase the quantity of water available from Lake Fully, which has a very small drainage area, by the addition of water pumped from a little lake located 450 ft. below Lake Fully. The penstock passes very near this lower lake, and a centrifugal pump, operated by a 640-hp. electrical motor and discharging directly into the penstock, pumps water from the lower lake through the penstock into the upper lake. The difference in elevation between the two lakes is approximately $\frac{1}{12}$ of the total head of the power plant. Inasmuch as the pumping efficiency averages about 50 per cent, the pumped water produces in the high-head plant six times the energy which is required to pump it to the upper lake.

FIG. 1—GENERAL VIEW OF THE POWER HOUSE AND PENSTOCK

The Penstock—The penstock has a total length of about 15,200 ft. and it is made up of a series of steel pipes of different diameters and thicknesses according to the head of water. The inside diameter of the upper 7,500 ft. is 24 in. (60 cm.) and of the lower 7,700 ft. is 20 in. (50 cm.). The thickness of the pipe is approximately $\frac{1}{4}$ in. at the intake, and increases in steps in proportion to the pressure, to $1\frac{5}{8}$ in. at the lowest point where the static head is 5,400 ft.

The pipes sustaining the greatest head were manufactured by a special process, and all pipes were tested

in the shop for 50 per cent over the given pressure. The whole penstock was put about four feet underground, and no expansion joints were provided. Fig. 3 shows a profile of the penstock location. With the exception of three short tunnels, the trench follows closely the topography of the ground.

The whole penstock is built up of straight pipes 20 ft to 40 ft. in length, according to the permissible weight of each section as limited by the transportation facilities. A special type of joint was used which permitted the making of small angles in the pipe line. Two wedge-shaped rings are inserted between the pipe ends, as illustrated in Fig. 4. By rotating these rings in a suitable manner relatively to each other and to the pipe-ends, any angle up to 10 deg. was obtained, either in a horizontal, vertical or inclined direction. This greatly facilitated the laying of the pipe. The pipes were fastened together by means of special flange rings and bolts, which for the lower portions of the penstock were made of nickel steel.

All joints were tested in the field for 25 per cent over-pressure. The excellence of the workmanship is well illustrated by the fact that the penstock has been in successful operation for several years although, in addition to the waterwheels, a battery of twelve hydraulic presses which cause considerable fluctuation of the pressure in the penstock, is directly connected to the pipe line.

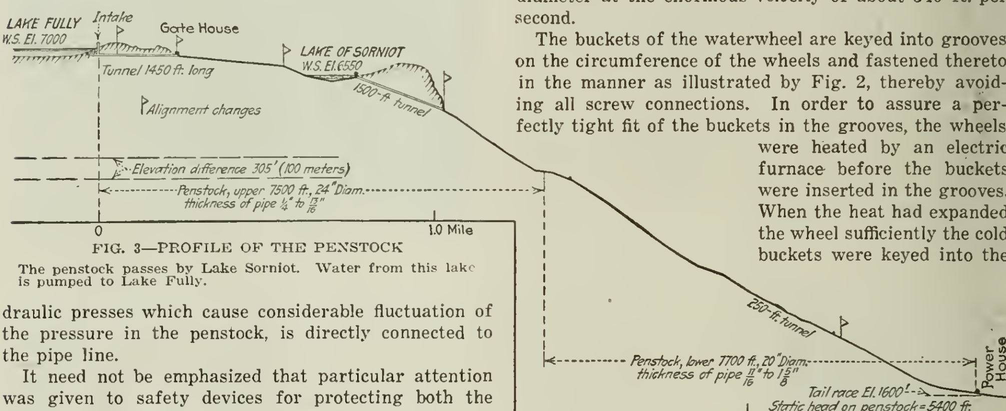


FIG. 3—PROFILE OF THE PENSTOCK

The penstock passes by Lake Sorniot. Water from this lake is pumped to Lake Fully.

It need not be emphasized that particular attention was given to safety devices for protecting both the penstock and power house in case of breaks in the pipe line or a runaway condition of a waterwheel. As a matter of some interest in this connection may be mentioned novel automatic high-pressure needle valves which close at a pre-determined variable speed as soon as a serious disturbance of the water pressure in the penstock occurs. The time required for closing varies from 30 to 60 sec., so that no dangerous water-hammer can occur. When the power plant is operating at full load, the penstock delivers 28 sec.-ft. for the total 12,000 hp., and the velocity of the water in the penstock is about 13 ft. per sec. The loss of head for these conditions was calculated at 530 ft. or practically 10 per cent of the static head. Inasmuch as the power plant is a reserve installation, and will work at full capacity only during short periods of time, a 10 per cent loss of head was deemed permissible.

The Power Plant—The power plant is equipped with four units of 3,000 hp. each, arranged lengthwise with ample clearance to provide a maximum degree of safety in case that, for instance, a bucket should fly off. The waterwheels are of the Pelton type, and their construction and the design of nozzles and valves was unusually difficult owing to the large head under which they operate. Each 3,000-hp. unit is driven by a stream of water of 7 sec.-ft. issuing from a nozzle of 1⅞ in. in diameter at the enormous velocity of about 540 ft. per second.

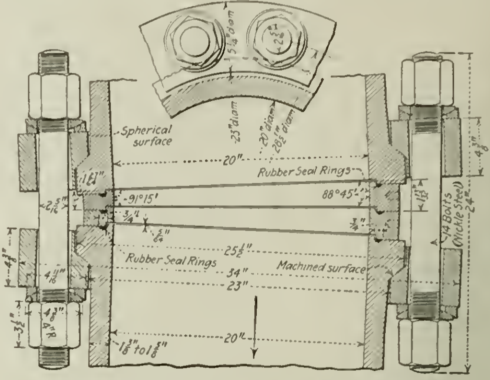


FIG. 4—SPECIAL JOINTS IN THE PENSTOCK

The joints are provided with wedge-shape rings to allow for minor changes in alignment.

The buckets of the waterwheel are keyed into grooves on the circumference of the wheels and fastened thereto in the manner as illustrated by Fig. 2, thereby avoiding all screw connections. In order to assure a perfectly tight fit of the buckets in the grooves, the wheels were heated by an electric furnace before the buckets were inserted in the grooves. When the heat had expanded the wheel sufficiently the cold buckets were keyed into the grooves. The contraction of the cooling steel of the wheel produced the desired result.

The speed of the waterwheels is held within close limits to avoid undesirable effects upon both the penstock and the machinery. If the load of a unit is thrown off instantaneously, the nozzle is deflected within 2 seconds, and the movement of the needle is timed so as gradually to close the nozzle in 40 seconds.

No unusual features are involved in the design of the generators. Each of the four units has a capacity of 2,800 kva. and generates three-phase current at 10,000 volts, and the power is transmitted at this voltage.

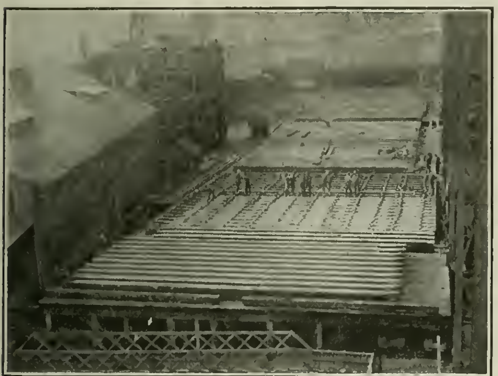
This project was designed and constructed under the direction of A. Boucher, hydraulic engineer, of Lausanne. All machinery was furnished by Swiss manufacturers. The power is used for electro-chemical purposes by the Société d'Electro-Chimie de Martigny, Switzerland. A detailed description of this development, which is the highest-head hydro-electric power plant that was ever built, is given in *Schweizerische Bauzeitung*, Nov. 25 to Dec. 30, 1922.

Quay Wall Reconstruction at Mare Island Navy Yard

Old Wall Embodied in New Structure Which Includes Concrete-Protected Ties Extending Inland 200 Ft.

By A. W. Earl
Supervising Engineer, Public Works Department, Mare Island Navy Yard

Early in 1920 a serious outward movement began on about two-thirds of the entire length of a 3,600-ft. quay wall at the Mare Island Navy Yard in California. During the year this movement amounted to over 3 in. and culminated in the total failure of one stretch 120 ft. long. The wall was being subjected to pressure greatly in excess of that for which it was designated, and it was apparent that immediate steps toward reconstruction were necessary to prevent its complete collapse. An effective means of anchoring the reconstructed wall was worked out, using a system of long ties extending from a reinforced-concrete beam along the seawall to deadmen inshore.

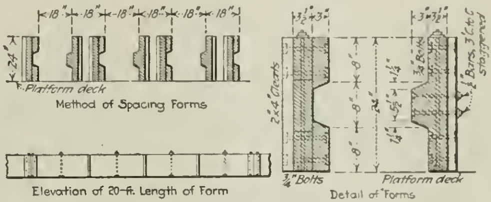


PILE CASTING YARD AND MIXING PLANT
Cantilever traveling crane supports at right. Finished piles in foreground spaced ready for next pour. Concrete mixing plant in left background.

The old wall was built in a number of short sections between 1898 and 1904. The type of construction varied somewhat but in general consisted of a concrete or ashlar faced rubble seawall supported on wooden piles. The walls were of the platform type with a timber sheet pile bulkhead in front of the rubble, masonry or concrete face wall. At the time the original wall was built naval vessels were much smaller than those of today and consequently a lesser depth was required alongside the wall than at present. As repeated increases in the draft of ships necessitated deeper dredging the wall was required to withstand a continually increasing pressure which finally resulted in partial failure. However, while the outward movement of the wall was the immediate reason for reconstruction, the work must have been undertaken in any event on account of the very serious damage caused by the teredo.

Previous to the year 1917 the waters of Mare Island Strait had been free from teredo and consequently all waterfront structures were constructed on timber foundations. Beginning in 1917 the teredo made their presence known and during the succeeding years caused extensive damage in Mare Island and Carquinez Straits. Fortunately, with one short exception, quay walls at Mare Island were constructed with a timber bulkhead at the front of the wall which protected the wooden pile supports of the relieving platform. This made it possible to incorporate the old wall in a concrete structure of design suited to present needs. It also facilitated the new construction and made the removal of the old wall unnecessary.

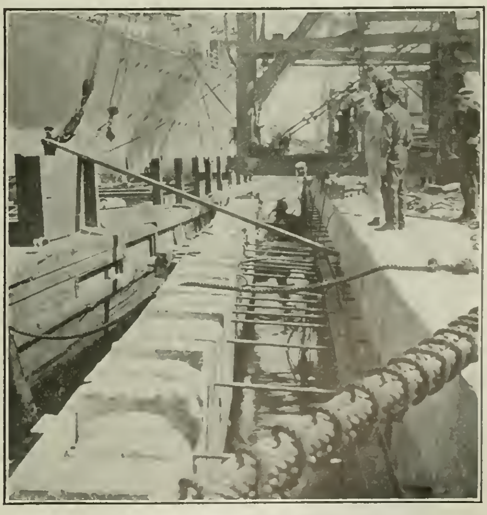
The wall as reconstructed consists of a row of



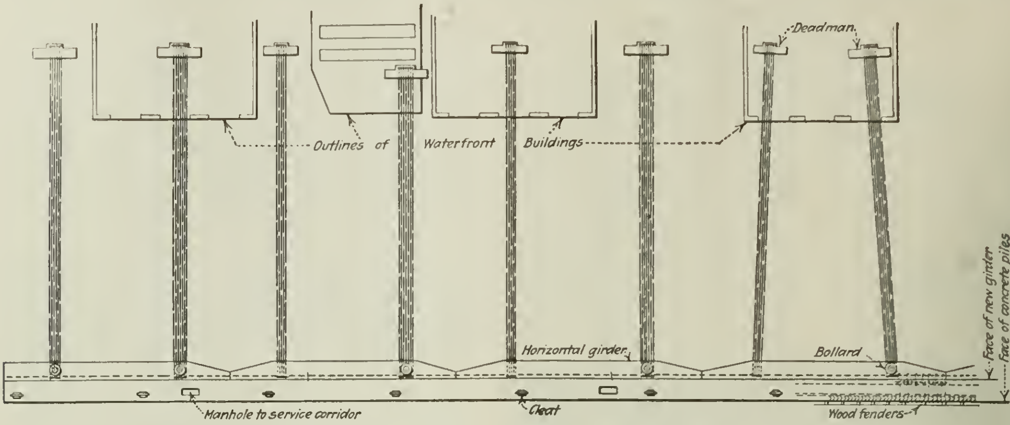
DETAILS AND SPACING OF FORMS IN PILE CASTING YARD

18x24-in. reinforced-concrete sheet piles driven with the inner faces about 6 ft. 6 in. outboard of the face of the old wall. These piles are driven until their tops are 1 ft. below the top of the wall and are tied back by steel rods to a horizontal reinforced-concrete girder which replaces the top portion of the old masonry face wall. This horizontal girder in turn is tied back at intervals varying from 30 to 60 ft. to concrete deadmen which are buried at distances varying from about 100 to 200 ft. back from the wall. The deadmen are buried with their tops 5 ft. below the surface and are 12 to 19 ft. long and 8 ft. deep.

The space between the back of the new concrete sheet piling and timber bulkhead under the old wall is filled with rock up to about 2 ft. above mean low water. The



PILEDRIVER AND PARTIALLY COMPLETED WALL
Note waling strip tied by rods into beam made of two channels which in turn is anchored in large concrete beam. Space between wall and sheet piling is concreted up to form service duct.



PLAN OF TYPICAL PORTION OF NEW CONCRETE SEAWALL

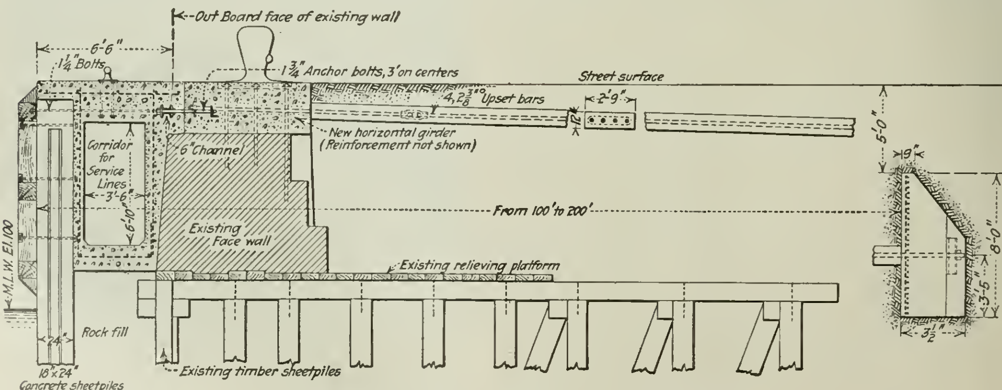
space between the concrete piling and the old face wall is utilized to form a corridor for the accommodation of service lines which, through outlets in the face of the wall, will supply ships berthed alongside with air, steam, electricity, fresh and salt water, and telephone service.

In addition to the 2,300 ft. of quay wall reconstructed on this plan, there remains about 1,300 ft. of wall to which, on account of different construction of the original wall and different conditions at the site, the design described will not apply without modification. Final designs for this remaining portion of the wall have not yet been developed.

Because of the urgent necessity of stopping further outward movement, the reconstruction of the old wall was started in November, 1920, with the limited funds available at that time. When the first 200-ft. section was completed it became necessary to stop work until Congress made a special appropriation for continuing it. This was done July 1, 1922. By July 1, 1923, about 900 ft. of wall had been finished and concrete piles had been cast for about 500 ft. more. The estimated cost for the 3,600 ft. of wall is $1,260,000, or an average of $350 per foot. The portion now under construction runs about $325 per foot.

The work in its entirety will require approximately 2,400 reinforced-concrete sheet piles varying in length from 50 to 60 ft. and consequently it was of the utmost importance to have an adequate casting plant. Fortunately, there was available a small ship-building slip, used during the war for the construction of destroyers, which is served by a traveling, ship-building-type cantilever crane of 15 tons capacity. This slip was adapted to service as a pile casting yard by flooring it with 2-in. plank to make a level platform 65 ft. wide by 400 ft. long. This area is sufficient for laying down 200 piles at one time. About midway of one side of this platform a concrete mixing plant was constructed, with the usual storage and bunker equipment. The bunkers are served by means of a locomotive crane and grab bucket operating on a track. The cantilever crane completely covers the whole area of the platform, and is used in placing forms and reinforcing frames, in transporting concrete from the mixing plant to the forms, and in transporting the finished piles to the barge which berths at the outboard end of the platform.

The forms used, shown in the accompanying illustration, have proved very satisfactory, being durable and easily placed. When first set up they are so spaced that the spacing of piles cast in the first pour is just right to permit the pouring of alternate piles between those already cast, thus conserving space and forms. The platform is constructed with two slots or openings

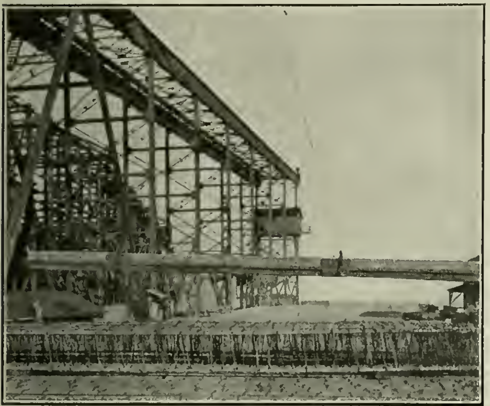


TYPICAL SECTION THROUGH WALL, TIE AND DEADMAN

about 6 in. wide running its full length transverse to the piles and at about the third point. Before the concrete is poured these slots are filled in with short pieces of 1-in. boards, which can later be removed from beneath to allow the use of jacks in separating the piles and to afford a convenient means of passing slings around the piles for lifting them.

It should be stated that the construction of the casting platform could have been improved by laying the plank flooring at right angles to the piles instead of parallel thereto. The unevenness between adjacent planks caused trouble in separating the piles, whereas if the planks had been laid the other way, in separating the piles, the movement would have been lengthwise of the planks instead of across them.

Considerable experimenting was done before a satisfactory coating was found to put on the sides of the concrete piles when casting the alternate piles between



FINISHED PILE BEING MOVED DOWN THE CASTING YARD

Finished piles are delivered direct to barge moored at end of yard or stored in piles near that point awaiting transfer to the barge.

those from which the forms had been removed. It was finally determined that a mixture composed of two parts of axle grease and one part of rosin, melted together and applied hot, gave the most satisfactory results at the least cost.

In general the plant has been very satisfactory. When casting is proceeding opposite the mixing plant the rate of output is 20 piles in 8 hours. At the ends of the platform, because of the longer haul, this rate is decreased to 12 piles per day. The mixing plant has also proved very useful as a central plant from which to transport in trucks concrete for the horizontal girders, deadmen and other parts of the new wall, which are poured in place. The capacity of the plant for this work is somewhat over 200 cu.yd. a day. Exclusive of the fabrication of reinforcement the plant operates with a force of about 12 men.

When sufficiently cured the piles are transported on a barge from the outboard end of the casting platform to the site of the work. They are driven by means of a skid driver, fitted with a No. "0" Vulcan Steam hammer, operating on the face of the old wall. In general the driving has been very hard but little difficulty has been encountered due to breakage.

This work is under the cognizance of the Bureau of Yards and Docks, Rear Admiral L. E. Gregory, C. E. C., U. S. Navy, chief of the bureau. It is being done by yard labor under the immediate supervision of Captain L. M. Cox, the senior officer of the Corps of Civil Engineers of the Navy attached to the station at Mare Island.

Bates Road Tests Do Not Apply to City Streets

By Ivan E. Houk
City Engineer, Dayton, Ohio

While the various articles describing the Bates road experiments have set forth the general conclusions which may be drawn from them, they have not made clear the fact that these conclusions are not necessarily 100 per cent applicable to city pavements. Many of the results can doubtless be applied to city streets. The conclusions regarding strength of brick, asphalt and asphaltic concrete surfaces as compared with the strength of the concrete base and those regarding different thicknesses of brick, different proportions of concrete, and so forth, as set forth in *Engineering News-Record* of Jan. 11, 1923, p. 57, probably hold for city streets as well as for country roads. However, it is doubtful if the conclusions regarding the relative thickness of the pavement in the center and at the edges can be applied to city pavements, except in special instances where some unusual circumstance throws the heavy traffic to the sides of the street.

In the first place city streets are wider than country roads. Then again practically all city streets have curbs at the edges of the roadway and sidewalks back of the curbs, built enough higher than the curbs to cause the water to drain into the gutters at the edges of the pavements, whereas, in the case of country road pavements, the sides of the road are generally lower than the edges of the pavement and slope downward toward drainage ditches at the sides. Therefore the conditions at the edges of a city street are much better as regards strength of foundation than are those at the edges of a country road. The straight curb, which is often used in the case of a concrete roadway, goes down into the ground several inches below the bottom of the pavement, extends several inches above the top and has earth back of it. Certainly this condition tends to hold the subgrade in place at the edges. The combined curb and gutter has the same effect, though probably not to so great a degree. Moreover city streets are generally well sewered. Consequently the subgrade at the edges is much less likely to become water-soaked.

On country roads the traffic generally follows the edges of the pavements, even though there are but few vehicles on the road. In the city the opposite situation prevails. There the traffic generally keeps near the center of the roadway, even though there may be nothing to prevent its following the edges. There are several reasons for this: (1) The parking of cars along the curbs requires the traffic to keep away from the edges; (2) Trees just back of the curbs often partially obstruct or cloud the view along the edges; (3) There seems to be an inherent tendency in the most of us to keep away from the gutter on the steeper portion of the crown whether we are driving slow or fast, whether cars are parked at the sides or not.

Improved Location and Equipment of Passing Tracks

Space Sidings by Time Rather than Distance and Operate Switches from Tower to Avoid Train Delays at Small Cost

THE LOCATION of passing sidings and the mechanical operation of their switches to avoid delays to trains are important factors to be considered by the engineer in connection with the effective or economic handling of traffic on busy single-track lines. This subject was included in a copyright paper on methods of increasing the traffic capacity of single-track railroads, read at the annual meeting of the American Association of Railroad Superintendents by Bertram H. Mann, signal engineer of the Missouri Pacific Ry. The purpose of his study was to show that operation of a freight-train district is a mathematical problem and that the proper balance of a budget for physical improvements to the road may have a close relation to this problem. His plan is based on careful analysis of train movements in relation to the positions of telegraph offices and passing sidings. The paper deals largely with operating conditions, but the portions which are of more direct interest to the engineer are summarized below.

In the first place, telegraph offices at sidings should be systematically spaced and these sidings should not be located arbitrarily at stations. Each run between telegraph offices should have at least one intermediate siding to provide for heavy traffic. In the second place, the spacing of sidings must be fairly uniform, with due allowance for grades and other conditions, in order to insure a steady movement of traffic. If the train periods between sidings vary considerably, the stream of traffic will be governed largely by the movements on the longest run. To handle traffic effectively on a single-track line whose business seems to call for double-tracking: (1) Trains must be forwarded from the starting point at such intervals as are determined by experience with average performance, and (2) the predetermined time periods between sidings must be maintained.

On a freight-train district the saving in operating expense which may be made by correct location of sidings and providing them with continuous-service telegraph offices is too great to permit of arranging them arbitrarily to coincide with traffic requirements by enabling the operators to sell tickets or handle freight at stations. On a single-track district of moderate traffic density the accounting item of "cost of freight-train train-miles" may amount to \$50,000 or even \$75,000 per month, divided equally between locomotive repairs, wages and fuel. A freight train run of 145 miles made in an average time of 12 hr. 5 min. costs \$201.19 for these three items, representing 28.7c. per minute or \$17.21 per hour.

In the art of handling a single-track railroad freight subdivision, any consideration of distance in locating the sidings is far from the point. The main question is the time spacing. Profile of grades is one factor in fixing the number of minutes for this time spacing between sidings, and another is the time required for service or work at the station. Traffic movement on single track must be in waves, and the best condition exists when the waves marked by adjacent sidings are equal and the continuity of flow is least broken at the sidings. The waves are made up of three parts: (1) running time between sidings, (2) time required to "head in" and "head out" at the sidings, and (3) time required at the siding. It has been held by many officers that a spacing of four to five miles for lap sidings on single track was sufficient for full capacity owing to the delays involved by heading in and heading out of the siding. But such delays should not govern traffic movements or siding location.

Delays incident to taking sidings may be reduced materially by having the telegraph operators handle the switches mechanically. From the financial viewpoint a railroad can hardly afford the expense resulting from delays on districts operated by heavy engines and long trains, when these trains have to be stopped while their crews operate the switches. With a rule for one-direction traffic and all trains headed in at the lapped end of the sidings, it requires only small expense to install a simple mechanical interlocking plant with levers in the telegraph office. At the farther end of the siding, a remote-control low-voltage installation handled from the telegraph office, or a spring switch with automatic electric signals, will save a stop for the train when heading out to the main track. Such helps are in successful use.

Ordinary freight trains standing on sidetracks for more than 20 per cent of the time of the entire trip are subjects for investigation, but in many cases this period is from 30 to 40 per cent. For an average speed of 12½ m.p.h. from starting point to destination, an average speed of 20 m.p.h. between stops is required, and the aim should be an average speed of 20 m.p.h. between sidings, with idle time on sidings not exceeding 20 per cent of total time of run. The Adamson law has one good feature in that it has shown convincingly the gain of the moving train as opposed to the loss by unproductive time. Punitive pay for overtime of train crews stimulates a search for causes of delay when the desired speed cannot be maintained.

Four factors in the operating output of ton-miles are the ruling grade, the drawbar pull, the weight of train and the train speed. Further, every freight-train district has a characteristic movement or period. For development of traffic capacity this period must be determined, the train movement arranged in consonance with it and the spacing of sidings and telegraph stations made to synchronize with it.

Study of the problem of improving freight-train service develops certain laws of single-track operation and proves the money value of the mathematical operation of trains. Such a study prompts the use of special devices on the locomotive (booster, superheater, feed-water heater, thermic syphon and arch), of signal and interlocking plants, and, last but not least, of a uniform scheme for the operation and arrangement of sidings and siding facilities. The length of subdivision is fixed, so that the only variable factors are tonnage and time. For a meeting on single track under present train rules, the switch at which the inferior train takes siding becomes a "bumping post" or stopping point for the opposing train. With the recommended plan, it is feasible for both trains to drift the entire length of each siding at the meeting point. The next step is the extension of individual sidings as traffic demands, with a view to the ultimate double track.

In considering a budget for improvements there may be seven or eight freight-train districts or subdivisions which are not satisfactory as to performance. It is not unusual to select the worst subdivision and provide large outlays for double-tracking or grade reduction which builds up its capacity beyond its immediate traffic requirements, while nothing is done to the other subdivisions which equally require relief. The plan outlined above contemplates the study of each subdivision, with such rearrangement of siding, spacing and handling as will fairly meet the existing demands. The layout would permit growth as traffic increases until double track is reached eventually. Such a program will supply the needs of several subdivisions at a cost perhaps less than the single comprehensive overhauling of one selected subdivision. Waste of time by idle trains may be overcome in many cases by slight rearrangement of or addition to existing facilities.

Local Laboratory Control of Water Supplies in California

SUCCESSFUL chlorination depends on a certain amount of laboratory control under the immediate direction of the operator or water superintendent. Holding this viewpoint the California State Board of Health has recently undertaken to establish local laboratories wherever chlorination or any other treatment of the water supplies of the state is practiced. Once before the board tried to interest the officials of the various cities in laboratory control but the tests proposed were too elaborate and the work was gradually abandoned. Recently the procedure has been reduced to the simplest terms possible, viz., the bacterial count on agar before and after treatment.

C. G. Gillespie, director of the bureau of sanitary engineering, states that the making of the tests accomplishes three things: (1) It gives the people responsible for the supply a record of results achieved which, in case of litigation and damage suits, is most valuable. (2) It apprises the consumer and officials every day as to just how successfully the supply is being safeguarded. (3) It stimulates the interest of the man in charge more than anything else he can do, because it gives him visible evidence and a yard stick by which to measure the results of his carefulness.

EQUIPMENT FOR BACTERIAL COUNTS

Quantity	Description	Size	Price
1	Incubator, electric	12x12x12 in.	$20.00
1	Oven, drying, electric, three heats, state voltage	18x14x14 in.	42.00
1	Hot plate, circular, 3 heats	6 in. in diam.	9.25
24	Pipettes, graduated without bulb, 1 c.c. capacity for bacterial work	....	3.32
1	Pipette box, copper	10 in. in length	2.00
24	Bottles, water sample, ground stopper	4 oz.	5.70
24	Petri dishes	100x10 m.m.	7.20
1	Beaker, copper, with lip, capacity 500 c.c.	....	1.50
2	Beakers, pyrex, with lip, capacity 250 c.c.	....	0.54
1	Thermometer (ordinary bath thermometer, armored in wood)	....	0.75
1	Reading glass	3½ in. in diam.	2.00
3	Grease pencils, red or black	....	0.45
6	Brushes, test tube	¾ x 9 in.	0.40
12	Counting plates for petri dishes, cardboard	....	1.80
72	Tubes, culture	⅝ x 6 in.	1.38
½ lb.	Dehydrated 1 per cent agar	....	2.00
1	Pressure cooker, with ground cover joint, vent, safety valve and pressure gage, basket and support	12 qt.	30.00
1	Aluminum kettle and spoon, 6 in. in diam.	2 qt.	2 00
1	Set standard measuring spoons	....	0.15
1	Pint measure or standard measuring cup	....	0.25
1 lb.	Absorbent cotton	....	0.60
1 gal.	Distilled water	....	0.25
6	Dish towels	....	0.75

Operators of average intelligence have been taught without difficulty to make the tests and obtain reliable results. Mr. Gillespie states that in his opinion establishment of these local laboratories is one of the longest steps forward in putting chlorination on a more dependable basis.

W. F. Langelier, chemist, and bacteriologist for the board, has tabulated the following list of materials for equipping a "minimum" laboratory and given certain instructions, but he recommends that the operator visit Berkeley, or a laboratory already installed. Simple instructions are given for making media, sterilizing glassware, plating, incubation, counting and keeping records.

Low Sewage Sludge Freight Rates in England

Dried sewage sludge, bagged, will be carried at special rates by the railways of England hereafter, says the London *Surveyor*.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Dr. Waddell Asks Help for Japanese Engineers

Sir—Owing to the awful calamity that has just occurred in Japan, many of our brother engineers in that country must be in dire need, and will be for some time to come—as will be also the families of those engineers who have perished. It has struck me that it would be a kind and friendly act for the engineers of America to contribute individually *but as engineers* through the New York City Branch of the Yokohama Specie Bank, one-half of the money thus sent being used immediately for general relief of the suffering populace, and the other half later for engineers and their families. I have arranged with the manager of the bank to receive and distribute in that manner all moneys thus sent, working later through the Civil Engineering Society of Japan. Please make checks payable to Engineers' Relief Fund of Yokohama Specie Bank, the address being 120 Broadway, New York City.

For years it has been an earnest desire of mine to see the peoples of Japan and America brought permanently into harmony and close friendship, and if we Americans now help the Japanese generously in their hour of need, they will never forget it; because, from long personal experience, I know them to be a truly grateful and appreciative people.

I trust that each American engineer will contribute as liberally as he can, but even small amounts would help—on the principle that "mony a little maks a muckle."

New York City, Sept. 4, 1923. J. A. L. WADDELL, Consulting Engineer.

[While we sympathize with Dr. Waddell's desire to render every aid to the Japanese sufferers we are inclined to doubt the desirability of separating the various aid funds by professions or other divisions. It seems to us that a much better way would be for everyone to contribute within his means to the American Red Cross.—EDITOR.]

Engineers in the Public Service

Sir—I take pleasure in reading your editorial comment in the current issue on the explanation offered by the Secretary of the Interior relative to the reorganization of the U. S. Reclamation service.

Leaving aside personalities, it is well known how often engineers are supplanted in this country by so-called business men as soon as the major construction problems have been solved. It cannot be contended that all engineers are necessarily good business men but there are abundant examples where engineers have succeeded in the business sense because of spcial fitness for administration and operation of engineering works.

In the public service every citizen has a right and duty to demand that the best possible service shall be given. It is certainly reasonable that heads of departments having vast engineering enterprises in charge should themselves be engineers of the highest qualifications. It is deplorable that politicians or so-called business men should get control and subordinate or dominate at will those who do possess the ability to manage these nation's enterprises. Each time it occurs, vigorous opposition should be given. Let engineering work be done by engineers and let them have the honor—yes, and the pay, too.

Newport News, Va., August 25, 1923. GEORGE C. LOVE, Consulting Engineer.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The Contract Has Been Let for the First 25 miles of the new railway being built by the Ontario Government from Swastika to Larder Lake in the gold mining region of Northern Ontario. It is expected that it will be completed as far as Kirkland Lake this fall.

The British Columbia Government is continuing work on its reclamation project near Sumas. Thirty thousand acres of land that lie along the Fraser River are being protected from the river by concrete dikes and water from this low land is to be pumped up into the river by four electric pumps of a capacity of 1,250 hp. each.

Arrangements Have Been Effected by the Montreal and Quebec interests for the organization of the Laurentide Hydro-Electric Power Co. Ltd. Power rights have been acquired on the North River near St. Adele and the company will be in position to serve the industrial centers of St. Agathe, Piedmont, St. Margaret, Strawbridge and St. Adele.

Contracts for Two Extensions to northern Alberta railways, viz.: thirteen miles west of Berwyn, north of Peach River, Alberta, and fifteen miles to Lake Saskatoon, west of Grand Prairie, on the Canada Central Ry., have been let by the government to James Mohler, Sr., of Ohaton, and construction will be commenced shortly, though it is not thought probable that the work will be completed in time to be of service in handling this year's crop.

Plans Are Being Prepared for a dam 400 ft. long across the North branch of the Ottawa River near Bryson, Quebec, and for a transmission line about 50 miles long to Ottawa, Ontario. This plant is being built by the Ottawa River Power Co., a subsidiary of the Ottawa and Hull Power Co., Ltd., and will add 9,000 hp. to the 31,000-hp. capacity of the two plants of this company on the Ottawa River near Ottawa. In addition, the company controls at Bryson, Quebec, another power site capable of developing 60,000 hp.

D. C. Coleman, Vice-President of the Canadian Pacific Ry., Western lines, states that the branch line program carried out this year will bring into operation on the prairies a larger mileage than any year since 1914. Of the 431 miles of line under construction 281 miles will be ready for grain handling in the fall if sufficient labor is available. Branch lines complete and ready for grain handling are the Consul Easterly 60 miles; Rusetown 45 miles; and Naicam to Melfort 32 miles. Most of the lines constructed or under construction tap territories hitherto without railway service or too far from lines to make extensive farming profitable on account of the long haul.

Miners Strike as Pinchot's Plan Fails

Strike of about 155,000 anthracite miners in the Pennsylvania fields began last Saturday, when representatives of the United Mine Workers of America and the operators were unable to agree on the terms of the compromise plan of Governor Pinchot.

Governor Pinchot's plan included: recognition of the basic eight-hour law for all employees; a uniform increase in pay of 10 per cent; full recognition of the union by the operators, without the check-off, but with the right to have a union representative present when the men were paid; and complete recognition of the principle of collective bargaining.

Though the miners have gone out, apparently doors are not closed to the Pinchot plan, as conferences between contesting parties are being carried on, without, however, any suggestions so far from the U. S. Coal Commission, which body has kept entirely out of the negotiations since the unsuccessful attempt it made two weeks ago to avert the strike by calling the New York City conference.

Economy to Be the Policy of the New York Public Works Dept.

Special Correspondence

The policy of the re-organized Public Works Department of the State of New York is to be one of economy according to the new superintendent, Col. Greene. He is reported to have said that "the idea of this consolidation is not more jobs, but fewer jobs just as soon as I can find a way to do it."

Among the early economies hoped to be effected is the housing under one roof of the canal and highway divisions and the consolidation of the two bridge and grade crossing elimination divisions now in the department of highways. Under the new law the superintendent has the right to abolish any position or to consolidate it with another and all of the appropriations made for the various departments are lumped. Consequently the personal patronage at the disposal of Col. Greene is enormous, totaling in excess of $4,370,000. In the highway division, outside of the $240,000 for the Albany office, there was appropriated this year for engineering supervision, inspectors, laborers, mechanics, chauffeurs and trucks on the nine highway divisions of the state $2,290,000; the division of public works has at its disposal $1,540,000 for personal service while the division of public buildings has $300,000.

Amongst political leaders the appointment of Col. Greene is not entirely a popular one because of his known desire for economy and its possible effect on the barge canal situation.

The waterways advocates have been most active in circulating stories that the opposition, convinced that the canal is a failure, has advised the Governor to abandon the canal for navigation purposes and use its flow for the production of hydro-electric energy.

Colonel Greene Heads New York Public Works Department

Frederick Stuart Greene, commissioner of highways, has been named superintendent of Public Works of the State of New York under the reorganization bill which went into effect July 1, 1923. The appointment, which expires with that of the Governor, must be confirmed by the Senate when it convenes in January next. The reorganized department of public works, as outlined in *Engineering News-Record* May 17, p. 895, and June 7, p. 1015, includes the commission of boundary waters, the department of highways, the interstate bridge commission, and the department of public buildings.

Edward S. Walsh, superintendent of public works before the reorganization became law, has been appointed commissioner of canals and waterways; Lowell Grossman has been appointed to head the highway division, and John J. McNulty has been reappointed as head of the department of public buildings.

Colonel Greene has been engaged in engineering work since 1893. He is a graduate civil engineer of Virginia Military Institute and a member of the Am. Soc. C. E. Previous to 1917 he was engaged in highway, tunnel, subway and foundation work, chiefly in New York State. He served through the war as a battalion commander with a combat engineer regiment of the 77th Division. In April 1919 he was appointed commissioner of highways by Gov. Smith, which position he held until asked to resign by Gov. Miller in 1921, but was reappointed this year by Gov. Smith. In the interim he was in highway work, both in Panama and in Pennsylvania.

Edward S. Walsh has been prominent in canal transportation for years. He was deputy superintendent of public works in 1919 and later superintendent, and was reappointed by Gov. Smith in 1923.

Lowell Grossman has been in the state highway and engineering department since 1906, having worked his way up from rodman to assistant to the first deputy. During the war he served as a captain with the 23rd Engineers.

Reappointment Confirms Positions of California Officials

In accordance with an opinion recently rendered by the attorney-general of California, the act passed by the last legislature divorcing the state department of public works from the state highway commission, made it necessary for the Governor to reappoint the heads of both these departments. This was done on Aug. 27, the appointment confirming the positions held by W. F. McClure, state engineer and director of the reorganized department of public works, Robert M. Morton, highway engineer and Harvey M. Toy, Louis Everding and Nelson T. Edwards as members of the state highway commission.

$1,000,000 So Far Raised for Sesqui-Centennial

Exposition Building Program Includes Expenditure of $15,000,000—Engineers Are Active

Definite progress has been made in the development of the organization and of detailed plans for the sesquicentennial exposition in Philadelphia in 1926 by the Sesqui-Centennial Exhibition Association, the organization of which was noted in *Engineering News-Record* March 30, 1922, p. 543. To date a million dollars has been subscribed to the Association by individuals and corporations, and plans are complete for a campaign to raise five million dollars by sale of bonds to the public. Five million dollars has been pledged by the city of Philadelphia. Five million more will be secured from other sources, making a total of fifteen million dollars, which is the estimated cost of building the exposition.

The site for the exposition begins on the Parkway at Logan Square, and extends through Fairmont Park to include the buildings and grounds on the west side of the river used for the Centennial Exposition. Schuylkill River flows down the middle, and at either side are rolling banks topped by broad plateaus. The trees and shrubbery are of mature age, and so set as to be usable for decorative purposes. The grounds as now outlined include 515 acres, and the buildings already projected contain 60 acres, and are arranged to permit of such further extension as may be required.

Construction Program

It is proposed that construction on a large scale shall begin in the Spring of 1924, giving a year to prepare the grounds and get the buildings ready for the installation of exhibits, and another year for the completion of the project. The gates will open on April 30, and will close on Nov. 13, 1926.

Engineering problems involved in the development of the site are simplified by the inclusion within the area of a number of permanent buildings, and by the fact that the area is now developed park land with roads and paths and supplied with sewage and water facilities. Permanent buildings on the site include the Philadelphia Art Museum and the Philadelphia Free Library, both of which are now under construction, and the Pennsylvania Museum and Horticultural Hall, which were built for the Centennial Exposition. The United States Government and the Commonwealth of Pennsylvania will be asked to construct permanent buildings to house their exhibits. Victory Hall, a convention hall planned as a memorial to the Philadelphians killed in the World War, is within the site and will be completed when the Exposition opens. The women of Pennsylvania are planning to construct a large permanent hospital. Some of the other buildings will be of temporary nature, to be removed when the Exposition closes, but many of the buildings will be of semi-permanent nature, to last for fifty years or more.

In the organization to carry on the work of the Sesqui-Centennial, engineers have from the start played leading roles. The executive director of the association is Col. John Price Jackson. Directors and department chiefs are now being selected tentatively, and will be appointed after the public sale of bonds is complete. The grounds and buildings committee, one of the most important committees, has a total membership of 54, of whom 19 are engineers.

Brazilian Railway to Electrify 35 Additional Miles

Contract for upward of $1,000,000 worth of electrical equipment has been awarded to the International General Electric Co. by the Paulista Ry. of Brazil for the electrification of 35 additional miles of its railway. This contract is in addition to the one awarded to the General Electric Co. in 1920 for 28 miles of double track electrification, and brings the total electrified mileage up to 63 miles, starting at Jundiahy and extending north to Tatu. This is approximately half the total mileage which the Paulista Ry. intends to electrify. The new order includes five 62-ton, 3,000-volt, d.c. switching locomotives, a complete substation of 4,500-kw., and auxiliary equipment for the overhead line and the transmission line.

New Secretary, A. P. H. A., Is Sanitary Engineer

Homer N. Calver, since July 1 acting secretary of the American Public Health Association, was graduated in sanitary engineering from the Massachusetts Institute of Technology and afterwards became assistant health officer of Winston-Salem, N. C. During the war he served in France as an ambulance driver and then in the sanitary corps, attaining a captaincy and the command of a mobile field laboratory. After the war he was for a time acting director of the health service, American Red Cross, and recently he has been engaged in a survey of child health agencies in New York City, under the Public Health Committee of the New York Academy of Medicine.

Large Power Development Planned for Alaska

In connection with the announcement that the government has made a conditional sale of 334,000,000 ft. of timber in the Cascade Creek unit on Thomas Bay in the Tongass National Forest of Alaska to the firm of Hutton, McNear & Dougherty of San Francisco, it was announced that the purchaser has agreed as part of the consideration to build a pulp manufacturing plant of not less than 100 tons daily and of an ultimate capacity of 200 tons at the Cascade Creek water power site on Thomas Bay 20 miles from Petersburg, Alaska. The estimated capacity of this site is 23,700 hp.

Licenses to develop the water power in the National Forest of Alaska are obtained from the Federal Power Commission under an arrangement which allocates the power sites to the manufacturers of the timber most logically available to them. The Forest Service and the Federal Power Commission are collaborating in a survey of the more important water powers in southeastern Alaska which will ultimately be developed in establishing the paper industry.

Engineering Editors Broadcast from New York

All during this summer various editors of the McGraw-Hill Co., Inc., have been broadcasting short talks on engineering information from station WJC in New York City. This will continue through the fall and the program as at present arranged is for Wednesday, from 8:15 to 8:30 p.m. The schedule so far determined is as follows:

September 5, Earl E. Whitehorne, commercial editor, *Electrical World:* "Who Has More Slaves than Pharaoh—A Talk on Electricity."

September 12, Kenneth H. Condit, editor, *American Machinist:* "Automatic Machines and Their Effect on Men."

September 19, H. C. Parmelee, editor, *Chemical & Metallurgical Engineering:* "The Work of the Chemical Engineer."

September 26, E. J. Mehren, editor, *Engineering News-Record:* "What Engineering Is and What It Is Not."

Skill and Responsibility Required in Concrete Sea Wall Bidders

Skill and responsibility of bidder was announced as being of first consideration in the awarding of the contract for the construction of a concrete sea wall at Vicksburg, Miss. This attitude was taken in view of the fact that the work was of a special nature and needed to be handled with skill and dispatch in order that it will be finished by the next season of high water, and a statement to this effect was included in the "information for bidders." Each bidder was required to fill out a questionnaire giving the following information and attach it to his bid:

Length of time in the contracting business and in responsible charge of work, educational qualifications and training, outline of work similar to that under consideration, training and experience of the proposed superintendent in charge of the work, whether any part of the work is to be sublet, etc.

To discover the integrity of the bidders the following were among the points to be determined: Names and addresses of responsible references, information as to whether any work had been taken away from bidders because of dissatisfaction of owner or engineer, controversies with subcontractors, information as to whether any bidders had been involved in lawsuits.

As a result of the questionnaire only the most reputable contractors submitted bids, according to the Miller-Butterworth Co., of Little Rock, Ark., who had charge of engineering. These bids follow:

Mills Engineering Co., Tupelo, Miss., $322,417.50; Doullutt-Williams, New Orleans, La., $307,133.35; Delta Cement & Tile Co., Greenville, Miss., $349,822; Jefferson Construction Co., New Orleans, La., $259,402.40; List & Weatherly Const. Co., Kansas City, Mo., $274,850.07; Case & Cothran, Atlanta, Ga., $326,102.75.

The questionnaire stated that the information required would be treated in strict confidence, that it would be returned immediately after it had served its purpose and no copy kept, and that questionnaires submitted by contractors whose work along similar lines was well known to the chief engineer would be returned unopened.

Random Lines

Why Contractors Are So Wild

In the Hermitage, Mo., *Index*, the following proposal advertisement recently appeared. Unfortunately there is not time for contractors all over the country to get in bids:

Notice is hereby given that separate bids will be received by the undersigned acting County Highway Engineer until 12 o'clock noon, MONDAY, SEPTEMBER 3rd 1923, for the following project at the Halbert Bridge across Pomme de Terre on Pittsburg-Elkton Public road as follows:

The erection of five concrete piers upon which to place approaches of said bridge described as follows; Length at top of pier 14 feet and 6 inches; Top thickness 18 inches; Bottom of pier 3 feet under surface same size at surface which shall be two inches longer than at top for every foot in height. Thickness at base and at top of ground 36 inches; to be so placed that center of pier nearest bridge shall be 16 feet from center of heavy steel beam connecting and resting upon iron tube piers at end of bridge. The next pier to be 16 feet from first in same manner, and so on. The height of the piers shall be to a line drawn from top of said heavy iron beam at top and end of bridge to top of concrete pier at end of dirt fill at each end of bridge. Two of said piers to be placed on one side of river and three on other side to fill space. These piers to be paid for by the cubic yard, the person building same shall furnish his own material including concrete and forms. Concrete to be made of one part cement to six parts of clean gravel which shall be approximately one fourth sand. Also this work will include the furnishing and placing of one bolt 8 inches long and size to fit each hole in I beams and channels for support of floor. Said to be so placed that the holes in beams will fit same. Concrete to be well reinforced with barbed wire which the builder will also furnish.

* * *

Even in France

An American engineer resident in France sends an advertisement of the Temple Tours which reads "Our travel engineers are at your service . . . Telephone or call for particulars of delightful tours."

* * *

Last week it was reported in the newspapers that a road laborer in Maryland had dug up a box with $10,000 (some said $100,000) in gold coin in it. Since then the laborer has claimed that it was all a hoax. We thought there was something fishy about the first report. It was the first time we ever heard of anyone admitting there was money in road building.

* * *

Life is getting so complex. Now there's a "new industrial science"—fence building. One of the advertised functions of a fence company "*includes the services of highly specialized fence experts, using blue prints, contour maps and mathematical formulae unknown to laymen.*"

125,000-Hp. Hydro-Electric Plant Proposed for West Virginia

Washington Correspondence

In reply to the protest of the Norfolk & Western R.R., the Chesapeake & Ohio R.R., and the Appalachian Power Co., against approving the application of the West Virginia Power Co., for a license to develop power on the New River below Anderson Falls, the Federal Power Commission states that its engineering staff proposes recommending the approval of the application. The proposed development would drown out the proposed plant of the Appalachian Power Co. at Anderson Falls and its steam plant at Glen Lyn.

The commission's engineers maintain that the West Virginia Power Co.'s project is more comprehensive than the one at Anderson Falls and is preferable to it, and that the question of damage from backwater is a routine one. The proposed development of the West Virginia Power Co. will produce 125,000 hp.

Hearing on Colorado River Project Set for Sept. 24

Washington Correspondence

A hearing which may be expected to bring out fully the conflicting views regarding power and irrigation rights along the Colorado River and which probably will have an important bearing on the pending compact among the states interested will be held Sept. 24 before the Federal Power Commission in Washington.

J. B. Girand, who holds a preliminary permit for development of a hydro-electric project on Diamond Creek, Arizona, recently wrote the Commission asking that action be taken on his application for a license which has been pending since March, 1922, or that he be permitted to present arguments in behalf of the application. A few days later, the governor of Arizona wrote the Commission requesting a conference between that body and a committee of Arizona citizens on the Girand application and the Colorado river problem in general.

In view of these requests, the Commission has notified Mr. Girand to appear before the Commission Sept. 24, and the governor of Arizona has been notified that a committee of citizens or officials from his state will be received on the same date. In order that all interests may be represented, the Commission has invited the governors of Colorado, Wyoming, Utah, New Mexico, Nevada and California to send representatives to this hearing.

The proposed convention for use of the Colorado River waters has been ratified by all the states excepting Arizona and has been advocated earnestly by Secretary of Commerce Hoover as a means of obtaining maximum development in that valley.

An interesting angle of the situation is that the Arizona State permit held by Mr. Girand, which was granted as the last act of Water Commissioner Norviel, will expire Dec. 31 by default if work is not started under its terms, and it is generally believed that, owing to a change in state administration, he would experience considerable difficulty in securing a renewal. But he cannot proceed under the state permit without a license from the Federal Power Commission, which has withheld action on his application for a year and a half.

Commission Changes Bidding Basis for Delaware Bridge Cables

Readvertisement of the contract for the cables of the Delaware River Bridge upon the basis of reduced quantities of work, was directed by the Delaware River Bridge Joint Commission at a special meeting on Wednesday, August 29. Bids had been received for the cables on August 15, but were rejected because the low bid was in excess of the funds available for the purpose. The changes in the amount of work are intended to bring it within the available limits.

The changes made in the work involve the elimination of all castings for attachment of suspenders to the cables, and elimination of the hand ropes, together with a reduction in the quantities of other items except the cable wire itself. Suspender rope is to be furnished in sufficient quantity for construction of the erection foot bridges, but the rope is not to be cut to length.

Suspenders, sockets, and suspender castings will be furnished and erected later under another contract. The estimated quantities of work on the new basis are as follows:

Item 1	Wire Cables	13,500,000 lb.
Item 2	Suspender Rope	50,000 ft.
Item 3	Castings	180,000 lb.
Item 4	High Tensile Bolts	6,000 lb.
Item 5	Structural Steel Shims	30,000 lb.
Item 6	Cast Iron Separators	30,000 lb.

Bids for the work are to be opened on September 19.

Geological Survey Begins Texas Topographic Study

Washington Correspondence

Engineers of the United States Geological Survey began work September 1 on a topographic survey of sections of Texas in co-operation with the State Water Board. Before the end of the month, Glenn S. Smith, chief engineer of the topographic division, expects to have 50 engineers working on the survey.

The work is in connection with the plans of Texas to control the flood waters of the streams of that state which have done millions of dollars of damage in the last few years. The plan contemplates creation of reservoirs to store surplus water and linked with this are plans for irrigation, reclamation and power projects.

The work will require two years. For the first year, the Geological Survey has made plans to spend nearly $100,000 and hopes to be able to make a similar allotment in the second year in order that the work may not be delayed. This amount will be matched by the state, which has appropriated to various funds $600,000 for topographic work. Charles E. Cooke, who is engineer in charge for the Geological Survey in the Texas work, has been in the state making arrangements several weeks.

More states have asked to participate in the federal co-operative topographic surveys this year than ever before. Some work will be done in 27 different states. The federal appropriation available for field topographic work under the co-operative plan this year is approximately $400,000.

Civil Service Examinations
UNITED STATES

For the U. S. Civil Service examinations listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Superintendent of Construction — Vacancies in the Central Office of the Veterans' Bureau, Washington, D. C., for field work on building projects of the Bureau, salary $3,000 to $3,600 per year, rating to be by sworn statement of applicant and corroborative evidence. Application must be filed by or before September 25.

Computer—Vacancies in the Coast and Geodetic Survey for duty in Washington, D. C., at an entrance salary of $1,400 a year plus increase of $20 a month; for duty in the Manila, P. I., office at entrance salary of $2,000 a year plus $20 a month increase; and for duty in computing the triangulation of the Hawaiian Islands, at entrance salary of $1,860 a year. Examination will be held throughout the country on October 4 and 5.

Information and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or from the secretary of any local examining board.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; Annual Conference, Chicago, Sept. 27-28, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga.; Nov. 12 to 16.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Meeting, Washington, D. C., Nov. 13-15.

Society of Terminal Engineers, New York City, will have as its speaker at a meeting Sept. 11 F. W. Hersey, director of commerce of Wilmington, Del. The meeting will be held in the Engineering Societies Building at 8 p.m.

The Western Society of Engineers' opening fall meeting will be held Sept. 10, when E. Marshall, electrical engineer, Great Northern R.R., will speak on "Railroad Electrification." Other subjects for September are as follows: M. M. Leighton, chief, Illinois State Geological Survey, Sept. 17 on "Influence of Geology on Engineering" and W. A. Gildack, superintendent, W. K. Lithrall Co., on the "Gravel-Washing Plant at Forreston, Ill.," one of the largest in the world.

Personal Notes

H. A. THACKREY has opened an office for general engineering practice in Camden, Ark. Mr. Thackrey is a civil engineer graduate of Kansas State Agricultural College, year 1914.

H. L. OGLE has been made junior partner of the M. Miller Co., contractors and engineers, New York City. Mr. Ogle was formerly district sales manager for the Youngstown Pressed Steel Co., Warren, Ohio.

MAURICE AYRER, Fort Myers, Florida, has been made assistant engineer with A. L. White, civil engineer, Fort Myers, in general engineering practice and in drainage work.

JAMES R. NEVIN, formerly foreman with Harness Bros., general contractors, Ottumwa, Iowa, has been appointed a junior highway engineer in the service of the Illinois State Highway Commission.

LOUIS PARENT, city architect of Montreal, has resigned from the service of the department of public works of the city. Mr. Parent is the architect who designed the new city hall of Montreal, now under construction.

H. F. FLAGG, chief engineer of the State Board of Public Works at Olympia, Wash., has been selected by appraisal engineers of the city of Yakima and the Pacific Power & Light Co. to arbitrate reports of other engineers in fixing the valuation of the Pacific Power & Light Co.'s water system which the city is contemplating purchasing. The three engineers on the board have already begun their sessions in Olympia.

HERBERT HOOVER was elected to honorary membership in the Czechoslovak Engineers and Architects Association, at the annual conference of the association held recently at Kosice, Czechoslovakia, in recognition of "merit in engineering science and practice and good rendered to our people." Mr. Hoover was chairman of the Committee on Elimination of Waste in Industry, of the Federated American Engineering Societies, whose report has been translated by the Government of Czechoslovakia and distributed to the industries and educational institutions of that country.

CARL SITTINGER, Winchester, Mass., is now senior engineer with Stone & Webster, Boston, Mass., in the division of engineering and construction. For the past twelve years Mr. Sittinger was associated with John A. Stevens, consulting engineer, Lowell, Mass., as district manager of the Southern New England office and later as a director in the firm. During the War he was in charge of plant engineering for the Bethlehem Loading Co., a subsidiary of the Bethlehem Steel Corp., which was commissioned by the Government to design, construct and operate a large plant for the manufacture of high-explosive shells.

ROY C. MORTON, a civil engineering graduate of the University of North Carolina, has been appointed assistant sanitary engineer in the Tennessee State Department of Health.

JAMES S. WATSON has been made resident engineer, at Philadelphia, for the Bethlehem Steel Co., Bethlehem, Pa.

A. D. DUCK, county engineer of Hunt County, Texas, at Greenville, has resigned to devote his time to the office of city engineer of Greenville which he has held for some time. G. R. Burtner, assistant engineer, has been appointed county engineer.

VAN CAMP, recently assistant engineer of San Augustine County, Texas, and later of Somervell County, has been appointed resident engineer in charge of construction for Tarrant County under D. A. Davis, county engineer at Ft. Worth.

JOPLING-MARSHALL CONST. CO. has opened offices as general contractors at 522 Slaughter Bldg., Dallas. The firm is composed of J. C. JOPLING of Wichita Falls and ALLAN F. MARSHALL of Dallas.

J. C. DUNBAR, president of the Big 4 Engineering Co. and the Anaconda Gravel Co., Ft. Worth, Tex., was recently appointed colonel of the 111th Engineers, 36th Division. Col. Dunbar served as major with this regiment in France.

JOHN W. REID has been appointed Commissioner of Public Works for the city of Detroit to fill the vacancy caused by the resignation of JOSEPH A. MARTIN. Mr. Reid has been connected with the Department of Public Works since 1900 when he entered as a draftsman in the city engineer's office. He was engineer in charge of the grade-separation division from the time it was organized until March 16, 1922, when he was appointed city engineer. The new commissioner has been in close contact with the design and construction work of the department and the present grade-separation activities in Detroit are attributed largely to his efforts. Mr. Reid will appoint a city engineer in accordance with his power as Commissioner of Public Works.

C. E. SLONOKER has resigned as resident engineer with the Tennessee Highway Department and will go into private practice in Johnson City, Tenn.

Obituary

WILLIAM C. CLEMENT, formerly city engineer of Vancouver, B. C., and previous to that assistant city engineer for sixteen years at Toronto, Ontario, died recently at Somenos, B. C., aged 60 years. Mr. Clement had been living on a ranch at Somenos.

FRANK G. DRUM, for many years a leader in business and financial circles in California died in San Francisco on Aug. 28. Three years ago he resigned the presidency of the Pacific Gas and Electric Co., which he had held for thirteen years. At the time of his death he was identified with many financial and public utility organizations of central California and among other offices, held the presidency of the Yosemite Valley R.R. Co. and vice-presidency of the Pacific Portland Cement Co., Consolidated.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Building Concrete Roads in Half Widths Affects Use of Finishing Machine

Manufacturers Point Out Need for Revision of Methods and Equipment to Meet New Conditions Imposed by Road Builders

To care for traffic during the construction of a concrete road, particularly where detours can not readily be utilized, many of the state highway departments have resorted to the practice of building pavements in half-widths, thus providing a route for vehicles on one side while the other side is occupied by the contractor's operations. As a general rule this form of construction is more costly than if the slab were poured its full width in one operation The argument for it is that the added expense is justified by the service rendered to traffic.

Aside from the economics of this practice, viewed solely from the angle of traffic, another important problem is involved in the use of mechanical equipment for finishing the half-width concrete slabs. Most of the concrete-road finishing machines were originally designed for full-width slabs of 18 ft., more or less. Present practice is calling for the finishing of 9 or 10 ft. slabs, which imposes on the manufacturer of equipment for this purpose the problem of adapting the full-width machine to the half-width slab or designing a new machine for the narrower work. To get the point of view of the manufacturer on this subject *Engineering News-Record* queried several of the makers of finishing machines; their replies follow:

BY T. W. DIECKMANN

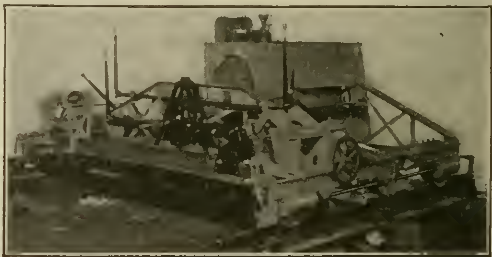
Paving Department, Lakewood Engineering Co., Cleveland

When the method of building concrete roads in half-widths was first proposed we immediately gave attention to the use of the finishing machine on this type of construction. The first half-width, of course, could be machine-finished in the same way as any narrow concrete road. The problem was to finish the second strip.

We developed the method of equipping the finisher with a special set of wheels for the second strip of pavement. The outside wheels, which run on the road forms, are double flanged, while the inside wheels, which travel on the concrete, are flat tread. The outside wheels serve to hold the machine in line with the double flange. When this method was first proposed it was thought it might be necessary to provide a metal plate on the concrete on which the flat-tread wheels could run. Actual operation has shown this to be unnecessary.

This method of building half-width roads was first used on an experimental road in France. That this method is practical was clearly demonstrated by this job, where the finishing machine was handled by men who had not had a great deal of experience with such equipment. This method was also used by J. C. O'Connor & Sons for the construction of the Ideal Section of the Lincoln Highway, a 40-ft. pavement. The contractor used a 20-ft. finishing machine in the above manner with satisfactory results.

We have sold a number of 9- and 10-ft. finishers this year for 18- and 20-ft. roads that are being constructed in half-widths. A photograph of the 9-ft. finisher is reproduced herewith. There is also illustrated the use of the 20-ft. finishing machine on the 40-ft. Ideal Section of the Lincoln Highway.



HALF-WIDTH FINISHING ON IDEAL SECTION, LINCOLN HIGHWAY, AND NEW 9-FT. FINISHING MACHINE (LAKEWOOD)

BY PAYNE G. WEST

Dunn Road Machinery Co., Conneaut, Ohio

We have discussed ways and means of trying to adapt our present machine to the narrow widths. We can cut down to the 9-ft. width, but not to the 8-ft., as our machine cannot be accommodated to this width. Later this year or next year we will probably go into the matter further and design a new machine, especially prepared for narrow widths. This would of necessity be a lighter and less expensive machine and as a result might fail to accomplish the big results which the present machine is accomplishing. If a demand comes from the contractors for a machine to handle this narrow work, we will build a machine to take care of the demand. It is our understanding, however, that in all cases where these narrow width roads are built, the highway departments offer the contractor the privilege of doing the work by hand instead of by machine and unless we can produce a machine which will be comparatively low-priced the contractor will not be interested.

It is evident that a road built in two sections is going to cost the state and the taxpayers considerably more than the full-width road. From the engineering standpoint there may be some real reason for carrying the work on in this way, but so far I am not convinced that the two halves are as strong or as good as a full-width road, with concrete all across, or with a dividing plate in the middle, as built in some of the states.

BY W. J. SAVAGE

Heltzel Steel Form & Iron Co., Warren, Ohio

The use of a full-width finishing machine will not be advantageous on half-width construction if the highway engineers insist on leaving half the road open to permit the passing of traffic alongside new construction where detours are not available. Further, we do not believe the method is practical even if the road were closed to traffic, as it would necessitate the setting of forms three times, putting the contractor to considerable expense. Even if this expense were disregarded, when the contractor started pouring the second half of the road, the tamper would be constantly hitting the finished road, causing some damage. Even this method would be impractical, as the finished half of the road would necessarily be covered either with straw or dirt for curing purposes, which would interfere with the proper functioning of the tamper strikeoff and belt.

We will shortly have a 9-ft. machine in operation on a half-width road. The use of a full-width machine on half-width construction is an expense to the contractor, unless of course provisions are made by the state highway department to repay the contractor for the additional cost

BY A. W. FRENCH & CO.

Chicago

Regarding finishing machines for different widths of road, our Ord concrete road surfacing machine is built in widths of 9 to 20 ft. and we have

a part which is standard for changing over from a 20-ft. machine down to 9-ft. machine.

Cement Production Returns 7.3 Per Cent on Investment

A return of 7.3 per cent on the total investment during 1922 is indicated by an analysis of the federal income tax statements of 11 of the principal Eastern cement companies producing 75 per cent of the cement manufactured in the Eastern states. This is the conclusion reached by H. Parker Willis, Professor of Banking at Columbia University, New York, to whom the companies submitted their operating figures for analysis and report. "It would appear," says Professor Willis, "that whether viewed as a return upon business turned over or upon the value of the output or as a return upon actual investment, the earnings of representative cement producers during 1922 have been well below the average obtained by industrial undertakings at large. The 11 companies under study materially reduced their prices during 1922, receeiving on the average $0.15257 less per barrel than in 1921. This figure represents the difference between an average 1921 price of $1.75453 and a price for 1922 of $1.60196."

For the 11 companies under consideration the output was 28,774,191 barrels or about 25 per cent of the entire production of the country as a whole. Gross sales of 11 companies, comprising both new and old products, were worth $49,592,872. The aggregate net worth of the invested property of the concerns, as reported, was $87,003,767. On the actual investment, Professor Willis states, the 11 mills have earned a total net income, after expenses and taxes, amounting to $6,363,461 or an average return of about 7.3 per cent for the entire group. Total cash dividends declared during the year 1922 were $2,278,634, or an average percentage slightly over 3.5 on a total capitalization of $64,664,061.

The largest percentage of return, the report points out, is by no means obtained by the largest companies.

Fence Manufacturers Favor Simplified Standards

Eighty per cent of the manufacturers of farm, field, and poultry woven-wire fences of the United States, representing over 90 per cent of the country's annual production of that commodity, have signified their intention of accepting the simplified practice recommendation promulgated at the Commerce Department, July 11 and 12.

Woven wire fence manufacturers, distributors, and consumers, representing at least 85 per cent of the national capacity, met with W. A. Durgin, Chief of the Division of Simplified Practice, at the Department of Commerce, in July, in an effort to get together on some mutually satisfactory plan for eliminating excessive varieties of styles and containers existent in that industry. As a result, this conference recommended a reduction from 552 styles of woven wire fence to 69; and a reduction from 2,072 sized packages to 138. This means an 87.5 per cent elimination in the former, and a 93.4 per cent elimination in the latter.

Injunction Granted in Zeolite Water Softener Suit

The Permutit Company, New York, recently brought suit in the Federal Court in New York City against the Paige & Jones Chemical Co. for infringement of the Permutit company's patent covering zeolite water softening apparatus that had previously been sustained by the District Court at Buffalo and the Circuit Court of Appeals, New York. At a hearing in July in the Federal Court, New York City, Judge Learned Hand granted an injunction against the Paige & Jones Chemical Co. restraining it from further manufacturing or selling of infringing apparatus. The first suit in this patent, which was against the Refinite Co. of Omaha, Neb., was carried to the Supreme Court of the United States which denied a writ of certiorari to review it.

Business Notes

J. H. KEMPSTER has been appointed general superintendent of the Buffington plant of Universal Portland Cement Co. located at Buffington, Ind., succeeding the late C. O. Soderquist. This plant consists of mills No. 3, 4 and 6. In 1907, two years after graduation as chemical engineer from the University of Michigan, Mr. Kempster entered the service of the company as chemist of the plant at South Chicago. In 1908 he was appointed chemist of the Buffington plant and in 1915 was advanced to the superintendency of mills No. 3 and 4. Three years later he became superintendent of mill No. 6 which position he has held until his present appointment as General Superintendent of the Buffington plant.

JOHN F. CUNNINGHAM, JR., has been appointed assistant manager of the production department of the Schenectady works of the General Electric Co. In 1901, after a service of two years with the Hoosic Falls Power & Light Co. on power station and line work, he entered the employ of the General Electric Co. in the armature department. In 1906, he was transferred to the turbine section of the production department and later became assistant to the production manager, in charge of requisition service. In 1919, he was transferred to the works manager's office in the capacity of special representative.

Equipment and Materials

Light Portable Pump Driven by Air-Cooled Gas Engine

Weighing 780 lb. and with a capacity of 50 gal. per minute against a total head of from 30 to 35 ft., the portable pumping unit, manufactured by the Pennsylvania Pump & Compressor Co., Easton, Pa., is designed particularly for contractors' use in unwatering excavations, pumping out sewers and delivering a supply of water for concrete road construction. The pump, as shown in the accompanying illustration, is mounted on a four-wheeled hand truck. Power is furnished by a 5-hp. New Way air-cooled gasoline engine, on the shaft of which is mounted directly a 3-in. centrifugal pump. The pump is of the single-stage side suction type with open impeller. The advantages of the air-cooled engine, the manufacturer points out, are its light weight, as compared with a water-jacketed cylinder, and the impossibility of trouble due to frozen

cylinders or clogged circulating pump or piping. That portion of the engine's shaft extending into the pump and exposed to the action of the liquid is covered with a bronze sleeve to prevent corrosion.

Water-Measuring Tank for Concrete Mixers

The new water-measuring tank, designed by The T. L. Smith Co., Milwaukee, for use on its concrete mixers and pavers, consists of an open-top trough, pivoted at both ends within the watertight outer shell of the tank. By tilting this trough at different angles, it is made to hold more or less water and in this way to regulate the amount of water that can be drawn from the tank. The action of this trough can be understood by taking up the operation of the tank, step by step:

Consider that the trough is in an upright position. The operator first allows water to run into the tank until it is full. Then he opens the valve at the bottom of the tank and allows the water to run out into the mixer drum.

The amount of water that runs out is equal to the tank full less the amount held in the trough. Tilting the trough so that it will retain less water permits more water to flow from the tank. When the trough is tilted to a position where it will no longer hold any water, the entire capacity of the tank can be drawn off.

A short arm at the end of the tank enables the operator to set the trough

in the position that will allow just the right amount of water to be drawn off for each batch. A graduated sector, along which this arm rotates, indicates the amount of water being used. A lock is provided to lock the arm at any point along the sector if desired.

The water enters and empties from the tank through a 2½-in. valve located at the bottom of the tank. This large valve insures fast filling and emptying. The fact that the water is drawn off from the bottom also enables it to be emptied much faster than was possible with the old-style tanks from which the water had to be siphoned off.

In place of the usual three-way valve which was liable to damage by the grinding action of the dirt in the water, the new Smith tank is equipped with a piston-type, two-way valve. The piston operates horizontally and the seating surfaces, which are rubber and finished cast-iron, are in a vertical position. This makes it practically impossible for dirt to cling to the seating-surfaces because the incoming and outgoing water is continually washing them clean. Any dirt that may be caught in the valve will drop to the bottom of the valve housing where it can do no damage and from which it can be drained off occasionally through a small plug.

Publications from the Construction Industry

Concrete Floors—PORTLAND CEMENT ASSOCIATON, Chicago, has published a 16-p. pamphlet containing the American Concrete Institute's tentative standard specifications for concrete floors. The text covers materials, construction, plain and reinforced concrete floors, two-course and one-course floors and heavy duty floors for industrial buildings. Suggestions are offered for hardening and increasing the density of floor surfaces and coloring them.

Mechanical Snow Handling—BARBER-GREENE CO., Aurora, Ill., has just published a 20-p. illustrated pamphlet on the general subject of snow removal with particular reference to the use of mechanical equipment. General descriptions and operating data are presented for the company's new type of elevating snow loader which is now in service in a number of cities.

Concrete Mixers—FOOTE CONCRETE MACHINERY CO., Chicago, has issued a 24-p. illustrated pamphlet on its 14-E and 21-E crawler traction paving mixers. The text describes in detail the principal parts of this equipment including traction, frame, drum, power plant, loading skip, spreader bucket and power loading derrick. One page is devoted to the company's transport trailer for moving paving mixers rapidly from one job to another.

Concrete Mixers—T. L. SMITH CO., Milwaukee, is distributing a small folder descriptive of two of the Smith line of concrete mixers—the new 4-S tilter (half-bag) and the 7-S non-tilting mixer (full-bag). Special reference is made to the newly designed and much simplified device which is now used on the 7-S for operating the discharge chute.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Slight Change in Lumber Movement

Production of lumber in the United States, as reflected by 390 of the larger commercial sawmills of the country, was about the same for the week ending Aug. 18 as for the preceding week, says the National Lumber Manufacturers Association. Shipments showed an increase of about 3 per cent and new business a decrease of approximately 3 per cent. With 128 mills reporting as against 122 for the week before unfilled orders of West Coast mills increased from 305,893,356 to 325,860,186 ft., and 137 Southern Pine mills showed a decline in their order file from 231,411,399 to 223,839,786 ft.

For all the reporting mills, shipments were 85 per cent and orders were 76 per cent of actual production; for the Southern Pine Association mills these percentages were 94 and 85 and for the mills of the West Coast Lumbermen's Association, 89 and 84 per cent. Of the entire number of reporting mills, 359 reported normal production for the week, in relation to which actual production was 108 per cent; shipments 94 and orders 85 per cent.

For the first 33 weeks of 1923 and the corresponding weeks of 1922 the lumber movement of reporting mills was as follows:

	Production	Shipments	Orders
1923....	8,267,570,284	8,287,450,163	8,193,307,052
1922....	6,942,857,907	6,900,666,282	7,405,047,392
1923 Increase	1,324,712,377	1,386,783,881	788,259,660

Wholesale Prices Decrease

The index number of wholesale prices in the United States, compiled by the Federal Reserve Board for the purpose of international comparisons, decreased 5 points in July as compared with a decrease of 2 points in June. There were declines in all groups, Goods Produced falling 4 points; Goods Imported, 7 points; Goods Exported, 8 points; Raw Materials, 8 points; Producers' Goods, 4 points; and Consumers' Goods, 1 point.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 129 to 142, are the following:

Dam, Danville, Ky., to L. E. Meyer, Chicago, $4,000,000.

Schools, Brooklyn, N. Y., to Lustbader Constr. Co. and G. A. Fuller, $1,012,000 and $2,492,000, respectively.

Gas container, Milwaukee, Wis., to Riter-Conley Co., Pittsburgh, Pa., $1,500,000.

Bank and office building, Miami, Fla., to R. C. Miller and Ingalls Iron Works, Birmingham, $1,500,000.

Schools, New York, N. Y., to T. A. Clark Co., Brooklyn, P. J. Brennan & Son and Frymier & Hana Co., Inc., $937,700, $1,054,000 and $905,480, respectively.

Bank and office building, Cleveland, O., to Hunkin-Conkey Constr. Co., $1,000,000.

Apartment, Long Beach, Calif., to Ransford-Goble Co., Los Angeles, $1,000,000.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 129 to 142, are the following:

Bridge, Jacksonville, Fla., for Florida East Coast Ry., St. Augustine, $1,800,000.

Bank and office building, Pasadena, Calif., for Pacific Southwest Trust & Savings Bank, $1,300,000.

Freight Loadings Continue Heavy

Loading of revenue freight, according to the Car Service Division of the American Railway Association, continues to run the heaviest for this time of year in the history of the United States. From Jan. 1 this year until Aug. 18, inclusive, (a period of 33 weeks) 30,999,244 cars were loaded with revenue freight. This is the largest number loaded during any corresponding period in history, exceeding by 5,195,251 cars the corresponding period last year, and by 6,904,844 cars the corresponding period in 1921.

For the week ended Aug. 18, 1,035,741 cars were loaded, the second highest total for any one week in history. This was only 5,303 cars under the record week of July 28, when, 1,041,044 cars were loaded. Compared with the corresponding week last year, this was an increase of 189,475 cars or 22.4 per cent, while it also was an increase of 220,594 cars over the corresponding week in 1921.

INDEX NUMBERS OF WHOLESALE PRICES IN THE UNITED STATES
(1913 = 100)

	Goods Produced	Goods Imported	Goods Exported	Raw Materials	Producers' Goods	Consumers' Goods	All Commodities
1922:							
July......	162	128	165	177	143	163	165
October...	161	135	163	179	150	156	165
1923:							
January.....	162	139	180	182	150	156	165
April........	165	156	186	181	169	158	169
May.....	162	155	179	176	167	158	166
June.....	159	148	182	171	164	157	164
July.....	155	141	170	163	160	156	159

The index number is compiled from 100 wholesale price quotations for representative commodities taken in leading United States markets, weighted according to the importance of the commodity. Part of the quotations used are furnished by the Bureau of Labor Statistics, the rest are compiled from trade journals and private firms of recognized authority.

Value of August Contracts Nearly Twelve Per Cent Under Same Month Last Year

Total of 820 Awards During August, Average Value $172,681 Compared With 755 in July, Averaging $216,502

Contracts awarded in the five issues of *Engineering News-Record* during August totaled $141,599,000 as compared with $163,459,000 in the four issues of July. This represents an average weekly value of $28,319,800 for August, against $40,864,750 during the preceding month.

The weekly average of $28,319,000 for the month of August represents a decrease in money value of 12½ per cent below the weekly average for the corresponding period in 1922. August 1922 contracts totaled $160,130,000.

The number of awards totaled 820 during August, with an average value of $172,681 as compared with 755 in July, averaging $216,502.

Mini. um costs observed in Construction News on each class of construction are as follows: Water-works, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings, $150,000.

Of the $141,599,000 a total of $13,442,000 represented Canadian awards, which gained slightly over the July lettings.

All classes of construction fell off during August except industrial works and sewers. August sewer contracts more than doubled those of July, in total money value, and industrial works gained over 25 per cent during the month.

Among the large industrial projects awarded during August were the following: hydro-electric power plant at Island Portage, Ont., $4,000,000 to $5,000,000; a cement plant at Ft. Worth, Tex., $1,000,000; an addition to a cement plant at Bonner Springs, Kan., $1,000,000. The largest sewer contract involved the construction of sewage treatment works at Chicago, Ill., $5,602,636.

The actual physical volume of construction represented by August contracts is 28 per cent less than August, 1922, and 5 per cent under 1921, but 37 per cent heavier than August, 1920.

Engineering News-Record Construction Cost Index Number

September, 1923	221.50
August, 1923	221.50
September, 1922	185.00
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number, 221.50, for September, is exactly the same as for the preceding month. Prices of basic building materials remained unchanged during the month. The average rate for common labor is still 54c. Thus, general construction cost is 20 per cent higher than one year ago and 19 per cent under the peak; it is 121 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
August, 1923 (*5 issues of E. N.-R.*)	111
July, 1923 (*4 issues of E. N.-R.*)	128
August, 1922 (*5 issues of E. N.-R.*)	154
1913	100
Yearly	
1922 (entire year)	130
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 111 for the month of August, and 130 for the whole of 1922, as against 100 for 1913. This means that the actual volume of construction in 1922 (not the mere money-value of the contracts let that year) is 30 per cent above the volume of construction for 1913. Our monthly volume number, 111 for August, 1923, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING AUGUST, 1923

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total United States	Canada	Total
Water-works	$135,000	$208,000	$152,000	$1,648,000	$1,012,000	$42,000	$3,197,000	$481,000	$3,678,000
Sewers	.....	2,194,000	455,000	7,617,000	595,000	2,743,000	13,604,000	149,000	13,753,000
Bridges	102,000	1,049,000	672,000	1,617,000	308,000	500,000	4,248,000	....	4,248,000
Excavation, drainage and irrigation	.....	...	108,000	322,000	916,000	991,000	2,337,000	....	2,337,000
Streets and roads	1,075,000	9,189,000	7,310,000	6,748,000	7,356,000	3,161,000	34,839,000	800,000	35,639,000
Industrial works	895,000	2,515,000	476,000	3,795,000	3,407,000	1,791,000	12,879,000	6,483,000	19,362,000
Buildings	2,005,000	11,818,000	1,926,000	11,750,000	9,616,000	11,991,000	49,106,000	1,957,000	51,063,000
Federal Government	46,000	1,779,000	285,000	238,000	90,000	98,000	2,536,000	....	2,536,000
Miscellaneous	50,000	2,181,000	590,000	690,000	1,662,000	238,000	5,411,000	3,572,000	8,983,000
August, 1923	$4,308,000	$30,933,000	$11,974,000	$34,425,000	$24,962,000	$21,555,000	$128,157,000	$13,442,000	$141,599,000
July, 1923	8,897,000	34,633,000	24,065,000	42,044,000	25,666,000	19,718,000	155,023,000	8,436,000	163,459,000
June, 1923	10,193,000	43,357,000	15,373,000	58,783,000	29,945,000	20,936,000	178,587,000	10,199,000	188,786,000
Total 3 months	$23,398,000	$108,923,000	$51,412,000	$135,252,000	$80,573,000	$62,209,000	$461,767,000	$32,077,000	$93,4844,000

Labor Rates and Conditions Throughout the Country

Continued advances in cost of food and clothing and further increases in rents, during the period between June 15 and July 15, 1923, resulted in an increase of 1.1 per cent in the cost of living throughout the country, according to reports of the National Industrial Conference Board. Living costs on July 15, of the current year, were 61.9 per cent higher than in July, 1914. Fuel prices, however, were a trifle lower, while average sundries and light charges remained unchanged.

Wage changes in the United States during the month ended Aug. 14, 1923, totaled seventy-seven, all of which were increases. The wage advances occurred as follows: Printing industry, 27; railroads, 14; building trades, 10; metal working trades, 8; street railways, 6 and miscellaneous industries, 12.

The average rate paid common laborers, pick and shovel men in construction operations, remains at 54c., the same as for July and August as against 53c. per hr. during June, according to *Engineering News-Record* figures. Local building conditions are as follows:

Baltimore—Conditions easing up in employment of carpenters, bricklayers and hodcarriers. Hoisting engineers advanced 10@12½c.; common laborers, 10c. per hr.

Birmingham — Plasterers increased from $1 to $1.25 per hr.

Boston—Scarcity of bricklayers and hodcarriers; attracted to other cities by higher wage rates. Hoisting engineers' rate at maximum of $1.35, against $1.25 per hr. formerly.

Chicago—Three of the largest building constructors in Chicago have withdrawn from the Landis Award Committee and begun to unionize their work.

Dallas—Increased demand for bricklayers and carpenters; building active.

Detroit—Masons and plasterers in

CURRENT BUILDING TRADES WAGE RATES PER HOUR
(Higher rates indicated by +, decreases by —)

Cities	Brick-layers	Car-penters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.90	$0.70	$0.50	.....	$0.75	$0.30@.35
Baltimore	1.50	1.00	.90@1.12½	.87½	$0.65	.80@1.00	+.40@.50
Birmingham	1.00	1.00	.50@1.00	.30@.40	.....	1.25	.30@.40
Boston	1.25	1.05	1.25@1.35	.82½	1.05	1.12½	.55@.70
Cincinnati	1.25	1.05	1.05	.82½	1.05	1.05	.45
Chicago	1.25	1.15	1.00@1.25	.88¾	1.10	1.25	.82½
Cleveland	1.40	1.25	1.25	.87½	1.00	1.10	.87½
Dallas	1.50	1.00	1.00	.40	.87½	1.00	.30@.50
Denver	1.37½@1.50	1.12½	1.12½@1.18¾	.75@.81¼	1.00	1.15⅝	.35@.55
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.37½	1.00	1.00@1.25	—.87½	1.00	1.07½	.35@.60
Los Angeles	1.25	.87½@1.00	.87½@1.00	.62½	.....	1.00	.50
Minneapolis	1.12½	.87½	.87½	.71½	.....	.87½	.50@.55
Montreal	1.00	.65	.50	.35	.50	.65	.30
New Orleans	+1.25	.90	+1.00	.65	.80	1.00	.35@.40
New York	1.50	1.25	1.25@1.50	1.00	1.00	1.25	.65@.75
Philadelphia	+1.50	1.12½	+1.02¼	.70@1.00	1.00	1.10@1.12½	—.45@.50
Pittsburgh	1.40	1.20	1.12½	1.00	.....	1.25	+.70
St. Louis	1.50@1.75	+1.25@1.50	1.25@1.37½	1.25	1.25	1.25@1.50	—.45@1.00
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	1.12½	1.00	1.00	.93¾	1.00	1.12½	.50@.62½

good demand. Conditions normal in all trades.

Kansas City—Structural iron workers now receiving $1.07½; will demand $1.25 per hr., effective Sept. 1.

Los Angeles—All building crafts busy; no labor shortage.

Montreal—Scarcity of carpenters, bricklayers and hodcarriers; other crafts ample.

New Orleans—Carpenters' strike still on, but effect on construction is negligible. Bricklayers granted increase of 25c. and structural iron workers, 10c. per hr. Strike of metal workers threatened Sept. 1.

New York—Base pay for carpenters $9, with bonus of $1 per day, effective June 1. Cement and concrete laborers $6.50, with bonus of $1 per day, effective July 16. Hoisting engineers' base wage $10, but when employed on jobs where bricklayers are working, both receive same rate.

Philadelphia—Situation easier with bricklayers; over-supply of carpenters. Plenty of other trades. No employment for pile drivers at present.

Pittsburgh—Scarcity of bricklayers; plenty of other crafts. Change from 12-hr. to 8-hr. shifts in steel mills will result in wage advance of about 25 per cent. Several thousand additional workers will be required under the new schedule.

St. Louis—Bricklayers will demand $1.75 per hr. after Nov. 1. Many being paid $14@$15 per day at present. Carpenters' scale to be $1.50, effective Oct. 1. Decided slackening in demand for building trades mechanics due to falling off in new projects. Surplus of workers noticeable in some crafts.

San Francisco—Building trades mechanics busy despite slow-down.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Market spotty. Sales reported as low as $24 per ton at Birmingham for No. 2 foundry; $27 demanded on small lots for immediate delivery, against $25, one month ago. August business heaviest since spring. Furnaces facing higher fuel costs; spot coke market up.

Railway Supplies—Heavy buying movement developed in steel rails, which form the largest item in steel exports. Railway ties tending higher. Fairly active demand for railroad equipment; prices firm.

Pipe—No changes in prices of wrought steel and iron pipe; demand improved. Cast-iron pipe higher in New York. Sewerpipe lower at Pittsburgh; advanced in Kansas City and Boston.

Road and Paving Materials—Asphalt, package and in bulk, advanced in Boston and declined in Cincinnati, during month. Granite paving blocks up $4.75 per M. in Montreal; down $2 in Boston. Wood blocks also declined in Boston, 10c. per sq.yd.

Sand, Gravel and Crushed Stone—Gravel, ¾-in., dropped 10c. in Boston and 25c. per cu.yd. in Los Angeles. Sand, however, advanced 10c. per ton in Cincinnati. Crushed stone, ¾-in., up 30c. in St. Louis and 33c. per cu.yd. in Dallas due to freight and labor adjustments; down 25c. in Los Angeles and 10c. per ton in Boston, during month.

Lime—Hydrated finishing, up 50c.; common, $1 per ton in Boston; lump, finishing and common, advanced 15c. per bbl. Los Angeles reports drop in common lump.

Cement—St. Louis reports advance of 10c. and Atlanta, 15c. per bbl. during the month. New Orleans, however, dropped 40c. Prices prevailing in Chicago, Detroit, Indianapolis, Milwaukee, Pittsburgh and two or three other points are the same as those in effect one year ago.

Structural Steel—August steel business slower than for any previous month since October, 1921. Prices firm despite dullness of market. Inquiries for steel plates and shapes plentiful, but mills finding difficulties in meeting delivery specifications. Plates and shapes firm at $2.50 per 100 lb., f.o.b. mill. Demand for shapes mostly in small lots. Bars firm at $2.40, with demand improving.

Brick and Hollow Tile—Common brick, $20 per M., alongside dock, New York, against $21@$22, one month ago and $18@$20, one year ago. Decline of 50c. per M. reported in Los Angeles and Detroit. Boston, however, quotes rise of $1. Hollow tile down in New York and St. Louis; higher in Los Angeles.

Lumber—Demand slack, due to seasonal dullness. Production and shipments low; stocks large; plenty of cars. August market weaker than preceding month. Price declines reported in San Francisco, Chicago, Boston, Minneapolis, Kansas City, Detroit, and St. Louis. Denver, however, quotes advances in fir and hemlock.

Explosives—Dynamite, 40 per cent gelatin, up in Boston and St. Louis; down in Kansas City; 60 per cent, higher in Boston and lower in Kansas City.

Scrap—Iron and steel scrap higher than month ago in New York and St. Louis, particularly in heavy melting steel. Market firm with increase in fuel prices.

Linseed Oil—Raw oil dropped 9c. in New York and 14c. per gal. in Chicago since Aug. 1. Declines reported in Atlanta, Minneapolis and San Francisco.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Sept. 6	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	$29.05@**31.05**	$25.05
Northern Basic	*28.17*	28.27
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	*28.27*	32.27
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	**34.37**	32.44
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	25.00@**27.00**	27.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	**29.16**	33.64
Virginia No. 2 (silicon 2.25 @ 2.75)	32.17	31.17
Basic	*26.16*	31.14
Gray Forge	*26.16*	31.50
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	*28.61*	30.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	**30.51**	28.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	27.77	33.00
Basic	26.77	26.00
Bessemer	28.77	30.00

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	**$15.00**	$11.50	**16.00**
Stove plate	**12.00**	12.00	**15.00**
No. 1 machinery cast	17.00	16.50	**20.00**
Machine shop turnings	*8.00*	4.00	**12.00**
Cast borings	*9.00*	5.50	**13.00**
Railroad malleable cast	**15.00**	12.50	**20.00**
Re-rolling rails	13.00	13.00	**19.00**
Re-laying rails	...	30.00	**28.50@36.50**
Heavy melting steel	**12.00**	.....	..

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Sept. 6	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$40.00		$43.00	$43.00
Standard openhearth rails	43.00	40.00	$43.00	43.00	43.00
Light rails, 8 to 10 lb	45.00	38.00	2.00*	43.00	43@45
Light rails, 12 to 14 lb	45.00	38.00	2.00*	43.00	43@45
Light rails, 25 to 45 lb	45.00	38@40	2.00*	43.00	43@45
Rerolled Rails	18.75@19.25	24@29.50	.....	....	....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.50	$1.65
Chicago, Hardwood and Red Oak	1.25	1.40
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco...... Green Douglas Fir	.84	1.14
San Francisco, Empty Cell Creosoted, Douglas Fir	1.70	2.25
St. Louis, White Oak	1.30	1.55
St. Louis (creosoted) (zinc treated)	1.70	2.05
St. Louis, Red Oak, plain	1.20	1.45
St. Louis, Sap pine-cypress	1.05	1.30

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Sept. 6	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, $\frac{9}{16}$-in. and larger	$3.15	$2.35@2.50	$3.00	$4.00	$*4.00*	$3.75
Track bolts	4.00@4.25	3.25@3.50	4.00	5.00	*5.00*	4.70
Standard section angle bars	2.75	2.40	2.75	4.00	*4.00*	3.10

PIPE

WROUGHT PIPE—The following mill discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	48%	50%	49%
2½ to 6 in. lap welded	44%	47%	46%

	Galvanized New York	Galvanized Chicago	Galvanized St. Louis
1 to 3 in. butt welded	34%	37%	36%
2½ to 6 in. lap welded	30%	34%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 15%. Cast iron, standard sizes, 17½% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York Sept. 6	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in	$53.00	$68.60	$60.30	$64.20	$61.60	$66.00
6 in. and over	49.00	63.60	55.30	60.20	57.60	62.00

Gas pipe and Class "A," $5 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Sept. 6	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$40.00	$50.00	$62.50	......	$73.00
4	55.00	53.00	50.00	75.00	$76.50	83.00
5	80.00	80.00	.	100.00	97.75	108.00
6	105.00	100.00	85.00	175.00	127.50	133.00
8	170.00	160.00	195.00	187.50	212.50	199.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	.....	$*0.105*	......	....	$0.15	$0.12	......
4	...	*.105*	$0.11	$0.1175	.15	.15	$0.15
5	.	*.1575*	.1375	...	.23	.18	.18
6	$0.24	*.1575*	.165	.1645	.23	.21	.21
8	.38	*.245*	.26	.26	.35	.30	.325
10	.57	*.3675*	.338	.364	.53	.42	.476
12	.72	*.4725*	.442	.468	.68	.54	.612
15	1.13†	*.63*	.65	.78†	.90	.90	.884
18	1.65†	*.875*	.85	1.092†	1.25	1.32	1.153
20	1.98†	*1.05*	1.125	.....	1.50	......	...
22	2.64†	*1.40*	1.375	1.456†	2.00	......	1.564
24	2.97†	*1.575*	1.625	1.872†	2.25	2.16	2.04
27	4.81†	*2.795*	....	2.95†	4.69†	3.00	3.34
30	5.33†	*3.096*	...	3.65†	5.94†	3.60	4.06
33	6.93†	*4.14*	....	4.45†	6.88†	......	4.99
36	7.91†	*4.715*	....	4.80†	7.50†	......	5.42

	3	5	8	12	24	36
Boston	**$0.129**	**$0.199**	**$0.315**	**$0.603**	**$1.99†**	$5.95†
Minneapolis	....	......	.40	.72	2.55	5.66†
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.13	......	.36	.72†	2.60†	.....
Los Angeles	.13	.165	.275	*.475*	1.65	.....
New Orleans	.112*	.168*	.28	.476	1.182	.....
Cincinnati	.12	.18	.28	.54	1.80	4.10†
Atlanta	1.05*	.16*	.27	.455	1.75	.....
Montreal, *delivered*	.68‡	.45†	.70	1.35	4.50†	.
Detroit	.117	.1755	.273	.5265	2.34†	6.15†
Baltimore	.126	.189	.294	.567	1.89	5.4375
Kansas City, Mo.	.15*	.21*	**33½**	**.56**	...	....
Philadelphia	.12	.18	.28	.54	1.80	5.22¾

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

	Sept. 6	One Year Ago
New York, 45% asphalt......(at terminal)	**$0.053**	$0.055
New York, 65% asphalt......(at terminal)	*.052*	.055
New York, binder..........(at terminal)	.06	.0625
New York, flux.............(at terminal)	**.06**	.06
New York, liquid asphalt....(at terminal)	*.058*	.065
St. Louis, 50@60% asphalt	.0565	.05
St. Louis, 40@50% asphalt	.0535	
Chicago, 40–50% asphalt	.0525	.0525
Chicago, 60–70% asphalt	.055	.055
Dallas, 45% asphalt	**.0495**	.10
Dallas, 55% asphalt	.0455	.13
Dallas, binder	.061	.15
San Francisco, binder, per ton	9.50*	13.00*

* F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbl. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Texas*)	\$23 00*	\$15.00†
Boston (*Mexican*)	21 50	17 50
Chicago (*Stanolind*)	22 25	16.00
San Francisco, *f.o.b. refinery*, Oleum, Cal	17.00	11.00
Dallas (*Texas*)	27 10	21.10
Seattle, "*D*" *grade, California, f.o.b. Richmond.*	24 75	20.50
Denver (*California*)	24 00	....
Minneapolis *f.o.b. Twin Cities* (*Stanolind*)	25 45	19.10
St. Louis (*Mexican*)	29 50	24 50
Baltimore (*Standard Oil*)	21.00	15.00
Montreal (*Imperial*)	28.00	21.00
Atlanta (*Mexican*)	26.00	23 50
Detroit (*Mexican*)	22 47	18.40
Cincinnati (*Kentucky Rock*)	*17.50*	*13.50*
Maurer, N. J. (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	21.50	18.50
Philadelphia (*Mexican*)	20.00	15.00
Kansas City (*Texas*)	27.30	22.30
Los Angeles "*D*" *grade, California, f.o.b. El Segundo Refinery*	17 00	11.00

*F.o.b. Bayonne, N. J.
†F.o.b. Marcus Hook, Pa.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade 1)	5-in. granite, 30 blocks per sq.yd.	\$134.50 per M.
Chicago	About 4x8x4 dressed	3 50 per sq.yd.
	About 4x8x4 common	3 10 per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M.
Boston	5-in. granite 28 blocks per sq.yd.	*128.00* per M.
Atlanta	Granite	2.66 per sq.yd.
Detroit	5-in. Granite	106 00 per M.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4 x 8 x 4	3.25 per sq.yd.
Cincinnati	Granite	138.00 per M.
St. Louis	4x8x4 dressed	3 15 per sq.yd.
	4x8x4 common	2.95 per sq.yd.
Kansas City	Granite	3.55 per sq.yd.
Philadelphia	Granite	3.75 per sq.yd.
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft wide	\$0.22 per sq.ft.
	Manhattan, 4 ft. wide	.22 per sq.ft.
	Queens, 5 ft. wide	.24 per sq.ft.
	6x24-in. cross-walk	1.10 per lin.ft.
Chicago	18 in. wide	.. per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 80c.; 5 x 20 in., Queens, 85c. *St. Louis*: Class "A" straight, delivered, 5 x 16 in., \$1.45 per lin.ft. *Chicago*: 5 x 8 in., \$1.65; 6 x 8 in., \$1.95 per lin.ft. delivered.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	\$2.58
New York (*delivered*)	3½	16	2.79
Boston	3½	18	*2.65*
Chicago	4	16	3.00@3.25
Chicago	3½	16	2 50
St. Louis	3½	16	2 55
St. Louis	4	16	2.90
Seattle	4	16	Off market
Minneapolis	3½	16	2.73
Atlanta	3½	16	2.00
New Orleans	3	16	2.45
New Orleans	3½	16	2.65
New Orleans	4	16	2.95
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4 50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	3½	16	2.38
Kansas City	4	16	2.75
Philadelphia	4	16	None used

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel				Sand	
	1½ In.		¾ In.			
	Sept. 6	One Year Ago	Sept. 6	One Year Ago	Sept. 6	One Year Ago
New York	\$1 75	\$1.75	\$1.75	\$1.75	\$1.25	\$1.00
Denver	1.90	1.75	1.90	1.75	1.00	0.75
Chicago	2.00	2.00	2 00	2.00	2.00	2.00
St. Louis	2 30	1.25†	2 35	1.30†	2 10	1.10†
Seattle	1.25	1.00	1.25	1.00	1.25	1.00
Dallas	2.38	2.25	2.38	2.25	1.89	2.25
Minneapolis	1.85*	1.75	1.85*	1.75	1.25	1.00
Cincinnati	1.50†	1.87½	1.50†	1.87½	1 30†	1.43
San Francisco	2.15	2.25	2.15	2 25	1.50	1.50
Boston	*1.40*†	....	*1.40*†	....	*1.10*†	....
New Orleans	2.85	2.85	2.85	2.85	1 25	1.35
Los Angeles	*2.50*	1.50†	*2.50*	1.50†	1.75	1.35†
Atlanta	1.90†	1 85†	1.90†	1.85†	1.24†	1.15†
Detroit	1.62	2.00	1.62	2.00	2.02½	2.00
Baltimore	1.86	1.40	2.06	1.60	0.80†	2.00†
Montreal	1.25†	1.25†	1.50†	1.50†	1 25†	1.25†
Birmingham (Crushed slag used instead of gravel)					1.30†	1.28†
Philadelphia	2.00†	1.60	2.00†	1.65	1.50†	1.60
Kansas City	1.75	2.00†	1.60	2.00†	0.66†*	0 66†*

New York—Grits, \$1.75 per cu. yd.; ready mixed, \$2.00
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit.
† Per ton.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In.		¾ In.	
	Sept. 6	One Year Ago	Sept. 6	One Year Ago
New York	\$1 65	\$1 65	\$1 75	\$1 75
Chicago	2 00	1.60	2 00	1 60
St. Louis	1.90	1.65	2.00	1 65
Dallas	2 83	1.65	2.83	1.65
San Francisco	2.15	2.25	2.15	2 25
Boston	*1.60**	..	*1.60**	..
Minneapolis, *at plant*	2.00	2.00	2.25	2.25
Kansas City	1.50	2.10	1.50	2.10
Denver	3.50	3.50	3.50	3.50
Seattle	3 00	3.00	3.00	3.00
Atlanta	2.00*	1 90*	2 00*	1 90*
Cincinnati	1.65*	1.75	1 65*	1.75
Los Angeles *delivered*	*2.75*	1.75*	*3.00*	1.85*
Detroit	1.75	1.90*	1.75	1.90*
Baltimore	2 50	1.75*	2.55	1.65*
Montreal	1.80*	1.50*	1 90*	2.00*
Philadelphia	2 00*	1.70*	2 00*	1.55*
Pittsburgh	2.85	2 85	2.85	2.85
Cleveland	3.25*	3.00*	3.25*	3.00*

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	\$1.30	\$1.40	\$2.00	\$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa	0.85	0.90	2.50	
Birmingham, Ala	1.05	1.15	2.05	0.80
Buffalo, N. Y., and Erie, Pa	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.45	1.45	1 45	1.25
Eastern Pa and Northern N. J	1.20	1.20	2.50	1.20
Western Pennsylvania	1.25	1.25	2.00	1 25
Longdale and Glen Wilton, Va	1.25	1.25	2.50	1 00
Toledo, Ohio	1 50	1.50	1 50	1 50

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	\$18.20	\$13.10	\$3.75*	\$3.00@3.25*
Chicago	20.00	20.00	1.50†	1.50†
St. Louis	23 20	20.00	1.87½†	1 87½†
Boston	22.50	16.00	4.30*	2.60*
Dallas	22.00	22.00	..	2 35†
Cincinnati	16.80	14.30	....	
San Francisco	22.00	....	....	2 10†
Minneapolis	25.50	21.00 (white)	1.70†	1.50†
Denver	24.00	.....	....	2.70†
Detroit	21.00	20.00	....	20.00‡
Seattle, *paper sacks*	24.00		2.80†	.....
Los Angeles	.....	18.50	....	*2.00*†
Baltimore	24.25	17.25	2.55	
Montreal	.....	21.00	....	10.00‡
Atlanta	22.50	*14.00*	*2.25*†	1.50†
New Orleans	.....	.....	2.40†	1.85†
Philadelphia	23.50	16.50	2.80*	1.93*
Kansas City	28 00	24 00	3.12*	2.96*
Birmingham	14 25	13.50	1.90†	1.65†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is \$1.80. Sheboygan \$1.70. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Sept. 6	One Year Ago
Minneapolis (Rosendale)	\$2.80	\$2.80
Kansas City (Ft. Scott)	1.50	1.60
Cincinnati (Utica)	1.72	1 77
Boston (Rosendale)	2.80	....
St. Louis (Carney)	*2.35*	1.87
Birmingham (Magnolia) pozzolan cement	2 10	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Sept. 6	One Month Ago	One Year Ago
New York, del. by truck	\$2.70@2.80	\$2.70@2.80	\$2.60
New York, alongside dock to dealers	2 30	2.30	2 30
Jersey City	2.48	2.48	2.73
Boston	2 90	2.90	....
Chicago	2.20	2.20	2.20
Pittsburgh	2 24	2.24	2.24
Cleveland	2.46	2.46	2.59
Detroit	2.48	2.48	2.48
Indianapolis	2.41	2.41	2.41
Toledo	2.48	2.48	2.53
Milwaukee	2.37	2.37	2.37
Duluth	2.25	2.25	2.14
Peoria	2 41	2.41	2.41
Cedar Rapids	2.48	2.48	2.48
Davenport	2.43	2.43	2.43
St. Louis	2.45	2.35	2.20
San Francisco	2.63	2.63	2.71
New Orleans	2.90	3.30	3.20
Minneapolis	2.50	2.50	2.39
Denver	2.84	2.84	2.85
Seattle	2.90	2.90	2.90
Dallas	2.25	2.25	2.25
Atlanta	3 00	2.85	2.50
Cincinnati	2.54	2.54	2.46
Los Angeles	*3.16*	3.16	3.30
Baltimore	2.65	2.65	2.50
Birmingham	2 70	2.70	2.10
Kansas City	2 90	2.55	2.85
Montreal	2.25	2.25	2.78
Philadelphia	2.75	....	2.41
St. Paul	2.50	2 50	2 39

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind	\$1.95	Hudson, N. Y	\$2.20
Universal, Pa	2 00	Leeds, Ala	2.20
Steelton, Minn	2.06	Hannibal, Mo	2.10
Fordwick, Va	2.10	Lehigh Valley District	2.10
Mitchell, Ind	2.10	Wyandotte, Mich	2.30
Iola, Kan	2.10	Alpena, Mich	2.10
Mason City, Ia	2.10	Richard City, Tenn	2.20
La Salle, Ill	2.10	Kingsport, Tenn	2.20

TRIANGLE MESH—Price per 100 sq.ft in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago Mill	Warehouse: New York	St. Louis	Dallas	San Francisco
032	22	$0 95	$1 02	$1.24	$1.04	$1 12	$1 16
049	28	1 20	1 30	1.58	1.32	1 38	1 47
068	35	1 47	1 59	1 94	1.62	1 67	1 81
093	45	1 89	2 04	2.50	2.08	2.00	2 32
126	57	2 34	2.53	3.09	2 59	2 55	2 88
153	68	2.79	3.02	3.60	3.08	3.15	.....
180	78	3 20	3.47	5.22	3.54	3.47	.....
245	103	4 22	4.57	4.60	4.66	4.58	.....
287	119	4 88	5.28	6 44	5.39	5.26	6.00
336	138	5 66	6.13	7.39	6.25	6.11	.....
395	160	6.56	7 10	8 67	7.25	7.12	.....
PAVING							
036P	17	$0 72	$0 78	$0 95	$0 79	$0.76	.....
053P	24	1 02	1 10	1 35	1 12	1 07	.....
072P	31	1 29	1 40	1 71	1 42	1 39	.....
097P	40	1 66	1 80	2 20	1.83	1 90	.....
049R	24	....	1.10	....	1.12	1 07	.....
067R	31	...	1.40	....	1 42	1 39	.....
089R	40		1 80	....	1.83	1 90	..

In rolls, 48, 52-, and 56-in. wide and in 150-, 200- and 300-ft lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27 Dia.	2.3	$22 00	$21 25	$20 72	*$20 00*	$25.50
26 "	2.5	22 00	22 50	22 39	*19.11*	27 58
25 "	3.0	22 00	25 25	24 93	......	30 71
24 "	3.4	24 00	27 25	27 10	*24 09*	33 16
22 "	4 33	27 00	31 75	32 27	.....	35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
¾ and larger..	$2 40	$2 65	$3 54	$3 20	$3 35	$3.80	$3 65
⅝	2 45	2 75	3 59	3 25	3 50	3 85	3 75
½	2 50	2 85	3 64	3 30	3 55	3 90	3 85
⅜	2 65	2 90	3 69	3.45	3 75	4.05	4.05
¼	2 90	2.95	4 04	3 70	4 35	4.30	4.65

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¾ and larger	$2 30	$3.05	$3 50	⅜........	$2 55	$3.30	$3.75
⅝ in........	2.35	3.10	3.55	¼........	2.80	3.50	4.00
½..........	2.40	3.15	3.60	....	.....	.....	....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Sept. 6	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)......	*$23.65*	$24.60@25.70	$21.30@ 23.50	$46.50	$54.00
New York (at dock)...	*20.00*	21@22	18@20	......	......
Chicago	11.00	11 00	11.00	34.00	42 00
St. Louis, salmon......	16@18	16@18	14 00	38@40	40@42.50
Denver, salmon.......	12.00	12.00	12.00	......	......
Dallas..............	13.10	13.10	10.90	33.00	......
San Francisco	15.00	15.00	15.00	......	....
Los Angeles (del.).....	*15.50*	16.00	15 00	(not used)	
Boston (del.)........	23.00	22.00	....	48.25	56 00
Minneapolis (del.).....	17@19	17@19	18@19	......	......
Kansas City.........	14 50	14 50	16 00	......	......
Seattle..........	13 00	13 00	14 00	50.00	....
Cincinnati..........	17@20	17@20	15.00	45.00	50.00
Montreal	16 50	16.50	16 00	100.00‡	68 00
Detroit (del.)........	*18.50*	19.00	16 50	38 50	41.50
Baltimore (del.).......	21.00	21.00	20.00	40.00	45.00
Atlanta.............	12 00	12 00	11 00	40.00	45.00
New Orleans.........	18 75	18.75	13.00	......	......
Birmingham..........	13.50@16	13.50@16	.512.00	......	......
Philadelphia..........	22 00	.....	17.50@18.50	38.00	46.00
Pittsburgh (del.)......	16.00	16.00	16.00	......	......
Cleveland	16.00	16.00	16.00	......	......

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Sept. 6 on Trucks*	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12...	*$0.1263*	$0.1112	$0 0724	$0.135	*$0 089*	$0 108	....
6x12x12...	*.1895*	.1667	.0996	......	*.122*	.156	....
8x12x12...	*.2369*	.2084	.1358	.23	*.162*	.244	*$0.2255*
10x12x12...	....	.....	.1695	......	*.186*	......	*.2779*
12x12x12...	....	.....	.1937	......	*.232*	......	*.3613*

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston....................	*$0 13*	$0.24	.. ..
Minneapolis (f.o.b. cars)........	.0736	.12125	$0.214
Minneapolis (delivered).........	.0816	.13375	.234
Cincinnati..................	.0815	.153	....
Kansas City................	.085	*.135*	....
Denver....................	.065	.123	.188
Seattle (delivered)	.11	.25	.36
Los Angeles factory...........	.1042	.1880	....
New Orleans................	.12	.23	....
Detroit (delivered).............	.1145	.2147	.27
Montreal..................	.115	.225	.30
Baltimore..................	.125	.27	......
Atlanta...................	.102	.175	......
Dallas....................	.115	....	......
Birmingham................	.11	.18	......
Pittsburgh (delivered).........	.068	.128	.179
Cleveland	.09	.172	......

San Francisco and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh Mill	Birmingham Mill	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in ...	$2 50	$2 75	$3 64	$4 20	$3 45	$3 40	$3.60
Channels, 3 to 15 in...	2 50	2 75	3 64	4 20	3 45	3.40	3.60
Angles, 3 to 16 in., ¼ in. thick...	2 50	2 75	3 64	4 20	3.45	3.40	3.60
Tees, 3 in. and larger...	2 50	2 75	3 64	4 20	3.50	3.40	3.60
Plates, ¼ in. thick and heavier.......	2 50	2 75	3.64	4 30	3 45	3.40	3.60

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York Sept. 6	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
¾ in. and larger	$3.00@3.25	$4.40	$3.85	$3.75	$4.15	$5.00	$4 90
CONE HEAD BOILER							
¾ in. and larger	$3 10@3 35	$4 50	$3 95	$3.85	$4.25	$5 10	$5.00
⅝ and 11/16........	3 25@3.50	4 66	4.11	4 00	4.40	5 25	5.15
½ and 9/16.... ...	3.50@3.75	4.90	4 35	4.25	4 60	5.50	5.40

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.......	$3.00	$3 45	$4 25	$4.25	$3.34	$4.95
Cut	.	5 50	5.80	5.75	3.74	5 00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco: Galv.	San Francisco: Black	Seattle Black
½..............................	$9.85	$7.65	$8.[illegible]
⅝..............................	7.80	6.30	7.[illegible]
¾..............................	7.75	6.15	7.[illegible]

Pittsburgh base in lots of 200 kegs or more, $3.50

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls 108 sq.ft. costs $2.50 per roll in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.75 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., *$5.55* per square.

ROOFING MATERIALS—Prices f.o.b. New York, in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton..............	$67 50
Tar pitch (in 400-lb. bbl.), per 100 lb	1 62½
Asphalt roofing (in barrels), per ton, f.o.b. plant*.................	38.75
Asphalt felt (light), per ton, f.o.b. plant*.......................	75.00
Asphalt felt (heavy), per ton, f.o.b. plant*......................	75.00

* Delivered in Metropolitan Dist., $3.00 additional.

WINDOW GLASS—Double strength, box list, united inches, 34, "AA" grade, at discount of 84 per cent from standard lists, f.o.b. New York; "A" grade less 86 per cent and "B" grade, 87 per cent.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10...............	$3.00	$4.45	$4 15	$5.25	$4.59
No. 12...............	3.10	4.50	4.20	5.30	4.64
No. 14...............	3.20	4.55	4.25	5.35	4 69
No. 16...............	3.40	4.65	4.35	5.40	4.79
Black					
*Nos. 18 and 20.......	3.70	5.00	5.05	*5.60*	*4.80*
*Nos. 22 and 24......	3.75	5.05	5.05	*5.65*	*4 85*
*No. 26..............	3.80	5.10	5.10	*5.70*	*4 90*
*No. 28..............	3.85	5.20	5.20	*5.80*	*5.00*
Galvanized					
No. 10...............	4.00	5.35	5 35	5.50	*5.00*
No. 12...............	4 10	5.45	5.45	5 60	*5.10*
No. 14...............	4 10	5.45	5 45	5.75	*5.10*
Nos. 17 to 21.........	4 40	5.75	5.74	5 90	*5.40*
Nos. 22 and 24........	4 55	5.90	5 90	6.05	*5.55*
*Nos. 25 and 26.......	4 70	6.05	6 05	6 20	*5.70*
*No. 28....	5.00	6.35	6 35	6.50	*6.00*

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Sept. 6	New York: One Year Ago	Chicago: Sept. 6	Chicago: One Year Ago
Raw in barrels (5 bbl. lots)	*$0.96*	$0.91	*$1.14*	$0.99

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry		In Oil	
	Sept. 6	1 Yr. Ago	Sept. 6	1 Yr. Ago
Red	14.00	12.50	15.50	14.00
White	14.00	12.50	14.00	12.50

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$37.00	$38.00	$39.00	$42.00
3x6 and 8	37.00	38.00	39.00	42.00
4x4-6 and 8	37.00	38.00	39.00	42.00
3x10 and 12	37.00	38.00	39.00	42.00
3x14	39.00	39.00	41.00	43.00
4x10 and 12	37.00	38.00	39.00	42.00
4x14	39.00	39.00	41.00	43.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$39.00	$41.00	$43.00
6x14	44.00	46.00	48.00
8x10	39.00	41.00	43.00
8x14	44.00	46.00	48.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22-24 Ft	20 Ft. and Under	22-24 Ft.
3x4 to 8x8	$50.00	$51.00	$45.50	$47.50
3x10 to 10x10	54.00	55.00	51.50	53.50
3x12 to 12x12	58.00	59.00	58.50	60.50
3x14 to 14x14	65.00	68.00	64.50	66.50
3x16 to 16x16	70.00	71.00	72.50	74.50
3x18 to 18x18	84.00	85.00	82.50	84.50
4x20 to 20x20	94.00	95.00	.....	.....

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under.

Other Cities

	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir	Hemlock	Spruce	P.	Fir
Boston	$65.00	......	$60.00	$60.00	$82.00	......
Seattle	.....	$28.00	......	......	......	$28.00
New Orleans	28.00	......	......	......	31.00	......
Baltimore	33.50	53.00	53.00	60.00	50.00	53.00
Cincinnati	40.00	75.00	75.00	90.00	44.00	80.00
Montreal	50.00	......	......	......	70.00	90.00
Los Angeles	.....	50.00	......	......	......	51.00
Denver	.....	43.25	......	......	......	44.25
Minneapolis	42.00	42.50	41.50	......	44.00	43.75
Atlanta	36.00	......	......	......	40.00	......
Dallas	47.50	......	......	......	52.25	......
Kansas City	43.25	......	......	......	56.25	......
Birmingham	30@35	......	......	......	40@45	......
Philadelphia	63.00	62.00	62.00	77.00	75.00	73.00
Detroit	45.75	50.25	......	......	58.75	50.25
St. Louis	44.00	......	......	......	56.00	......

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston	$50.00	$85.00	$50.00	$58.00	......
Seattle	......	24.00	.....	......	$26.00
New Orleans	72.00	......	.....	31.00	......
Baltimore	60.00	44.00	44.00	34.00	50.00
Cincinnati	76.00	81.00	76.00	35.00	90.00
Montreal	......	50.00	37.00	45.00	45.00
Los Angeles	......	45.00	.....	......	......
Denver	......	34.25	34.25	.....	34.25
Minneapolis	42.00	40.75	39.50	38.25	37.25
Atlanta	20.00	......	.....	30.00	......
Dallas	47.50	......	.....	50.83	......
Kansas City	47.50	......	.....	36.00	......
Birmingham	26@30	......	....	38@40	.....
Philadelphia	33.00	60.00	46.00	52.00	68.00
Detroit	49.50	37.00	.....	42.50	40.50
St. Louis	40.00	......	.....	29.00	......

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M.ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers price to contractors on large projects.

St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M.ft. additional.

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M.ft. additional.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

MISCELLANEOUS

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Sept. 6	One Month Ago	One Year Ago
$2.65	$2.65	$2.55

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	20%
Patent flattened strand, special steel wire rope	20%
Patent flattened strand, iron rope	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington Discount: 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft., ⅝-in., 6; ¾-in., 4½; 1-in., 3⅓; 1⅛-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.17½	New Orleans	$0.18½
New York	.18½	Los Angeles	.18
Chicago	.18	Seattle	.18
Minneapolis	.20½	St. Louis	.19½
San Francisco	.18	Montreal	.22
Atlanta	.20	Detroit	.20
Denver	.22	Baltimore	.18
Cincinnati	.21	Kansas City	.21½
Dallas	.21	Birmingham	.20½
Philadelphia	.19		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin	
	40%	60%
New York	$0.27	$0.295
Boston	.24	.26
Kansas City	.2225	.2475
Seattle	.165	.19
Chicago	.22	.25
Minneapolis	.1917	.2123
St. Louis	.2275	.2475
Denver	.2025	.2275
Dallas	.225	.305
Los Angeles	.17	.20
Atlanta	.23	.2575
Baltimore	.22	.23
Cincinnati	.225	.25
Montreal	.195	.235
Birmingham, *delivered*	.16	.17
New Orleans	.195	.22
San Francisco	.1625	1925
Philadelphia	.215	.240

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f. o. b. New York:

Sulphate of aluminum, in bags, per 100 lb.	$1.40@1.50
Sulphate of copper, in bbl., per 100 lb.	5.10@5.25
Soda ash, 58%, in bags, per 100 lb.	1.45@1.51
Chlorine, liquid, cylinders, 100 lb., per lb.	.09
Hypochlorite of lime (bleaching powder) in drums, per 100 lb.	2.00@2.10

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.29
Birmingham	.69	Kansas City	.735
Boston	.365	New Orleans	.515
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.34†
Cincinnati	.29	Philadelphia	.32
Cleveland	.215	St. Louis	.43
Denver	1.27*	St. Paul	.60

† Minimum carload, 40,000 lb.

* Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.

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E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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Structures and the Japanese Earthquake

LITTLE reassurance has come from Japan in the fragmentary bits of news that have drifted in since the first word of the earthquake of Sept. 1. A stupendous total of death and destruction is sure, even though the unavoidable exaggeration of first estimates has been slightly discounted. But there is somewhat better assurance than was available a week ago that the steel-frame and concrete buildings in the devastated area were not destroyed, as early rumors asserted, but survived substantially intact, as they did in San Francisco. This is at least an item of satisfaction, small though it be when measured in the total. It is now more certain too, that the violence of the movement was phenomenally great. Much is to be learned, therefore, from the effects of the earthquake in relation to safe construction, for the benefit of future generations. The full story of the engineering aspects of the disaster, however, will doubtless come only after weeks or months..

An Expedient Settlement

BY THE terms of the anthracite coal settlement the miners gain a horizontal raise in wages, the operators prevent the check-off and lose no part of their profits, the State of Pennsylvania will gain close to a million dollars extra taxes on coal exports, and the public will have to pay more for its coal. It is easy, therefore, to figure out who wins by the settlement. The best that can be said is that in all probability anthracite coal disputes have been prevented for another two years, at a cost to the citizen's purse. The proposed investigation of freight rates and middlemen's profits may result in an absorption of some of the increased cost before it reaches the consumer but the possibility is remote. Governor Pinchot can hardly be blamed for making expediency the governing element in the agreement. By the time the dispute reached him there was probably no other way out. The fact remains that the horizontal wage raise is inequitable, even admitting that some of the miners are entitled to more pay, and that the whole fabric of the cost of coal to the consumer is so complicated that it needs radical readjustment by some other method than making the user pay more. The result of the strike and the agreement is disappointment that the strike of last year and the organization of the Federal Coal Commission have produced such meager results.

Six Examples

THE value of underground water-waste surveys is forcibly illustrated by the six examples of leaks thus detected at Detroit that fill a page of this issue. These six leaks alone were wasting water at the rate of 6.8 m.g.d., while other underground leaks found by the pitometer brought the total to nearly 10 m.g.d. Even more leakage of other sorts was located by the water-waste survey, bringing the total to a saving of 24 gal. per capita. If so much can be done where 98½ per cent of the taps are metered what would similar efforts do in some of our cities with practically no meters in use and no reliable knowledge of what leaks and other wastes are occurring daily?

An Engineer Wins a Prize

FOR some time we have been contending editorially what too few engineers seem to have taken seriously —that the engineer is the logical person for the solution of our greatest municipal problem, the growing congestion of traffic in our city streets. We are pleased to record one instance in confirmation of the contention. Some weeks ago some theatrical interests in New York City, concerned no doubt at the prospective loss of business from the difficulty of gaining access to their doors, offered substantial prizes for the best solutions of the traffic problem in the metropolis. A committee—on which there was no engineer—has just awarded the first prize of $1,000 to Arthur S. Tuttle, the chief engineer of the Board of Estimate of the city. The details of the award are given in the news pages of this issue. We congratulate Mr. Tuttle on having demonstrated to some of the people of New York, at least, that this is a subject on which an engineer's views are worth while.

Mobile Construction Equipment

MANUFACTURERS are making long strides in producing mobile construction equipment. The contractor is no longer satisfied by merely putting wheels under a machine or even by low-geared self-propulsion; he demands speed of travel and manoeuvering ability. Where he cannot get these practicably by self-propulsion he is calling in the motor truck and fast tractor and requiring his concrete mixers and other machines to be provided with running gear for fast hauling or so arranged that they can be speedily loaded and unloaded for truck or trailer transportation. The railways originated the demand for such equipment, the street railways followed with its development to a remarkable degree and now highway work and general contracting are becoming insistent in their demand. It is also the contractor doing many small jobs and not particularly the contractor for large operations who most wants highly mobile equipment. It enables him to use machines for many tasks for which, if much time were required to move machines, it would be necessary to use men. An equally important gain which is coming to be appreciated is that it enables the economy of large capacity equipment to be extended to small operations. For scattered jobs of yard paving and commercial garage floors, for example, time enough is saved by a 21-E paving mixer, if it can be shipped quickly, to increase materially the volume of work a contractor

can handle. This is not speculation. There are contractors who are successfully using these large machines for scattered small paving operations. Outfits are known where a 21-E paver is loaded onto a motor truck trailer in 15 minutes; at its destination it is unloaded and at work in another 15 minutes. The move from job to job is made at a speed of eight to ten miles an hour. These developments are making the large machine an economic factor in small job contracting which deserves further study. Similar opportunities exist in other fields than paving, such as water-works and sewer extensions and repairs, to name only two examples.

The Berlin Deferrization Plant

THE Berlin iron- and manganese-removal plant described in this issue is interesting both in itself and because it brings to engineers outside of Germany an account of how Berlin handled a problem of this sort just before the war. It appears that the Berlin capital, which for years had been removing iron from its water supply by aeration and slow sand filtration, fell into line with the strong trend of American practice some ten years ago and for the plant completed in 1914 substituted rapid or mechanical for slow sand filters. The impinging jet aerators, the prefilters and final filters, both in arrangement and details, have notable features. Both sets of filters are operated at high rates. The injector wash for the final filters, used only after the ordinary reverse-flow and compressed-air wash becomes inefficient, brings to mind the ejectors in the drifting sand filters at Toronto. The doubling of the iron content of the water at Berlin in six years is in general line with what must often be reckoned with in underground water supplies. Finally, the architectural attractiveness of the buildings that house the plant may be noted as a feature worthy of emulation in this country, although it is a pleasure to be able to say that a goodly number of American cities are not unmindful of the fact that good architecture is a municipal asset even in utilitarian buildings.

Roadbuilding a Market for Steel

RARELY is thought taken of the steel maker as a materials producer for road construction. Yet in 1921, according to the Bureau of Public Roads, 2.1 per cent of the money spent for federal-aid roads was spent for reinforcing steel for concrete pavement and structures. As about $112,325,000 were put into federal-aid roads in the year named, the cost of reinforcing steel was about $2,376,000 or some $318 per mile for the 7,480 miles constructed. In round figures about 10,000 miles of new road of the first class has come to be our annual production. When to the reinforcing steel for this mileage we add the steel for road signs and guard rails, for steel bridges and for the equipment employed in building roads there is had a rather impressive sum represented, by the products of the steel maker, in highway construction. This is a continuing market. The federal-aid program alone contemplates 187,000 miles of highway of which over 160,000 miles are still to be constructed and federal-aid road is not over half of the mileage of state trunk-line roads that have been planned for construction. Roadbuilding has become an important factor in the metal-working industries.

Dangerous Warning Signs

PROPER warning signs, we all know, prevent accidents and promote safety. But improper or unnecessary warnings are positively dangerous. Some highway warning signs are of this kind, and give daily evidence of a need for revising and establishing consistent practice in the system of posting danger spots on roads. The sign "Danger—Sharp Curve" posted at a moderate bend misleads more than it warns; repeated, it produces disregard of all curve warnings or, worse still, it brings on sudden disaster when the driver comes to a sharp curve which by chance has the warning sign omitted altogether. Similarly, the important safety warning "Narrow bridge" becomes a danger when used needlessly. So long as narrow bridges, sharp curves and dangerous crossings continue to exist on roads and high-speed transportation is demanded, warning signals will be increasingly important. The highway art is yet young in respect to thorough signaling, but the demands of the day nevertheless call for early and well-considered development of good practice.

Efficiency Rather Than Politics

AN ENGINEER, in the person of Col. Frederick Stuart Greene, has been appointed by the governor as head of New York State's Department of Public Works, which has just come into being in accordance with the provisions of the state reorganization act which took effect July 1. The post is an important one, both politically and technically. While it could readily be assumed by a politically minded official to be anything but an engineering position it involves the administration of such engineering works as highways, bridges, public buildings, waterways and canals. The very nature and scope of the department's activities necessitate the spending of large sums of money and the filling of a long list of jobs, so that from the point of view of party patronage the superintendent of public works of New York State is in the position of being able to dispense many favors. It is natural to suppose that great pressure must have been brought upon the governor to appoint as head of this new department a man who could be relied upon to "do the right thing" by the job-seekers of the party in power. Yet Governor Alfred E. Smith, himself the choice of Tammany Hall, has had both the wisdom and the courage to select his superintendent of public works on the basis of administrative and technical fitness for the job in hand rather than upon that of political expediency. Colonel Greene is an engineer of wide experience, a member of the American Society of Civil Engineers, a former New York State highway commissioner, and, during the war, the commanding officer of a combat engineer regiment in the 77th Division. Appointments of this sort go a long way toward raising public officials to a new plane of respect in the minds of the electorate. If more governors of states and mayors of cities would follow Governor Smith's example of appointing properly qualified engineers to managerial jobs, it is certain that the taxpayers would reap untold benefits in the form of better and less costly public works. Incidentally, the Governor of New York might well read the Secretary of the Interior a lesson on how politics may be eliminated in the conduct of public office, especially where engineering service is the main work which is to be administered by the department head.

Elementary Road Types Not Overlooked

ELEMENTARY road types—earth, gravel, macadam—astonish us often with their ability to carry traffic satisfactorily, even traffic of modern swiftness and volume, when scrupulous care has been given to detail in construction and when the maintenance is continuous and thorough. Such construction and maintenance were the requirements set forth as invariably necessary for good road service in the first textbooks on roadbuilding written when no other than the simpler types were contemplated for rural traffic; they also were the requirements usually realized in the roadwork of England and France and very seldom realized then in the roadwork of America. In coming back from his survey of roads in the Far East, with the same thought outstanding, Colonel Crosby does not offer us a new lesson in what he says on another page; he but repeats an old one in danger of being forgotten, he feels, in our present epoch of paved roads and of motor-bus and truck traffic.

This reminder is good for us. We accept it appreciatively from a veteran road builder knowing that he does not mean to be taken quite literally in calling quantity production our golden calf and "permanent roads" a will o' the wisp.

There is found, indeed, when we come to examine the facts, much less variance than might be anticipated between Colonel Crosby's implied thought and present American roadbuilding practice. "Permanent roads" have been emphasized in the talk of engineer and layman alike until it has seemed that paved road construction predominated in the improved road mileages of recent years instead of being only a small fraction of the total improved road and an almost infinitesimal fraction of the total road.

Of about 25,000 miles of road improved with federal aid 27 per cent are paved roads. All the remaining mileage is road of the elementary types, largely earth, gravel and macadam. Generally, too, federal aid goes only to the main trunk-line state roads. If improved roads of all classes were taken, it is shown by the few state highway censuses available, the ratio of paved roads to other improved roads would be still smaller.

There is scant evidence in either statistics or observation that the highway engineers of the United States are forgetful of the truth that for years to come it will be good economics to build more miles of roads of simple types than of concrete and asphalt and brick. Indeed if any alarm is to be felt it is because at the present moment some of the major roadbuilding states are showing an inclination to swing too strongly toward other than paved road construction. Less comfort is got from the situation when maintenance of the kind thought of by Colonel Crosby is given consideration. We have too little of it. Yet in some states maintenance is very good and every year it is getting better in more states.

Parallel conditions in roadbuilding do not prevail in the Orient and in America and Colonel Crosby never assumes that they do. His thought is merely that in America, due to carelessness in construction and, chiefly, to neglect of upkeep, we do not get the quality of traffic service from our roads of the elementary types which is being obtained in countries where road improvement procedure is comparatively primitive. He is correct. This carelessness in building and maintenance, however, is more a tradition of the past than a practice of the present. Our earth and gravel roads of today's construction are radically different structures from those of twenty years ago and they are being kept up in a way that they never were before.

It is quite worth while to stress these facts because it is getting to be too complacently assumed by too many that highway engineers are running wild in paved road construction to the neglect of the simpler types which must for a long time constitute the majority mileage of our rural highways. Consequently we are having such occurrences as the recent actions of the politician governors of Ohio and Michigan in usurping the technical direction of highway development. American highway engineers may not have sensed everywhere at all times the controlling problems of highway development, but it is certain that there is no group of men having a better grasp of all the factors that enter into the creation of a great highway transportation system. It is important that this truth should be spread before the people.

Laymen Water Bacteria Hunters

IN CALIFORNIA the State Board of Health is advocating the establishment of laboratories in small towns to check bacterial reduction due to chlorination or other water treatment, even where trained bacteriologists are not employed. More or less similar efforts have been made by the health departments of several other states. The equipment for a "minimum" laboratory under the California plan, as itemized in our issue of Sept. 6, p. 401, would cost about $135, which is certainly well within the financial capacity of any water-works plant, however small.

The serious question that arises is whether the ordinary operator can be trained by a state health department or otherwise to make even the simplest bacterial tests. Of minor moment but worth consideration is the effect upon trained operators, if they must compete with the relatively untrained operators in charge of these "minimum" laboratories. The argument is that the "minimum" laboratories are simple and are put in only where the employment of an experienced laboratory man is entirely outside the financial capacity of the town. Would it be better, where one town cannot afford the full time of a trained operator, for a state health department to urge that two or three or more communities within reasonable distance of each other combine in the employment of a trained man? In some states, at least, water testing could be combined with other laboratory work for health protection, either in county or other district laboratories.

In considering this matter account should be taken of the false sense of security which may be created in a community relying on the work of the tyro in making bacterial media, maintaining sterile apparatus and taking and plating samples.

At the same time, conditions may exist in some if not in most states where the choice in many communities is between state health board efforts to bring training to the layman filtration or chlorination plant operator on the one hand or on the other to leave the plants in question in the charge of men ignorant of what constitutes safe drinking water and even more ignorant of the simplest means of testing it. Broadly, the staff of a state board or department of health is better fitted than any outsiders to choose a plan best suited to conditions within its own borders.

Failure of Apishapa Earth Dam in Colorado—II

Two Independent Reports Written After Investigations and Interviews at Site Agree that Failure Was Due to Conditions in Body of Earth Fill

The first report attributes the failure to poor material badly placed and compacted, resulting in settlement, caverns and saturation, with final burst of water diagonally through the top portion of the dam. Conclusions of the second report absolve all concerned from carelessness or slighted work and attribute the failure to unequal settlement due to bottom subsidence and movement, without stating the primary cause. The second report points out some elements of weakness which the authors do not think had anything to do with the failure. Preliminary reports by the same authors appeared in Engineering News-Record, *Sept. 30, p. 357.*—EDITOR.

Sequence of Events and Their Causes

BY JOHN E. FIELD
Consulting and Supervising Engineer, Denver, Colo.

AT ABOUT 3 p.m. on Aug. 22, a flood occurred in the Arkansas Valley of Colorado which constitutes, next to the great flood in the same valley in 1921, the greatest disaster that has befallen any agricultural community in the state. Considering the many irrigation works, their value, and the long period from 1860 to date that irrigation has been practiced, the comparative immunity from serious losses through failure of the irrigation works is remarkable. At the hour

Photograph from Barton H. Jones and O. N. Floyd

FIG. 1—GAP IN APISHAPA EARTH DAM CAUSED BY FAILURE ON AUG. 22

Looking north downstream. Each end of dam, with concrete cutoff walls built into abutting canyon sides, left standing; no damage done to the outlet tower at left or west end of dam.

stated, the large earth dam on Apishapa Creek, some forty miles southeast of the town of Pueblo, failed.

At the time, the reservoir was practically full, the water being 1.1 ft. below the spillway level and about 10 ft. below the crest of the dam. The reservoir has an area of 640 acres and contained 18,500 acre-ft. of water. Briefly, the dam was 115 ft. high above river bed, 586 ft. long at crest, with 2 to 1 slopes on the lower and 3 to 1 on the upper side, and was located in a box canyon. The spillway was about one mile east from the dam.

Dwarf Cutoff Wall—Steel sheetpiling had been driven into the foundation to bedrock, surmounted by timber sheetpiling to the approximate level of the original ground forming the floor of the canyon. This sheetpiling terminated in concrete cutoff or baffle walls at each side of the canyon, which baffles extended up the sides to the crest of the dam. These portions of the structure have, so far as ascertainable, remained intact, as have also the outlet works, tower and tunnel.

The volume of fill in the dam is given as around 315,000 cu.yd., practically all of which was washed away. The water face was in part protected by rock riprap, which, however, did not reach to high-water level but remained uncompleted for some 20 ft. vertically below high water.

The reader is referred to the issue of *Engineering News-Record*, June 16, 1921, p. 1030, for a more detailed description of the dam and to p. 357 of the Aug. 30, 1923, issue for a cross-section of the dam and preliminary reports on its failure.

The material forming the lower layers of the dam, constituting, according to report, about half the total yardage, was taken from the bed of the reservoir above the dam and about one-fourth mile distant. The upper portion was of material taken from the mesa east of the canyon, also about one-fourth mile away. The plans called for selected material in the upstream four-fifths of the dam, but there appeared to be little difference between that portion and the downstream fifth. An examination of the plans shows that they were well conceived and that the work on the foundation, cutoff walls, etc., was excellent.

The material is fine sand with some cementing material. When wet it becomes very soft, though when shaken up with water in a vessel it settles to comparative clearness in a few minutes. When dried it becomes very hard and forms into lumps which are hard to break with the hand and into which an oak survey stake is driven with difficulty. To those familiar with western soils the description would be a light sandy soil with alkali.

Test of Soil from Dam—A sample treated with water for two hours resulted in a loss by weight of nearly 6 per cent. When treated with weak (5 per cent) hydrochloric acid, there was a strong effervescence, carbonate of lime and magnesium probably being the principal solubles in this case. The portion treated first with water and then with the acid showed a loss of 4 per cent in the acid treatment, and a combined loss of 10 per cent. The sample used was from the lower slope from a hole or cave-in which will be mentioned later. The sample is fairly typical of that taken from the borrow pits on the mesa.

In 1921 the maximum storage in the reservoir at any one time was 9,770 acre-ft., or a gage height of 65; the zero point being the lip of the inlet-well to the tunnel, or El. 4840 on the drawings. In the winter of

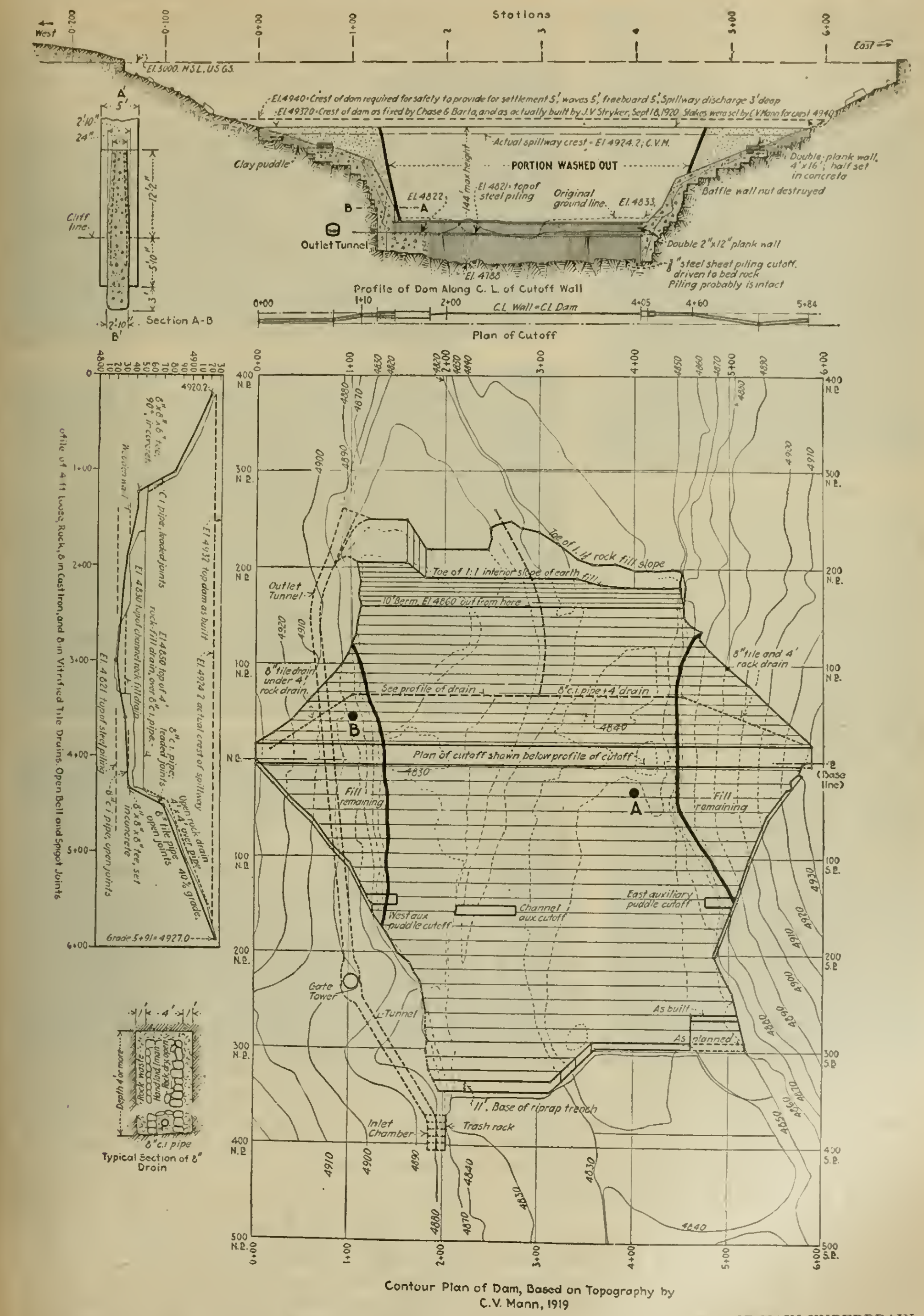


FIG. 2—PLAN OF APISHAPA DAM, WITH PROFILES ALONG CUTOFF WALL AND ALONG THE MAIN UNDERDRAIN

1921-22, 5,000 acre-ft. of water was carried over. This was used in 1922. The reservoir was dry during the winter of 1922-23.

Storage in the reservoir began in the spring and reached a gage height of 66, when some water was withdrawn; it was again allowed to rise, this time to a gage height of 76, where it stood until Tuesday, Aug. 20, when it began to rise still more. The valves were at full opening for sixteen hours prior to the break, discharging at an estimated rate of 2,500 sec.-ft. The rains and cloudburst caused the water to rise and fall somewhat until the 23rd, when an unusual rain caused such a rise in the Apishapa that the water rose in the reservoir to gage 83.1 ft. at 3 p.m., Aug. 23. The spillway level is about gage 84.2 (El. 4424.2), though there is a small channel a fraction of a foot lower.

The Failure—There were at the dam during the week of the failure about thirty men, including Mr. Knowlton, an engineer-contractor and a landowner in the project, and Mr. Dallimore, the engineer of the system. These men were being employed in miscellaneous work but particularly in repairing a small leak near the west end of the dam and in filling in some settlement areas and cracks near the point marked *B* on the plan shown herewith.

At 2:45 p.m., the repairs on the leak were about completed and the leak at this point was stopped. Mr. Knowlton had walked across the dam at about 1 o'clock, carefully observing the dam crest, and down to the water edge to see if any additional cracks had started or any settling or subsidence. None were observed by him, and except where the repairs had been made there was no apparent danger.

At 2:45 Mr. Dallimore made a trip of inspection and observed a settlement at the water edge at a point about 100 ft. west of the east end of the dam (Point A of the plan). Water was running into the settled area and apparently passing downward into the body of the dam. He called for his workmen, who started to try to stop the break.

At the same time or a few minutes after the break was first observed, water began to appear on the lower slope some 500 ft. west and 30 ft. below the crest. This point [*B* on plan] was about 60 ft. east of the point where repairs had been in progress. Almost immediately after the leak on the lower side was observed, wet spots appeared on the lower slope, first a short distance east of the break on the lower slope, and then in rapid succession wet spots appeared further to the east, each a little higher in the slope than the last. The flowing water rapidly ate back on the fill diagonally up the lower face of the dam and finally to a point immediately opposite the first observed break in the water side. Desperate efforts to choke the break were made by the workmen; among other things a galvanized steel tank 6 ft. in diameter and 20 ft. long was rolled into the hole. It held but an instant and passed through the hole. It is apparent the dam was doomed from the moment water began to flow in the lower side.

Cavities in Top of Dam Before Failure—An examination of the hole where the repairs were being made showed it to have been a cavity shaped like a beehive, the material near the surface being arched over. No distinct line of saturation was observable on the two ends of the dam as they were left after the break. The material was very dry. The laminations of the fill were distinct and approximately horizontal. Whether the material in the base of the dam was different from that above was not observable, as the portions remaining were above the edge of the cliff walls and less than one-half of the height of the dam. The wet area on the section of the dam remaining appeared from about gage 65 on the water face and sloped downward at an angle of about 30 deg. to the cutoff wall. Below the center line none of the material seemed to be wet from causes other than from the out-rushing water at the time of the break. On the westerly end in particular no line of saturation was observable, leading to the conclusion that the cavities did not have water in them for any considerable length of time, and if they filled it was during the period when the water rose from gage height 76 to 83.

The cavities apparently extended from near point *A* some distance within the dam from the upper slope diagonally across the center line to a point nearly 400 ft. westerly, where the water broke through the lower slope. The cavities were doubtless connected by a longitudinal crack as the break on the upper face was followed within a few minutes by the appearance of flowing water on the lower face.

At the A. T. & S. F. railroad bridge the discharge of the Apishapa was about 60,000 sec.-ft., from 10:45 p.m. to 1 a.m., and the river was again within its channel at 9 a.m., Aug. 24.

The principal damage below the reservoir was to headgates and dams in the Arkansas River, though even at the Catlin dam, which is just below the mouth of the Apishapa, the water did not reach the 1921 flood height by 3 ft., and at La Junta was reported as not within 15 ft. of the 1921 flood height. The headgates of the Holbrook and Fort Lyons storage intake canals were destroyed. There were many minor cases of damage, such as to the railroad bridge and embankment, the state highway and bridge, the west half of which, an old pile structure, was entirely destroyed by the flood.

Cause of Failure—The results of the observations of the writer lead him to conclude that the material was unsuitable for an earth fill, especially for the upper face; that sufficient water in puddling and rolling was not used, and that the thickness of the layers of the fill [previously reported as 12 in.] was too great. These things resulted in a considerable settlement in the dam not observable on the surface, and a cavernous condition at about 30 ft. below the crest. When the water rose in the reservoir above gage 76, the caverns filled and the adjacent earth became saturated with water, and when the water rose to gage 83 the hydrostatic pressure on the outside of the upper slope and inside of the lower slope was too great to be held by the shell arching the caverns or forming the walls of the crack and faulting planes.

Where a dam in whole or in part remains dry and untouched by water for even a year in the dry air of the arid west, sudden filling of the reservoir is dangerous. Within the experience of the writer several dams have failed at or within a few hours of the first filling, after there had been ample time for the dam to dry out in its upper and thinner section. In two of the cases a considerable percentage of solubles was in the fill mate-

Photographs from Messrs. Jones and Floyd

FIGS. 3 TO 7—EAST AND WEST ENDS OF STANDING PORTIONS OF APISHAPA EARTH DAM AND CUTOFF WALLS

3. Bluff and remaining portion of each end of dam, showing layers as placed, each about 1 ft. thick.
4. Close-up of material in upper portion of east end showing rolled layers more clearly than does (3).
5. Remaining portion of west end. Note large wet spots along bluff. In left foreground may be seen some of lower part of upstream portion of dam left in place after the failure.
6. Close-up view of west end looking downstream.
7. Near view of earth fill and cutoff wall at west end.

rial. Particulars [sent by wire at our request—EDITOR] follow:

Lyman Dam, Arizona, failed the day after the first filling on account of poor material and construction in the closure section. Solubles were present in this material.

Terrace Dam almost failed. Its upper part was wagon fill. This dried, settled and cracked, permitting water to reach sand layers below, placed by hydraulic sluicing.

Antlers Dam failed in 1899 after a hole had formed similar to the one in the Apishapa dam. The Antlers Dam had been raised and failed shortly after first filling.

Jumbo and Horse Creek dams failed by piping [?] on shallow bedrock before they had been in full use more than a year.

Dry Creek Dam, 15 ft. high, failed at the first filling. It had gone through one summer empty.

Unequal settlement due to varying heights, especially where there are abrupt changes in profile, cause shearing planes. These remain open while the fill is dry but when the water rises suddenly it flows along the shearing planes.

Every earth dam should be regularly inspected by competent observers, and the inspection should not be left to the watchman or to any one other than the engineering force.

* * *

Further Report on Apishapa Dam Failure

By Barton M. Jones and O. N. Floyd

Engineers with the Dayton Morgan Engineering Co., Pueblo, Colo.

A BRIEF account of the failure of this dam was given by the authors of this article in *Engineering News-Record*, Aug. 30, 1923, p. 357, to which the reader is referred for details not here repeated. The type of failure is unusual and its exact cause is somewhat puzzling. It is evident that more than ordinary care was exercised to obtain a good job, yet the dam failed suddenly and almost without warning with the water 10.5 ft. below the top, where it was being held by the discharge through the outlet tunnel.

The construction of the Apishapa dam is described in *Engineering News-Record* for June 16, 1921, p. 1030,

FIG. 8—HOLE IN DOWNSTREAM FACE OF APISHAPA DAM

Caused by leak through horizontal seams in sandstone of west canyon wall. The text indicates that this had nothing to do with the failure of the dam.

by Clair V. Mann, resident engineer. The dam is described as having been constructed to a height of 112.2 ft. A cross-section (reproduced in *Engineering News-Record*, Aug. 30, 1923, p. 357) shows that originally a height of 120 ft. was intended. Lack of funds prevented the completion to this height. The riprap was likewise carried up 60 ft. in elevation above the toe instead of to the top. The cross-section also indicates that the downstream one-fifth of the dam was made of coarse material. There remains at the east end of the dam an exposed cross-section about 45 ft. high and at the west end a section probably 60 ft. high, and there is no visible evidence that the material in the downstream fifth is any different from that in the other portions of the dam at the same elevation. From our observations at the site and information obtained from those familiar with the work it appears that in all other respects the dam was constructed substantially as shown on the cross-section mentioned.

Leaks—At different times in the past when the water in the basin reached within about 35 ft. of the top of the dam small leaks occurred through the rock underneath each end of the dam. Because of a recurrence of these leaks and the rapid rate at which the basin was rising as a result of heavy rains at the Apishapa headwaters, A. N. Dallimore, chief engineer, and H. H. Knowlton, secretary-treasurer of the Apishapa Consolidated Irrigation Co., owners of the structure, were at the dam for some time before the failure with a force of about 40 men and some teams. Messrs. Dallimore and Knowlton are both graduate engineers and have been connected with the project since construction started—Mr. Dallimore in charge of the outlet structures and concrete and Mr. Knowlton in his present capacity. We are indebted to these men as eye-witnesses for a description of the failure and for information concerning the construction of the dam.

The small leaks had all been stopped or reduced to a harmless flow when the big leak that destroyed the dam started. There seems to be no question but that an open crack had formed diagonally through the dam from the upstream slope at the east end to the downstream slope near the west end. It hardly seems possible that such a crack could have been formed unless a large portion of one of the toes had settled or moved.

Composition of Original Material—The bottom 60 ft of the dam was built of sandy adobe material taken from the river valley while the top 50 ft. was built of a light brown finely powdered material containing sand and gravel from high ground east of the dam.

There were probably 5,000 or 6,000 cu.yd. of the lower material left in the upstream portion of the dam at the east end, but practically none was left in the downstream portion, although a number of large masses of it had been washed down the valley [i. e., en masse (?) Editor]. Wherever this material was found it appeared to be damp throughout and resembled very much the outer edges of the core of a hydraulic-fill dam when exposed by a washout from the core pool.

Extent of Saturation—The light brown material in the upper part of the dam was very dry, so dry that whenever a small portion of it would scale off the nearly vertical exposed face and slide down to the river below a noticeable cloud of dust would rise. Each rolled layer was plainly visible. The top 2 or 3 in. of each layer was very hard, somewhat resembling soft shale. The rest of the layer, while fairly compact, could readily be dug out with a stick. At one place a quantity of this material had caved and fallen on a dry ledge of rock. It resembled road dust except for the small amount of gravel and slabs of the hard layers. In walking over this dry material, pulverized by the fall, one's feet would sink into it 6 to 8 in. This material apparently gave a very impervious fill. On the upstream slope of each exposed cross-section the line to which the water had penetrated could be followed for a distance down of 20 to 25 ft. in elevation from the water surface. At the lower depth the water had gone into the fill only 5 or 6 ft. Aside from some wet spots where leaks occurred from seams in the canyon walls this upper part of the dam appeared to have remained remarkably dry.

It seems likely that the material in the bottom 60 ft. of the dam became saturated or at least damp throughout and settled more or less, causing a slight movement in the downstream toe.

Cracks and Settlement—We were told that about a year ago a crack developed in the upstream face near the top of the west end and extended for some distance diagonally across the crest toward the east downstream slope. This crack was above the water in the basin at

the time. It was filled and puddled and gave no further trouble. It may be noted that this crack was symmetrically located, but crosswise to the crack that resulted in the failure.

The nature of the material in the top 50 ft. of the dam is such that cracks would be expected to develop in case of any appreciable uneven settlement. There may have been some tendency for this hard dry material to arch the 300-ft. rock canyon and crack, for certainly the rock shoulders of each bluff would prevent it from readily adjusting itself to settlement of the material below. The material in the bottom 60-ft. portion was quite probably somewhat susceptible to saturation and consequent settlement and spreading. The water could all have entered it through the upper slope, but on account of the drainage system in the downstream slope and the high tailwater in the valley below, resulting from the heavy outlet discharge, some water may have entered directly into the downstream portion.

Underdrainage—The drainage system for the lower toe is shown in the cross-section already mentioned. We were told that these drains had shown some flow of clear water after the basin began to fill and that this flow increased slightly with the increased head. Before the failure, for several hours, these drains had been covered with backwater from the outlet tunnel, but before they were covered the discharge was clear and was estimated to be about 1 sec-ft. There was nothing to indicate that the flow underneath the dam contributed in any way to the failure.

Leakage Through Seams in Canyon Walls Not Cause of Failure—The dam contained a dangerous element of weakness. It caused trouble to develop, but this damage was repaired. It is fairly certain that the failure was independent of this weakness, although the symptoms were such as might lead to a failure. Water reached the portion of the fill downstream from the concrete cutoff wall through horizontal seams in the sandstone formation of the canyon walls. This was clearly seen in the saturated appearance of large spots in the face of the fill that remained at the west end of the dam. These spots were at the same elevation as the visible seams in the rock. Small leaks in the fill, no doubt from this cause, had been plugged and considered safely repaired prior to the failure. This was observed at both ends of the dam, in the portions remaining that were not affected by the failure.

Effect on Steel Cutoff Wall—The narrow canyon just below the dam was filled to a depth of about 25 ft. with material from the dam. This filling tapered out until it was hardly noticeable at a point 1,200 to 1,500 ft. below the dam. A small rim of the upstream toe covered with the riprap to an elevation of 25 to 30 ft. above the original creek bed was not washed out and its straight lines show that it had not moved. It is likely that the scour in the base of the dam reached bedrock during the heavy discharge and that this hole had been filled with material carried by the later smaller flow.

A steel sheet piling cutoff about 300 ft. long joined the concrete cutoff walls at each bluff. The piles were reported to be from 25 to 33 ft. long and their tops were at about the elevation of the old river bed. A thousand feet or so below the dam we found a portion of these piles. Although they were badly bent and twisted they were hanging together. Thirty piles were exposed but others probably were under the earth that had been washed downstream. Those we saw were Carnegie sheet piling, 38 lb. per ft. It is possible that the entire steel cutoff was torn out. The concrete cutoff walls remain intact.

It was interesting to see the amount of silt that had been deposited in the basin above the dam. Although the dam was only finished in September, 1920, the old creek channel was entirely silted up and on the valley floor there was a deposit from 6 to 8 ft. deep.

Gage Height and Flood Down the Valley—The fight to save the dam was abandoned at 3:00 p.m. The gage was read at 3:45 and at each 15-minute interval until 4:45 when the water in the basin was below the gage. The accompanying table shows the readings and the discharges which they represent.

Time P.M.	Gage, Ft.	Total Fall, Ft.	Storage, Acre-Ft.	Discharge, Acre-Ft.	Average Rate of Discharge, Sec.-Ft.
3:00	82.9	..	18,500	....	....
3:45	81 0	1 9	17,400	1,100	18,000
4:00	79 8	3 1	16,000	1,400	68,000
4:15	70 0	12 9	11,700	4,300	208,000
4:30	55 0	27.9	6,700	5,000	242,000
4:35	51 0	31 9	5,600	1,100	160,000
4:45	42.0 *	40.9	3,600	2,000	145,000

* Bottom of gage.

The basin was seven miles long and rather narrow so that the slope of the water surface must have been considerable during the last few readings. This would indicate an exaggerated drop in gage and storage and consequently the later rates of discharge would be somewhat too high.

The flood water reached a point down the valley eleven miles below the dam at 5.20 p.m., according to one man and 5.30 according to another one near by. At this time there was quite a large flow still passing the dam site and the total length of the moving body of water must have been fifteen to eighteen miles. As the deepest water was near the lower end it would tend to get longer rather than shorter. This, together with the valley shortage, seems to account for the small depth of the flood wave and its low rate of travel. However, in determining the rate of the flood wave it would probably be more accurate to count from 4 rather than from 3 o'clock as the flow prior to 4 o'clock was comparatively small. This seems to be borne out by the fact that the flood wave reached the railroad bridge at the mouth of the river near Fowler 35 miles below the dam at 8 o'clock or traveled the last 24 miles in 2½ hours or at the rate of about ten miles per hour.

At this railroad bridge the valley is more than a mile wide while the bridge opening is probably not over 350 ft. long. The railroad embankment across the valley is from 10 to 15 ft. high and it formed a retarding basin which reduced the maximum flow that entered the Arkansas to 50,000 sec.-ft. or less. The flood wave down the Arkansas River was slow and more or less harmless. It reached Las Animas about fifty miles below the mouth of the Apishapa River at 11 o'clock the next morning and produced a rise of only 5 or 6 ft., while the maximum rise there occurred about two hours later.

Drainage Downstream—No loss of life was reported. One set of farm buildings was flooded 8 to 10 ft. deep and damaged considerably but not destroyed. These buildings were 11 miles below the dam and the farmer had been warned in time to get his family out about twenty minutes before the water arrived.

The two diversion dams of the project were not seriously damaged but the canal banks were overtopped

and broken at a few places. A few highway bridge approaches were washed out. The flood washed around the diverting dam of the Ft. Lyon canal about three miles west of La Junta and around the headgate of the Holbrook canal on the north side of the Arkansas, eight miles west of Rocky Ford.

Conclusion—It is apparent that this failure was not the result of carelessness or slighted work. It was not related to outlet or spillway structures inasmuch as these were separated from the dam and were not affected. We suspect that more water could have been used to advantage in rolling the material that came from the high ground, although we found no reason to consider this defect as a factor in the failure.

Our principal criticism of the dam as a whole is that the narrow rock canyon is not a desirable site for an earth dam. This criticism might be modified in case of a hydraulic-fill dam on account of its almost total freedom from settlement, but even then there would remain the uncertainty of maintaining a water-tight joint between the earth fill and the rock walls.

The failure was in the body of the dam, through a diagonal crack believed to be the result of unequal settlement brought about by subsidence and movement in the bottom portion of the dam. Eye-witnesses say they saw the water flow longitudinally through the dam in the diagonal crack and that neither extremity reached an abutment. This fact would eliminate theories that the failure originated from trouble at either canyon wall.

Engine Terminal Design, Capacity and Equipment

Track Layout and Enginehouse Leads—Rectangular and Circular Enginehouses—Turntable Capacity—Coaling Plants

Abstract of report of Committee on Design of Shops and Engine Terminals, presented at the annual meeting of the Mechanical Section of the American Railway Association.

Terminal Design—Engine terminals must be laid out so that one operation will not interfere with another. This requirement cannot be overemphasized. Few operations can be conducted efficiently for any length of time if the facilities are strained to the limit. To this end each facility should be designed to perform double the work ordinarily required and at important terminals duplicate facilities should be provided.

A single-track lead to an enginehouse is inexcusable. With three or more tracks available a majority should be assigned to incoming engines. Sufficient leads, switches and crossovers must be provided to avoid delays at coaling station, ash pit, inspection pit or other facility. As a general rule a number of short leads are preferable to a single long lead, as the former arrangement enables one engine to move independently of others. Where the number of leads is restricted, frequent crossover switches should be provided to prevent blocking any locomotive. The lead track to turntable should line up with corresponding tracks in enginehouse for convenience in placing dead engines.

Enginehouse Design — Modern enginehouses are divided into three classes: (1) brick wall with wood frame and roof; (2) reinforced-concrete frame and roof; (3) a combination of steel frame and reinforced concrete. The first is cheapest and most generally used, but the trend has been toward reinforced concrete. Enginehouses should be of fireproof construction as far as possible. Provision should be made for doubling the capacity needed, but it is first necessary to determine the class and extent of repairs to be made.

It is desirable to locate the house some distance from a city in order to get cheaper land, but it must not be too far away from an adequate labor market. The number of stalls to be provided is a function of the engines to be handled and the expected detention. If 100 engines are to be cared for and each may occupy a pit twelve hours, then fifty pits will be needed. If the average detention is only eight hours a day then thirty-four stalls will be ample. Quality of water (as affecting boilers) and amount of local switching may also exert considerable influence upon the number of stalls necessary.

Enginehouses are made in various cross-sections to suit local conditions, facilities, funds and tastes. Columns may be omitted in the drop pit section and trusses substituted. This provides a clear passage for moving wheels from the pits to the rear of the house. The outer row of columns should be made strong enough to support jib cranes, which may then be installed at any time desired. The modern house for a large terminal may have an overhead crane, down-draft ventilation system, boiler-washing plant, drop pits for driving, engine truck and tender wheels, jib cranes at frequent intervals and many other facilities. Practically all of the later enginehouses have increased head room to improve ventilation and lighting. The continuous monitor type of house, single or double, is now being more generally adopted. On several large roads the depth of the house has increased to 132 ft. The rear wall or outer circle wall should be practically all windows, with window sills about 4 ft. from the floor.

A rectangular enginehouse may fit the shape of the property better than a roundhouse. For large stations a transfer table may be located between two transverse rectangular enginehouses and some rectangular layouts will require both a transfer table and a turntable. In a rectangular house a transverse track arrangement is preferable to a longitudinal arrangement. The rectangular house, owing to its parallel spacing of pits, is easier and cheaper to build than a roundhouse. One particular advantage of the rectangular house with a wye track is the saving in space permitted inside the building on account of the parallel track arrangement. Leads and wye tracks cost less to maintain than turntables.

Turntables—Turntables are generally 100 to 110 ft. long, and 120-ft. length is being used for large engines. All turntables should be equipped with suitable tractor or tractors. One turntable is ordinarily sufficient for a 50-stall enginehouse. Such a house would provide for despatching 100 engines per day if each engine was detained in the house an average of twelve hours a day. This would mean 200 moves of the table daily, if each despatchment required two moves, one in and one out, and if all engines were despatched. In other words, the table must turn once every 7.2 minutes. If a peak load period occurs in which 25 per cent of the movements are made in four hours, this would require the table to turn once in every 4.8 min., which is about as fast as dependable operation will justify. Another consideration is the delay on account of failure of power or table, which in some cases may justify more than one table for an enginehouse with less than fifty stalls.

The size of the turntable has a considerable bearing upon the number of stalls in the house, and longer tables permit more track approaches without having frogs in the track at edge of table. Generally, the longer the table the less waste floor space at outer circle of house, owing to reducing the angle of stalls. The turntable should be long enough to balance the engine when tender is empty. A deck turntable is preferable to a through type with shallow pit, when the cost of construction is not greater and when drainage will permit.

Coaling Stations—The type selected usually depends upon the number of engines handled, the number of tracks available for coaling engines and the kind of coal used. Station capacity should be at least a 24-hour supply and better 48-hour for maximum demand. The coal storage bins should be made self-cleaning as far as possible by proper sloping of floors. Gravity tipple outlet fixtures may be of the under-cut or over-cut type, but the over-cut fixture seems to provide more even mixing of coal delivered.

Mechanical coaling stations should be of the transverse type and a station serving several tracks is preferable to the longitudinal type because it facilitates engine movement to and from the station. When it is necessary to deliver coal to two or more tracks it is best to install a mechanical type of station. Loaded coal car tracks should have a down grade toward the track hopper to permit easy feeding of cars. The receiving hopper must be long and wide enough to handle a complete car and provide sufficient room for unloading and handling coal. The hopper should be protected from the weather. It is not good practice to have a steel coal chute too close to the ashpits, on account of fumes from wet ashes corroding the steel. A good many modern mechanical stations are built of concrete and have bucket conveyors. Under certain conditions a belt conveyor has been found satisfactory and economical. A coal measuring or weighing device is recommended for all coaling stations.

A longitudinal coaling station designed recently has the coal dumped into a pit below the ground level and a traveling crane with grab bucket lifts the coal to gravity chutes which deliver direct to tenders. This type of coaling station has a number of new features which may prove superior to other types in operation or economy.

Movement of B. Coli in Ground-Water and Pollution of Wells

Abstract of part of the 1922-23 annual report of the Board on Excreta Disposal, presented to the Conference of State Health Officers May 17, 1923, by C. W. Stiles, Professor of Zoölogy, Hygienic Laboratory, and Harry R. Crohurst, Sanitary Engineer, U. S. Public Health Service; slightly condensed here from the Public Health Reports, June 15, 1923.

IN CONNECTION with investigations by the United States Public Health Service into methods of disposal of privy wastes in rural districts, extensive and rigorously controlled experiments have been made which bear upon the movement of fecal bacteria in the ground-water. These studies have involved the experimental pollution of the ground-water (namely, the water in the saturated zone, which supplies wells and springs) and have been correlated with the rise and fall of the ground-water table, the flow of ground-water, and the rainfall. Natural can material (human excreta from can-type privies) was used as pollution material. B. coli was taken as the bacterial test, and a dye (uranin) was utilized in tracing the movement of the water from the dosing trenches to the more than 400 experimental pipe wells which were arranged at intervals from the trenches and at various depths into ground-water.

The examination of thousands of water samples from the wells during a period of more than a year has resulted in the following data regarding the movement of bacteria in sand:

1. Pollution with fecal B. coli has up to date been definitely and progressively followed in the ground-water for distances of 3, 6, 10, 15, 25, 35, 45, 50, 55, 60, and 65 ft. from the trench in which the pollution was placed; uranin has been recovered from these same wells and has spread to other wells at 70, 75, 80, 85, 90, 95, 100, 110, and 115 ft. from the pollution trench. The soil in question is a fine sand with an effective size of 0.13 millimeters.

2. The pollution has traveled these distances within a period of 187 days, or about 27 weeks, and only in the direction of the flow of the ground-water; no convincing evidence is present that the pollution has traveled against the flow of the ground-water or at right angles to it.

3. The pollution has traveled only in a thin sheet at the surface of the zone of saturation; there is no evidence at present that it has dispersed radially downward, and even when heavy pollution is recovered at the top, water from lower levels (in near-by deeper wells) is negative both for uranin and for B. coli.

4. As the ground-water level falls, owing to dry weather, the pollution tends to remain in the sand above the new (lower) ground-water level, namely, in the new capillary fringe.

5. There is no evidence which would justify a conclusion at present that either the bacteria or the uranin is carried or moves to any appreciable distance in the capillary fringe itself, and there is neither theoretical reason nor experimental evidence to justify a conclusion that either the bacteria or the uranin progresses in the dry, aerated intermediate belt (between the capillary fringe and the upper soil belt). All present evidence is to the effect that when the ground-water level falls the pollution remains practically stranded in the capillary fringe or in the intermediate belt—according to the degree of fall of the ground-water.

6. A rainfall of 1 in. results in a rise of 5 to 6 in. in the ground-water table (in the particular experimental area in question); and if this rise is sufficient to re-establish the zone of saturation up at the level of the stranded pollution, the bacteria and the uranin are again picked up and carried along farther in the direction of the ground-water flow until dry weather again intervenes to cause another fall of the ground-water level.

7. Thus the progressive (passive) movement and the stasis (stranding) of the pollution are intimately connected with, are dependent upon, and alternate with the rise and the fall of the ground-water level, and this latter factor is dependent upon the alternation of wet weather (rainfall) and dry weather (lack of rain at the intake area of the ground-water table). Experiments are now under way to determine, if possible, whether pollution placed directly into a deeper level of the ground-water will travel up to the surface of the saturated zone.

8. In explaining these results, capillarity, filtration, and gravity seem to come up for special consideration.

9. In one experiment the pollution traveled only 45 ft. from September, 1922, to May, 1923, and remained stranded at this distance. Study of the formation of the ground revealed that under the belt of pollution there is an impervious or nearly impervious stratum of peatlike material, which gradually tilts upward distally from the pollution pit and forms a ground-water dam; the pollution traveled out on high ground-water to the dam, the ground-water level fell below the crest of the dam, and the pollution is now stranded, pending a rise of the ground-water table sufficient to produce a ground-water cascade which will carry the pollution over the crest of the dam.

10. The ultimate distance to which the pollution will be carried is dependent upon a number of complex and interlocking factors, namely, wet and dry weather, with resulting rise and fall of the ground-water; the length of each of these periods; the rate of the ground-water flow (depending upon the "head," which, in turn, is dependent upon the rainfall); and, obviously, also the factor of the viability of the organisms under conditions of moisture, pH, food supply, etc., *ad finem.*

11. In another series of experiments human feces were buried in pits, in a locality of high ground-water, and covered with sawdust. Of five samples taken three years and two months after burial all were both macroscopically and microscopically recognizable as feces, but the odor had become somewhat musty; three of these samples were positive and two were negative for B. coli; ova of *Ascaris lumbricoides* were recognizable in all five samples, but all 57 ova found were dead.

12. The bearing of the foregoing results upon the intermittent pollution of wells, the location of water supplies, and the location of camps in peace or in war will be evident to persons who are called upon for technical advice in these matters; the justification of the laws forbidding the use of abandoned wells for the disposal of excreta is self-evident; the possible effect of the custom (in some localities) of digging pits into ground-water (as advised by some persons) is obvious.

13. In protecting wells, special attention should be given not only to surface protection, as is now generally recognized, but also to a new element, namely, the danger zone which exists from the highest water level to about a foot below the lowest water level. A leak in the pipe in this region is potentially very dangerous, and all wells unprotected in this danger zone are to be considered as potentially unsafe.

Deferrizing Additional Water Supply of Berlin

Aeration Followed by Rapid Passage Through Gravel Beds and Sand Filters Removes High Iron Content of Ground Water of Additional Supply for German Capital

By Gordon M. Fair
Instructor in Sanitary Engineering, Harvard University, Cambridge, Mass.

DEFERRIZATION is one of the most important problems of water supply in the glaciated areas of middle Europe. German engineers have solved it in a variety of ways, among which the methods used for the purification of the additional water supply of Berlin present numerous departures from common European practice. The extension of the water-supply system of the German capital was completed just prior to the outbreak of the Great War. As a result, it is little known and has since completion not even been de-

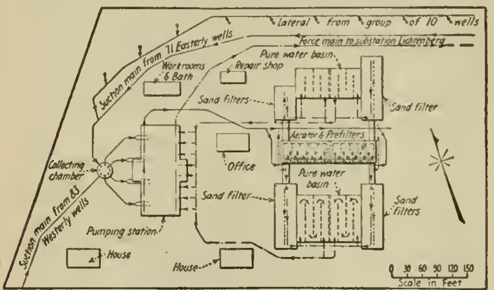


FIG. 1—GENERAL PLAN OF PUMPING STATION AND DEFERRIZING PLANT OF BERLIN WATER-WORKS

scribed in the German technical journals. The present description of the plant is based upon observations made by the writer when he visited the works, supplemented by information just received from one of the plant engineers, who furnished the writer with the illustrations.

Sources of supply—The central city of Berlin, with a population of about 1,500,000, obtains its water supply from three sources, all of which require treatment for iron removal. The oldest collecting and purification works still in operation were built in 1877. This plant, situated on Lake Tegel about seven miles from the heart of Berlin, has a capacity of 17.5 to 23 m.g.d., the maximum demand occurring during the summer months. The supply is obtained from wells driven along the lake shore. The iron bearing water (1.2 to 3.4 mg. Fe per liter) is aerated prior to slow sand filtration. In 1893 a second plant, with a capacity of 64 m.g.d., was put into operation on Lake Müggel about eleven miles from the city. It derives its supply from three different sources. The bulk of the water is obtained from driven wells intercepting the underflow towards the lake. This water, containing 1.1 to 2.9 mg. Fe per liter, is purified by aeration and slow sand filtration. From 10 to 20 per cent of the supply is drawn from Lake Müggel itself and purified by slow sand filtration alone. About 5 m.g.d. are pumped from the lake on to large sandy areas whence the water percolates into the ground to increase the well water. In 1910 the rapid growth of Berlin necessitated the construction of a third plant, which was completed in July, 1914.

The new plant is situated about seven miles east of Berlin in a forested area about three square miles in extent, known as the "Wuhlheide." The region is traversed by the sandy bed of an ancient glacial stream whose modern progeny is the much smaller river Spree. The bank of the ancient river bed, rising 150 ft. above the plane, forms the catchment area of the ground water flowing towards the Spree. The water is intercepted by means of 154 wells that parallel the river and yield from 6 to 17 m.g.d. The highest demand is made upon the plant during the four summer months, when it delivers 17.2 m.g.d. to the city; the lowest demand occurs during the three winter months, when the pumpage sinks to 5.7 m.g.d. During the five spring and fall months, 11.5 m.g.d. of water are used. The water contains relatively large amounts of iron which is removed by aeration and double filtration. The pumping station and purification works are situated in the center of the well field. A general plan of the plant is shown by Fig. 1.

The Wells—The wells are driven at intervals of 80 to 160 ft. to a depth varying usually from 115 to 200 ft. The extreme westerly wells, in the driving of which heavy strata of clay were encountered, penetrate to a depth of 325 ft. A main conduit receives the flow of 83 westerly, another that of 71 easterly wells. The average daily yield of each well is 78,000 gal., the demand varying from 38,000 to 111,000 gal. The wells are connected in groups of six to ten that discharge through a metered branch line into the collecting main. The branches and individual wells can be closed off separately. The wells are constructed of seamless drawn copper tubing provided at the proper depth with a strainer whose slots are protected by copper screening. The collecting conduits are laid on a slope of 1 in 4,000 and lead to a receiving chamber situated in front of the pumping station. The diameter of the mains increases gradually from 8 to 43 in. The drop leg of the main leading into the receiving well is reduced to 36 in. Two rotary air pumps remove the air from the suction mains to start the flow of water and operate automatically in removing the gases discharged by the water, thus preventing interruption of flow.

Collecting Chamber—The collecting chamber, 26 ft. in diameter and 13 ft. deep, is constructed of brick walls built upon a heavy reinforced-concrete foundation. A cross-wall bisects the structure. Each collector main discharges into one of the compartments thus formed. A suction pipe from a low-lift pump enters each half of the collecting chamber. The two compartments communicate by means of gate-controlled openings in the dividing wall. It is possible to operate either half of the plant independently of the other. Electric indicators in the superintendent's office and in the pumping station record the water level.

Pumping Station—The pumping station, about 80 ft. from the collecting chamber, like the remaining build-

FIG. 2—VIEW OF BERLIN WATER DEFERRIZATION PLANT, LOOKING EAST

ings of the plant, is a reinforced-concrete structure finished on the outside in yellow-brown stucco with a red tile roof. In the construction of its foundation and waterproof basement the ground water level had to be drawn down over 20 ft. The main pumping-equipment consists of four sets of electrically driven raw-water and pure-water pumps of the double-acting plunger type. During the winter only one set is in operation; during the spring and fall, two; during the summer, three. The fourth set remains in reserve. The raw-water pumps operate vertically. They are situated in the basement of the building. The horizontal pure-water pumps occupy the main floor of the station. Each pumping set consists of a raw-water and a pure-water pump attached to a common shaft operated by a synchronous alternating-current motor. The capacity of each raw-water pump at 70 r.p.m. of the motor is about 6 m.g.d. The pure-water sister pump has a capacity smaller by 8 per cent to allow for wash water losses and other plant uses. When less than 8 per cent of the water is actually consumed, the excess is permitted to accumulate in the pure-water basins and is pumped from time to time to the city by means of two special centrifugal pumps. The raw-water pumps force the water through a common main to the aerators. The pure-water pumps take the treated water from the clear-water basins and force it through a 36-in. main to large storage basins in the substation "Lichtenberg" on the outskirts of Berlin, whence it is pumped under the requisite pressure into the distributing system of the city. Each pump is equipped with a suction and discharge air chamber. The main conduits are further provided with special air chambers 6½ ft. in diameter and 26 ft. high. Strong check valves are inserted in the 5.6-mi. force main to Lichtenberg to prevent flooding of the pumping station in case of a break of a main within the building.

FIG. 4—AERATOR NOZZLE IN OPERATION

A conical spray ascending at an angle of 60 deg. is obtained.

Aerators—Two aerating chambers are situated in the upper story of the pre-filter house (Fig. 2). The raw-water main runs the whole length of the building and branches into horizontal aerator feed pipes controlled by separate gates. Each feed pipe supplies 40 nozzles screwed into the pipe at 3-ft. intervals. The aerator nozzles (Fig. 3) are of the double-jet type. They have a capacity of 32 g.p.m. (46,000 gal. a day) and divide the water into a fine spray that falls within a radius of 8 ft. Fig. 4 shows one of the nozzles operating as a lawn sprinkler. Ventilators provide circulation of air through the falling water. The ferrous iron dissolved in the water is oxidized rapidly and precipitates. Hydrogen sulphide and carbon dioxide present in the water are removed at the same time.

Gravel Filters—The drops of the water from the aerator are caught upon ten prefilters or scrubbers situated beneath the aerating chambers (Fig. 5). The area of each bed is 442 sq.ft. (about 1/100 acre). The filtering medium is 24 in. deep and consists of gravel 6 to 10 mm. in diameter resting upon a false bottom of perforated copper plates. The gravel is arranged in two layers placed between copper screens to prevent its displacement during washing. The average rate of filtration is 168 m.g.d. per acre, with a filter period approximating 100 hours. When the gravel has become clogged with iron, the filter is washed by reversing the flow and introducing compressed air beneath the filter. The air is obtained from two five-step turbine blowers each capable of delivering 1,750 cu.ft. of air per minute against a head of 10 ft. of water. Distribution of the air under the filter is accomplished by means of a system of 2-in. pipes provided with ½-in. orifices. The coarse pre-filters remove about 50 per cent of the precipitated iron. The filtered water passes by way of an overflow to the sand filters situated in four buildings connected to the aerator house by covered passageways. The wash-water is conducted to two 26x130-ft. sedimentation basins, in which most of the iron sludge settles readily. The clear effluent from these basins flows through a ditch to the River Spree.

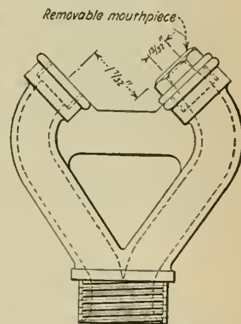


FIG. 3—AERATOR NOZZLE

Two impinging jets divide water into fine spray.

Sand Filters—There are sixty filters (Fig. 6), of the rapid sand pressure type, called "Bollmann" filters after their designer. Three of the filter buildings contain eighteen tanks each; the fourth has but six. The filters operate under a head of 10½ to 11½ ft. of water and each delivers on an average 317,000 gal. a day. The filtering surface is 67 sq.ft., the average rate of filtration therefore being 206 m.g.d. per acre. The initial rate approaches 240 m.g.d. The diameter of the filtering quartz sand is 0.8 to 1.5 mm.

Each filter tank (Figs. 7 and 8) consists of a steel shell 9 ft. in diameter and 8 ft. high, with a 4-ft. conical bottom, resting on cast-iron columns. The shell is closed water-tight with an arched cover. An air valve situated on the cover operates automatically when the filter is filled or emptied. The water enters at the top of the filter and flows over a distributing gutter on to the sand, passing through it to the underdrains. These are situated 5 ft. below the sand surface and

consist of 2-in. bronze laterals branching from a cast-iron main. The laterals are provided with fine slits $\frac{1}{64}$ in. wide and $\frac{5}{8}$ in. long cut into three-quarters of the circumference of the pipe, the unperforated quarter facing upward. The effluent pipe is arranged in the form of a gooseneck vented at the top to prevent siphonage. After a filtering period of 100 to 120 hours

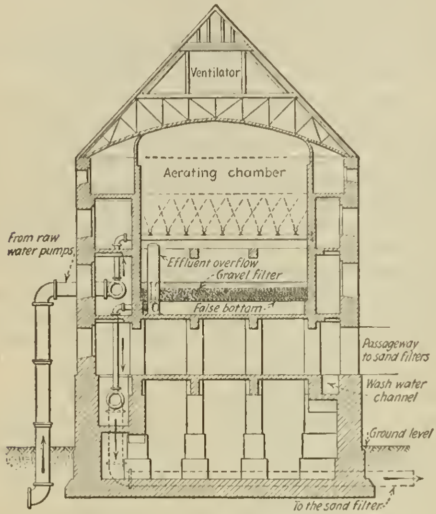


FIG. 5—AERATOR HOUSE AND GRAVEL PREFILTERS
The aerating chamber is only indirectly accessible to the air.

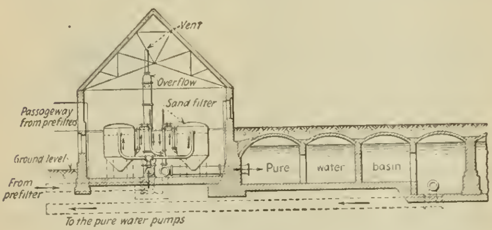


FIG. 6—RAPID SAND FILTERS AND PURE-WATER BASINS
The filters operate under a head of 11 ft.

the rate of filtration has commonly decreased to 144 m.g.d. per acre, when the filter is washed by reversing the flow for eight to ten minutes. This method of backwashing is effective for six to eight times, that is, for three to six weeks. A thorough cleansing of the sand grains then becomes necessary. This is accomplished by means of an injector situated at the bottom of the conical filter bottom. When the injector is operated the sand is sucked into the injector discharge and thoroughly scoured in its upward passage through a vertical tube situated in the center of the filter and rising above the sand surface. The washed sand (spec. gr. 2.65) falls on to the sand bed, the waste water carrying with it the lighter iron deposits (spec. gr. 1.18) flows over a peripheral wash-water gutter to the wash-water sedimentation basins used in connection with the prefilters. The sand content of the filter, about 160 cu.yd., is washed in 1 to $1\frac{1}{2}$ hours. The process requires but slight supervision. The double conical body in the bottom of the filter conducts the sand to the injector in uniform quantities. The wash-water required does not exceed 2.2 to 2.5 per cent of the water filtered.

Some of the filters were opened in the writer's presence after being in service for $5\frac{1}{2}$ years or longer. The sand was removed mechanically by means of the injector and sifted. The sand loss during the long period of operation, together with the sand discarded as having become too fine, amounted to 0.1 per cent of the filter contents. The sand was free from incrustation as was the shell itself. The bronze underdrains were slightly corroded and some of them had to be replaced.

Pure-Water Basins—The four pure-water basins (Fig. 6) have a combined capacity of 1.6 m.g. They are constructed of brick walls upon a watertight concrete floor. Each basin has three round-the-end baffles that prevent stagnation of the water. They are roofed over and covered with 40 in. of sodded earth. A water tower (Fig. 9), holding 80,000 gal., serves the suburb "Oberschöneweide."

Results of Operation—The raw-water delivered to the plant is colorless and, due to its high iron content,

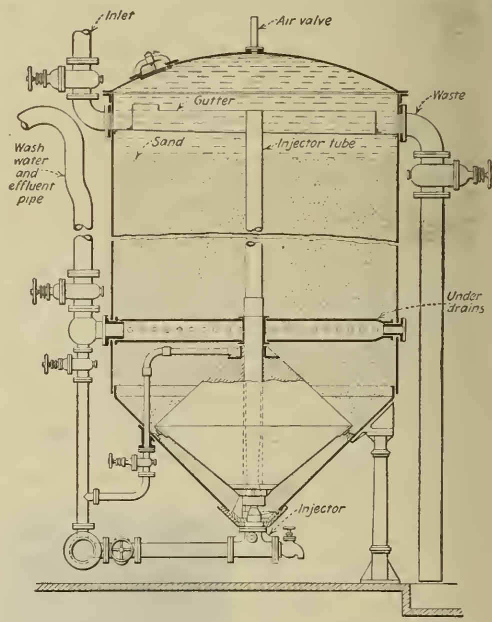


FIG. 7—CROSS-SECTION OF BOLLMANN FILTER
The sand is washed by reversing the flow of water through the underdrains. When this is no longer effective the injector at the bottom of the filter is used.

becomes opalescent on standing. It has a slight odor of hydrogen sulphide, is rather hard, but bacteriologically very pure. During five years of operation the iron content has increased from 4 to 8 mg. per liter, together with the other mineral substances. The sanitary quality of the water has remained unchanged. Aeration and filtration remove the iron and manganese

FIG. 8—ARCHITECTURAL TREATMENT OF WATER TOWER OF BERLIN DEFERRIZATION PLANT

almost completely and the pure water is colorless, remains clear on standing, and is odorless. Results of analyses in March, 1915, and August, 1921 (latest available) are shown in the accompanying table. There is no routine laboratory control of the purification process, and the hygienic quality of the water is considered sufficiently constant and secure to require examination of the water from that viewpoint at rare intervals only.

ANALYSES OF BERLIN WELL WATER BEFORE AND AFTER AERATION AND MECHANICAL FILTRATION

	March, 1915		August, 1921	
	Before Filtration	After Filtration	Before Filtration	After Filtration
Temperature, deg. F.	48.2	48.4	49.1	49 6
Ammonia, mg. per l.	0.6	0	0.6	0 02
Nitrites	0	0	0	0
Nitrates	0	0	0	0
Oxygen consumed	16.4	12 0	9.8	5 4
Total solids	360	341	534	528
Total hardness	272	272	335	333
Permanent hardness	36	36	168	168
Sulphates (SO_3)	22.8	20.3	108.5	106.8
Chlorides	16	16	24	24
Iron	4	0	8	0 00–0 03
Manganese	Trace	0	0 3	0.07
Bacteria per c.c.	1	3	0	2

Final Report on Franklin Furnace Typhoid Outbreak

The cross-connection water-borne typhoid outbreak at Franklin Furnace, N. J., late in 1922 (see *Engineering News-Record*, Dec. 7, 14 and 28, pp. 959, 1045 and 1134) caused 114 known cases and 18 deaths, according to the final report on the subject recently completed by Cecil K. Blanchard, assistant epidemiologist, Bureau of Local Health Administration, New Jersey State Department of Health.

An open gate valve and a leaky check valve, both apparently forgotten, between the industrial and the town water supply systems of the New Jersey Zinc Co. were established by tests conducted jointly by the state health authorities and the company as the probable cause of the epidemic. The probable specific infection was two cases of typhoid the dejecta from which would naturally reach the Walkill River a short distance above the intake of the industrial water-supply system.

Inoculation against typhoid was voluntarily taken by nearly half the population of the borough. This and hospitalization, etc., were provided at the expense of the Zinc Co. The local health authorities are credited with efficient work during the outbreak. The State Department of Health undertook, for the first time in connection with an epidemic, to secure two successive negative specimens of stool and urine from all typhoid convalescents before releasing them from jurisdiction—a procedure followed with dairy typhoid cases for some years and held to be "the only method now available to secure gradually a record of the typhoid carrier population." Illness of the local health inspector prevented the completion of this program. Only two known secondary cases among the total of 114 cases occurred.

D. C. Bowen is chief of the New Jersey Bureau of Local Health Administration.

Identification of Douglas Fir

Douglas fir is one of the largest, most abundant and most widely distributed species of trees native to North America, and, next to the southern yellow pines, it is cut in the greatest quantities of all woods of commercial importance. It belongs to the coniferous family and is, therefore, a softwood. Other names for Douglas fir are red fir, yellow fir, Oregon pine, Puget Sound pine, red pine, red spruce, and Douglas spruce. Its botanical name is *Pseudotsuga taxifolia.* As there is a considerable range in the price and suitability of various similar softwoods, the Forest Products Laboratory gives the following identification features: Douglas fir is a resinous wood, with a characteristic sweetish odor. Exudations of resin on end and side surfaces and pitch pockets are common. Occasionally pitch streaks occur. The sapwood, which is from 1 to 3 in. wide, is white. The freshly cut heartwood is light reddish yellow in color. On exposure to light and air it becomes distinctly reddish, sometimes cherry red, or reddish brown, except the outer portion of old trees which often remains light reddish yellow, which explains why the wood is sometimes known as yellow fir. The summerwood is pronounced, except in very narrow rings such as usually occur in the outer portion of old trees. Under the microscope Douglas fir can easily be distinguished from other structural softwoods by the fine spiral thickenings on the inner side of the cell walls, similar to the thread in a nut.

Concrete Bottom for Mechanical Water Filters

Metal Strainer and Air-Wash Replaced by Concrete Channels, Half Cylinders and Spheres Giving High Velocity Wash

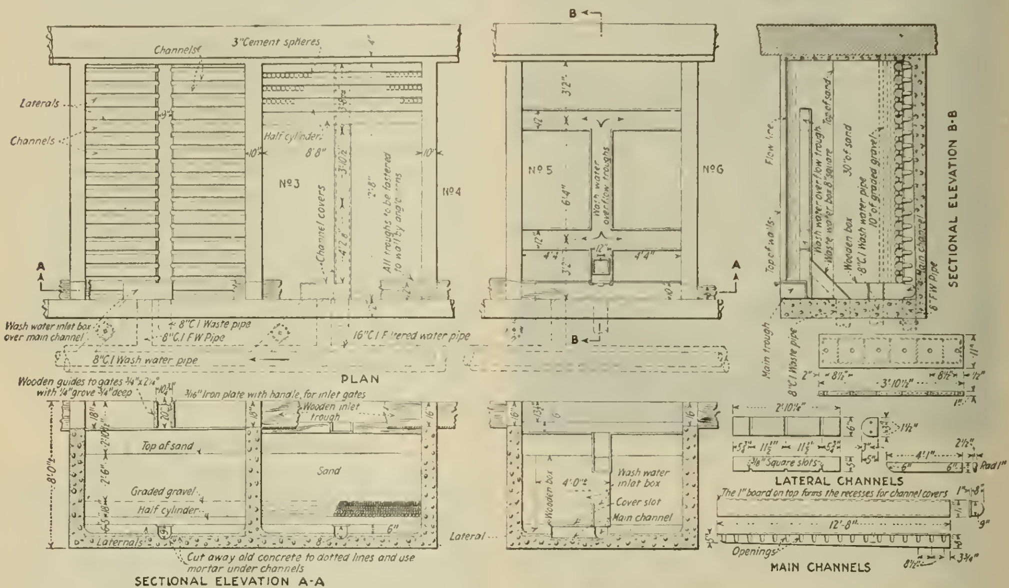
By A. L. Gammage
Engineers' Club, Boston, Mass.

An all-concrete bottom for mechanical water filters has been developed which can be built with a strainer system having any desired ratio of slot discharge to filter area. It can have any proper ratio of length to diameter of laterals. It has side jets which effectively break up and distribute the wash water so there is no danger of lifting movable elements of the filter gravel. Each of a series of upper channels is fed by two separate lower channels. This gives a uniform flow of wash water which the upper channels distribute evenly over the filter floor. There are no pockets below the jets, as in the perforated-pipe system. The all-concrete bottom will effectively break up and evenly distribute the highest velocity jets of water. This type of bottom has been developed in the period from 1919 to 1923 at the plant of the Hollingsworth & Vose Co., at East Walpole, Mass.

The company just named is the largest manufacturer of rope and jute manila papers in the world. Its East Walpole plant is located on the Neponset River. This stream heads in the Neponset reservoir, Foxboro, Mass. A short distance below its source it is joined by a brook carrying the effluent from the sewage-works of a state hospital. The river is also polluted by trade wastes from rubber factories, cotton washing, bleaching, and dyeing plants, and cotton and paper mills, before it reaches the Hollingsworth & Vose mill pond. The flow of the stream varies from a little more than the 3 to 4 m.g.d. of water used in the mill processes to over 20 m.g.d. at flood time.

The water is highly colored, polluted with suspended organic matter, and low in alkalinity. The color varies from 60 to 200 on the platinum scale; the suspended matter from 10 to 25 p.p.m., with about two-thirds organic, and the alkalinity from 3 to 16 p.p.m. The hydrogen-ion pH is almost always 6.0 or less. The filtered water has a color of 10 to 20 and may be easily made 5 or less.

Nine ¾-m.g.d. air-wash mechanical filters were formerly used to filter the alum-treated water. The strainers and galvanized-iron laterals of these filters corroded so rapidly that they were continually being replaced at considerable expense of money and loss of time in filter operation. The air-wash filters were unequal to the load of work, and about every six months all sand and gravel was removed and replaced by new material.



GAMMAGE ALL-CONCRETE FILTER BOTTOM AT HOLLINGSWORTH & VOSE CO. PAPER MILLS

Bottom wholly of concrete, including channels, raised half-cylinders with horizontal under-slots to form jets and with spheres placed in the spaces between the tops of the half cylinders.

It was thought that an all-concrete filter would be non-corrosive and if the filter bottom had a large ratio of slot to filter area the velocity of wash water would be great enough to lift the sand and make a high-velocity wash filter. One of the old air-wash filters was changed into a filter built with spheres over lateral channels and a slotted filter bottom with total discharge openings equal to about 4 per cent of the filter-bed area.

This filter worked excellently while it was clean. Until the sand clogged the wash water lifted the whole bed and washed it well. When the sand became dirty the gravel shifted and sand and alum hydrate and suspended dirt passed the filter. The filter bottom was rebuilt several times with decreasing ratio of slot discharge to filter area until a filter bottom was built with raised half cylinders having ½-in. horizontal under-

slots 20 in. apart lengthwise, which covered the lateral channels and threw jets opposite each other to a top series of lateral channels covered by 3-in. spheres and gravel and sand. This filter unit had a ratio of slot discharge to filter area of approximately 0.3 to 100. It worked so well that filters 4 and 6 were changed likewise, so that we had filters 1, 4 and 6 on high-velocity working alongside the original 2, 3 and 5 air-wash filters.

The results on comparative tests were such that the company built three new Gammage filters after sketches dated Oct. 20 and Dec. 8, 1919 (not reproduced here). These filters had a ratio of slot discharge to filter area of 0.5 to 100. While this ratio is high, the filters have always filtered and washed evenly, leaving a level sand bed when the sand was dirty. Closing each alternate jet gives a ratio under 0.3 to 100, but this has not been done and no gravel upset has occurred.

To secure a sufficient flow of water from the coagulation basin to the new filters the supply line had to be enlarged to furnish sufficient water for all filters.

After the new filters had been run successfully for some time it was decided to change over three suction filters to high-velocity filters, as all others are gravity filters, and these are giving satisfactory results. They have a ratio of slot discharge to filter area of some 0.4 to 100.

About a year later it was decided to change over the three remaining gravity air-wash filters to high-velocity, and as all the filters were now washing under a 100-ft. head it was decided to tighten the filter bottom to a ratio 0.28 to 100, as shown in the accompanying sketch. On full head the wash water was 28 in. a minute upward in a filter without any sand or gravel in place.

There are three filters each with a ratio of slot area to filter area of 0.28, 0.3, 0.4 to 100 and one of 0.5 to 100 and all are working under a higher wash-water head than is usual in mechanical filters. This wash-water head was used at the East Walpole plant because a tower tank built to supply a certain pressure to the showers of the paper machines on the floor above the filters was the only available wash-water source.

A number of the concrete filters have been surface treated with a zinc magnesium fluosilicate, to form a hard wearing surface.

Acknowledgment is given to John Cashman for all the drafting work and great credit is due the Hollingsworth & Vose Co. for co-operation in the development of a new mechanical filter bottom which is giving them good satisfaction. This mechanical filter bottom has been patented by the writer and has been leased to most of the largest filter companies in the United States.

Crystalline Areas in Wrought-Iron Fractures

Crystalline areas in the nicked-bend fracture of a wrought-iron bar do not necessarily indicate the presence of steel in the material from which the bar was made, nor do they indicate high-phosphorus iron, the Bureau of Standards has found. On the other hand, the presence of steel in the material of the bar does favor the formation of such crystalline areas, because it tends to produce uniform distribution and small size of the individual slag threads, and this latter condition is closely connected with the development of the crystalline areas. In such a test the crystalline areas developed on the tension side of the tested bar are more significant than those on the compression side.

Disinfecting the City Water Mains of Otsego, Michigan

Hypo Applied at Pumps Until Reactions Positive at Flushed Dead Ends—Flushing Kept Up Until Reactions Negative

By Edward D. Rich
Director, Bureau of Engineering, State Department of Health, Lansing, Mich.

To DISINFECT the seven miles of city water mains after sewage-polluted and muddy water from the Kalamazoo River had been used for years was the problem confronting O. G. Bacon, city manager of Otsego, Mich., three months after a deep-well water supply had been put into use and the river intake disconnected. The work was done by dosing the pump well heavily with hypochlorite and flushing the hydrants until a reaction for excess chlorine was obtained by ortho-tolidin tests. Flushing was kept up after the hypochlorite was discontinued until negative tests were obtained. The work was supervised by the Engineering Bureau of the State Department of Health, with W. C. Brockway in charge.

DEEP-WELL PUMP HOUSE

Located on top of concrete pump well into which deep-well pumps discharge. The two deep wells are drilled through the bottom of the pump well.

Otsego had a population of 3,168 in 1920. While the river had been drawn upon for eight years it was not supposed to be used for drinking purposes. Sewage from Plainwell, population 2,000, four miles above Otsego by river, and from Kalamazoo, population 48,000, fifteen miles above, is discharged into the Kalamazoo River.

The consumption of water is estimated at 400,000 gal. per day. Ten dead ends, mostly on 4-in. mains, exist, ranging from 400 to 1,000 ft. in length. Circulation on many of them does not take place unless hydrants are flushed because there are scarcely any house connections.

It was necessary to clear the mains of mud to get the maximum efficiency from the hypochlorite. For this reason the dead ends were flushed first. Then, starting from the pumping station, hydrants were flushed in order depending upon their distance from the station. After the entire system had been flushed and practically all of the turbidity removed, the dead ends only were opened. The color of the water from some of the dead ends when first flushed was jet black, and as much as one hour was required in some instances before the water became clear in appearance.

After the hypochlorite solution had been applied to the water for 24 hours, dead ends were flushed until a positive reaction for excess chlorine was obtained. Water not chlorinated was not entirely discharged from the system until two days after treatment began. One workman was kept busy continuously at flushing hydrants from Sept. 18 to Sept. 25, 1922, when the hypochlorite dose was discontinued, and until the ortho-tolidin test for excess chlorine gave a negative reaction, which was several days later.

The 130,000-gal. pump well into which the deep-well

pumps discharge water with much agitation at one side of the well, and from which the high-lift pumps have an intake at the other side, offered a possibility for applying the hypochlorite without the offensive task of mixing it into solution manually. With this arrangement the erection of an emergency or temporary plant was not necessary. Accordingly, about 28 lb. of hypochlorite was put into a sack and suspended by means of a rope at the end of the deep-well pump discharge, where the agitation of the water was quite effective in dissolving the chemical. A large initial dose, equivalent to 9 p.p.m. for the 130,000 gal. in the well, was used so that the strength would not be unduly dissipated by this large volume.

Hypochlorite was placed in bags in preference to throwing it directly into the well, because the dose could be controlled better. If the treatment had to be discontinued at any time, the bags could be removed. If the chemical had been thrown into the well, it would have been necessary to wait until the chemical was dissolved. By placing it in bags, no lumps were drawn into the distribution system, thus making the dose more or less irregular and uncertain.

BACTERIAL TESTS ON OTSEGO SAMPLES TAKEN FROM WELLS, DEAD ENDS AND TAPS

RAW WATER FROM WELLS
Sept. 18 to Oct. 3, 1922

	From Discharge Line	Dipped from Pump Well
Safe	12	2
Suspicious	1	2
Unsafe	2	1

	Dead Ends: Sept. 20 to Oct. 2, Excess Chlorine Present	Dead Ends: Oct. 30 and 31, Chlorine Absent
Safe	17	3
Suspicious	15	1
Unsafe	6	6

	Tap Water: Sept. 19 to Oct. 3, Excess Chlorine Present	Tap Water: Oct. 30 and 31, Chlorine Absent
Safe	7	2
Suspicious	4	0
Unsafe	1	0

Treatment applied Sept. 19 to 25 but chlorine persisted until Oct. 2.

An improvised mask, used by the men at the paper mill where the hypochlorite was obtained, was employed by the city workmen, so that no ill effects from handling were evident.

It was found that 21 lb. placed in the well every two hours during the day for seven or eight doses, 15 p.p.m. for an average dose of 400,000 gal. daily, was satisfactory. Since the consumption of water (not for drinking) was low at night, a dose of the disinfectant was placed in the well at 9 p.m. and not replaced until 7 a.m. the next day. Bags previously placed were not removed when a new one was put in. One bag lasted many hours, so several bags were in the well at the same time. The detention period and storage capacity furnished by the pump well were relatively great. These factors and the fact that hypochlorite dissolves slowly, were particularly favorable for this scheme. By means of the ortho-tolidin test it was discovered that the chlorine traveled through the pump well in less than 20 minutes, as shown by the positive reaction in a sample collected from a pet cock on a high-lift pump.

The initial treatment was not deferred until the mains were all flushed, but was commenced at noon, Sept. 19. and continued until Sept. 25, because flushing would draw the treated water to the dead ends that much sooner, even though the presence of organic matter and mud would make the dose less effective. If the treatment had been deferred, a second round of flushing would have been required to replace the raw water with chlorinated water which would have delayed the work about two days.

The only way of testing the efficiency of the treatment was by means of bacteriological specimens sent to the laboratory of the State Department of Health at Lansing. Before, during and after treatment, samples were collected daily from the raw well water and from taps and dead ends on the distribution system. U. S. Treasury Department standards were used for classifying results. To be considered "safe" the "count" was required to be less than 100 with not more than one out of the five 10-c.c. plantings showing gas followed by positive confirmatory results. If the count were greater than 100, and more than one out of five 10-c.c. portions showed gas, the specimen was considered "safe" provided the confirmation was negative, but if the confirmatory test were positive under these conditions, the specimen was classified as "Suspicious" if the standard was but slightly violated, and "unsafe" if decidedly in violation.

Due to delay in shipping (from 24 to 48 hours elapsed before the specimens were planted) it is believed that the counts increased materially and the above classification in consequence is too severe. The result of this classification is that the specimens considered as "suspicious" should in fairness probably be classified as "safe." In most instances, these samples had a count exceeding 100. In some cases specimens classified as "suspicious" were not confirmed but they were so classified because the count of 100 was exceeded. Aftergrowths in the dead ends and during the sample transportation period both tended to give less favorable results than the actual condition would justify.

Pitometer Survey Discloses Underground Leaks

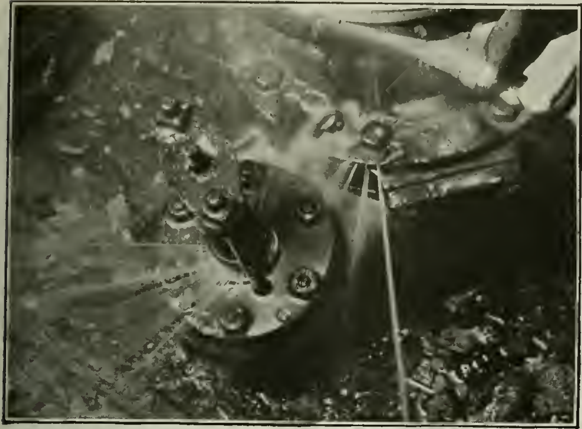
DURING the course of a pitometer survey in Detroit to locate water waste many kinds of leaks were discovered. Photographs were often taken for permanent record of some of the more striking instances to indicate the nature of the defects. Six leaks all in the street are shown on p. 433.

The survey was started July 1, 1919, by the Pitometer Co., which submitted its final report March 1, 1922, since which time a pitometer division of the water department has continued the work. The Pitometer Co. located and the department repaired underground leaks amounting to 9,557,000 gal. daily. There was also 3,380,000 gal. daily of unmetered fixture leakage and 9,600,000 gal. daily of metered fixture leakage eliminated, representing a total of 24 gal. per capita per day saved. The per capita consumption for the year ending June 30, 1922, was 148 gal. Detroit supplies 954,500 people and has 98.5 per cent of the taps metered.

As a result of the survey a systematic removal for test of all house meters is now under way. More than $200,000 is the estimated money saved annually.

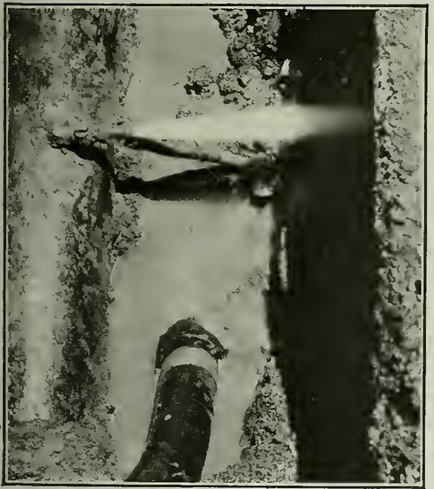
The water-waste investigations were carried out under the general direction of George H. Fenkell, superintendent and general manager, Detroit Water Department. The department's pitometer survey is being carried out by Maurice N. Girardy, reporting to F. H. Stevenson, assistant superintendent.

Six of the Leaks Revealed by Pitometer Survey in Detroit's Water Supply



1. DEFECTIVE GASKETS ON STANDPIPE FOOT VALVE

2. BROKEN 6-IN. MAIN; LOSS, 281,000 G. P. D.



3. A $\frac{5}{8}$-IN. LEAD BROKEN AT CORPORATION

4. SPLIT AND BREAK IN $\frac{5}{8}$-IN. LEAD SERVICE

5. VIBRATION BLOWS JOINT ON THIS 4-IN. SLEEVE

6. BLOWN JOINT ON CROSS UNDER CATCHBASIN WALL

Japanese Engineering Structures and Services

Notes on Status of Development in Buildings and Water-Works Before the Earthquake —A Background to Aid Interpretation of News Reports

As a background for later and more detailed reports regarding the effect of the earthquake which shook Japan, Sept. 1, the following notes on structures and services of engineering interest in Tokyo and Yokohama are presented. The comments on building design are based on an interview with Col. W. A. Starrett, of New York, who was connected with the construction of the first large steel office buildings erected in Japan.—EDITOR.

FROM THE fragmentary news that has reached this country regarding the appalling earthquake tragedy in Japan, Sept. 1, it is impossible, as yet, to form any reliable estimate of the effect of the shock on the principal engineering structures in the devastated areas of Tokyo and Yokohama, where, apparently, the most severe damage has occurred. With the loss of life reported as running into the hundreds of thousands the purely technical phases of the great disaster assume a position of secondary importance. Nevertheless, it is certain that in the wake of the world-wide effort that has been started to alleviate the human suffering caused by the great catastrophe, will come many valuable engineering lessons.

MARUNOUCHI BUILDING, MODERN STEEL STRUCTURE
Built by American constructors and reported standing.

The topography of Japan is mountainous. Tokyo, capital of the Empire, comprises uplands and lowlands, with hills ranging from 50 to 130 ft. high. It is located at the head of Tokyo Bay on the southeast coast and along the Sumida River. There are flats on both sides of the river intercepted frequently by canals, over which there are many small bridges. Tokyo is about 18 miles distant, by railway, from Yokohama, the seaport. According to the 1920 census, the population of Tokyo was 2,173,000 and of Yokohama 423,000. For years past records show that Japan is subjected, on the average, to three or four seismic disturbances daily.

Ancient and Modern Structures—While it is true that in design and construction many of Japan's buildings, bridges and other works of the engineer hark back centuries, the application of modern American and European building practice has long since been under way. Within comparatively close range stand the picturesque masonry palaces of the old Empire, the low, flimsy structures of wood or brick in the residence districts, and modern skeleton steel-frame office buildings of the skyscraper type comparable with those that flank lower Broadway in New York. For the engineer, the earthquake, when the full story is known, will undoubtedly contribute valuable information on the comparative stability of the old and the new structures under conditions of extreme shock such as occurred last week. In addition to the modern steel buildings to which reference has just been made, a considerable amount of reinforced-concrete building construction has been in progress in the leading cities of Japan for a dozen years or more. Have these structures stood, and, if so, to what extent have they been damaged? How does their condition, after the earthquake, compare with that of the skeleton steel buildings? Are modern methods of engineering design capable of producing structures which can resist collapse under such conditions as were created by the earthquake in Japan? These are some of the questions to which engineers, the world over, will seek an answer. The data necessary for an analysis of the results are not yet available.

From present reports, however, the indications are that extensive damage has been done not only to buildings, including private residences and commercial structures, but also to the bridges, water-supply and gas systems of Tokyo and Yokohama. In fact, breakage of the water-supply mains is given as one of the chief reasons to account for the failure to check the fires which swept the stricken cities immediately after the earthquake. Later reports indicate that the water supply systems have been partially restored to service.

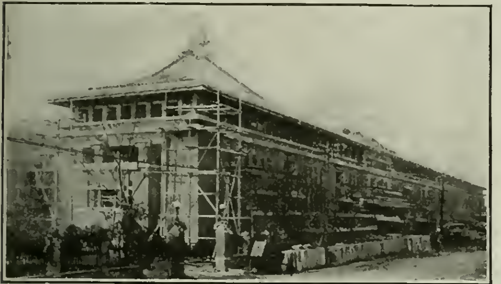
Modern Structures Stand—The one encouraging feature in the news thus far received is the probable safety of certain large steel frame office buildings constructed last year in Tokyo by an American organization, the George A. Fuller Co. of New York. These buildings, described in *Engineering News-Record*, Sept. 21, 1922, p. 476, are all about 100 ft. high (eight stories) and in their design great stress was laid upon providing resistance to earthquake shock in the form of heavy sway-bracing and the provision of adequate foundations by driving timber piles to a firm support 40 to 60 ft. below the surface. The largest of these structures, known as the Marunouchi building, in Tokyo, was eight stories high and covered a plot 340x300 ft. The other two structures were of the same skeleton steel frame type, although somewhat smaller in volume, and were built for the Nippon Yusen Kaisha Steamship Line and for the Japan Oil Co. Through the New York office of The Mitsubishi Co., the big Japanese banking and exporting organization, reports have been received which lead the American constructors to believe that all three structures are standing, although no details are available as to the extent of the damage done to them by the earthquake. These buildings represent the first use, in Japan, of American steel frame office building design and construction. Up to the time they were begun in 1920, modern construction in Japan found its expression chiefly in reinforced concrete.

One of the leading examples of a large reinforced-concrete building in Tokyo is the new Imperial Hotel,

shown in one of the accompanying illustrations. It is faced with brick and is a long, low structure. Reports state that it withstood the shock of the earthquake.

Colonel Starrett Discusses Buildings

In connection with the design and erection of these steel buildings Col. W. A. Starrett, formerly an officer of the George A. Fuller Co. and now member of the firm of Starrett Bros., Inc., New York, has made three trips to Japan since 1919. In an interview last week with *Engineering News-Record's* representative, he



TOKIO'S IMPERIAL HOTEL, OF REINFORCED CONCRETE

brought out the following points regarding Japanese building practice:

For centuries past Japanese construction has employed stone masonry, brick, or wood and only recently has accepted American and European standards involving the use of structural steel and reinforced concrete. Of the latter two types of building, the steel frame structure has made the least headway, and it was only after a delegation of Japanese engineers was sent by their government to the United States in 1919 that negotiations for three large steel office structures in Tokyo were completed.

The reinforced-concrete structure, Colonel Starrett stated, found acceptance in Japan a dozen or more years ago. British and European influence was responsible, in part, for its popularity. For a number of years the trend of design was all toward reinforced concrete, and the building of the large steel structures in Tokyo, beginning in 1920, marked a new era in Japanese building practice. The steel frames of these structures were designed by Purdy & Henderson, engineers, of New York, in collaboration with Japanese engineers. In Colonel Starrett's opinion a factor accounting, in some measure at least, for the widespread use of reinforced concrete by the Japanese is that they came upon the necessity for buildings stronger and better than their old-fashioned methods afforded at a time when concrete construction was prominent in America and Europe. It was a simpler and more practical form for them to adopt and consequently was used in their first fireproof structures. Moreover, the science of steel design was not so well known and the difficulties of detailing and predetermination were very great. The Japanese fondness for decorative ceramic effects on the exteriors of their structures may have had some effect also. In zones subject to seismic disturbances Colonel Starrett points out that such considerations are of secondary importance, for during a severe shock decorative surface applications become detached and fall.

While the Japanese, according to Colonel Starrett's observation, have been profound students of the causes and effects of earthquakes, it has only been during the last half dozen years that they have seen a clear analogy between the wind-bracing methods for steel structures common in American practice and bracing to resist earthquake shocks. Today, however, Japanese designers are attaching great importance to this feature of structural engineering, and the Tokyo office buildings above referred to are notable for their heavy diagonal bracing between columns and girders.

Earthquake shocks also have had an influence on Japanese practice in the design of steel columns. In the cases of columns consisting of successive lengths of steel members superimposed upon each other, the Japanese engineers place no value upon the bearing of the two surfaces against each other, but rely entirely on heavy splice plates, thoroughly riveted, for support at these column joints. This is a detail which was insisted on in the Tokyo office buildings.

OLD BUILDINGS ON YOKOHAMA WATERFRONT

The Oriental scheme of sway bracing, in its general features, is in accord with American practice, except that the wind loads assumed by the Japanese are many times the loadings on which calculations are ordinarily based in this country. Where an American engineer might assume a wind load of 40 lb. per square foot, the Japanese designer would base his calculations on 140 lb. per square foot. This results in exceptionally heavy sway bracing. Experience with earthquake shocks has shown the need for reinforcement of spandrel walls and substantial division walls to form stiff vertical plates throughout the structure.

Foundations—Subsurface conditions in Tokyo and its vicinity make important the subject of foundations for large structures. A large portion of the city is reclaimed ground and for a depth of 50 to 60 ft. below the surface the soil is soggy and swampy. Below the 60-ft. level sand is encountered, and below that, hardpan. Prior to the erection of the large steel office buildings some form of floating foundation was commonly employed in Tokyo, but in the case of the American-built structures the designs called for piers of concrete supported on piles extending down 50 or 60 ft. to a firm bearing. To accomplish this result it was necessary to import long timber piles from Oregon as local timber was too short and too small to penetrate to solid material. Colonel Starrett cited several cases where structures on floating foundations had settled a foot or more. The use of long timber piles in Tokyo, he pointed out, is under ideal conditions, inasmuch as the ground water

level is very close to the surface, so that there is no alternate wetting and drying with its consequent rotting of the timber.

Governmental building regulations in Japan limit the height of structures in the business districts to 100 ft., except where the material used is brick or stone, in which case a 65-ft. limit is imposed. Wooden buildings may not exceed 50 ft. in height.

* * *

Supplementing Colonel Starrett's discussion of Oriental building practice the following comment is based on statements by H. V. Spurr, chief engineer for Purdy & Henderson, consulting engineers, New York, who designed the three steel structures in Tokyo:

Foundations—The chief points in which the Japanese structures differ from American practice are in the foundations and column bases, the column splices, and the heavy diagonal sway bracing. The design followed assures an unusual amount of stiffness in the steel

DETAIL OF HEAVY SWAY-BRACING

frame. The knee-bracing consists of double channels, while there are both web and seat connections between columns and girders. The column splices, to which reference has been made, consist of four ¾-in. plates and more than 200 rivets on each side, thus providing material considerably over and above that required for vertical loading. In one case the column splice extends the height of a full story of the building.

A feature of the foundation design is the reinforced-concrete struts which extend between column footings in perpendicular directions like the lines on a checkerboard. These struts tie the whole pile-supported substructure together and are intended to add to the stability of the foundations in the event of earthquake shock. The columns are supported on special built-up bases through which, according to the desires of Japanese designers, anchor bolts extend into the concrete caps of the nests of long wood piles. These bases are equipped with wing angles to provide a connection with the reinforcing rods of the concrete struts and ties between foundation supports.

The spandrel wall details also provide for secure anchorage of terra-cotta or other facing material which might be shaken loose in the event of an earthquake.

* * *

Water Supply in Japan—While the interest of American engineers in the Japanese earthquake will undoubtedly center on the behavior of the buildings in the cities, there are other engineering works whose condition, after the disaster, should furnish data of great technical interest. Tokyo's water supply apparently has been severely damaged. The city, according to observations, made during a trip to Japan a number of years ago by Col. George A. Johnson, consulting engineer, New York, has had a public water supply of some sort ever since the year 1600, but it was not until 1892 that construction started on the present modern water-works system, which was completed in 1898. The original works were designed for 1,500,000 people and had a capacity of 45 m.g.d. Additions have been made to cope with the growing population which amounted, according to the 1920 census, to 2,173,000 people. The intake for Tokyo's supply is from the Tama River at Hamura, whence the water flows by gravity in canals, both open and closed, a distance of 30 miles to a filtration plant on the outskirts of the city. Here are located a battery of sedimentation basins (the original design provided for three, having dimensions of 360x720 ft. and 19.5 ft. deep). The settled water then passed to eighteen one-acre slow sand filters containing 30 in. of sand and 24 in. of gravel. They were designed to operate at a rate of slightly less than 3,000,000 gal. per acre daily, giving a capacity of about 53,000,000 gal. daily. Filtered water passed to three filtered water basins, each with a capacity of 7,500,000 gal.

During the time of Colonel Johnson's visit about two-thirds of Tokyo's supply was delivered by gravity to the low level districts and one-third was pumped to the high level areas against a head of 80 to 100 ft. by four 300-hp. pumping engines, each with a capacity of 7,500,000 gal. daily. Tokyo's water consumption averaged somewhat less than 20 gal. per capita daily.

Yokohama also installed a municipal water-works system in 1885, with an intake on the Doshi River and a 30-mile conduit delivering to a slow sand filtration plant.

Roads and Bridges—Press reports received in this country give scant information as to the condition of bridges and roads in the zone affected by the earthquake of Sept. 1. By the provisions of the Road Law passed in 1919, highways in Japan are classified under five subdivisions: (1) national; (2) prefectural; (3) district; (4) city; (5) village. On this road system, according to the 1921-22 edition of the "Japan Year Book," there are 346,144 bridges, of which 518 are metal, 71,258 stone, and 136,860 wood. In addition, there are some pontoon structures and others of a type not classified.

Japan has about 1,000 harbors, large and small, of which about 60 are open to foreign vessels. Yokohama, where the effects of the earthquake are reported to have been particularly severe, is one of Japan's leading seaports. The engineering works at this port include training walls and piers.

Railway—Prior to 1906 the railways of Japan were operated by a number of companies independently. In that year the railways were nationalized, and seventeen lines, with about 3,000 miles of track, were consolidated into a single system. Extension has been made since that time and in 1920 the mileage of Japan's railways is reported as 6,000. As the capital of the Empire, Tokyo is an important railway terminal. The station is located near the Imperial Palace and is a brick and steel structure about 1,100 ft. long with a maximum width of about 140 ft. The dome of the station is 124 ft. high.

Notes on Roads in the Orient

Observations on a Trip in China, Japan, Ceylon and the Malay States—Modern Machinery Seen But Manual Methods Predominate

By W. W. Crosby
Superintendent, National Park, Grand Canyon, Arizona

ONE LESSON again impressed on the writer by his recent observations of road work in the East is the adequacy of quality to make up for lack of quantity. The road authorities of the East have demonstrated the efficacy of simple methods and moderate expense to meet the needs of their traffic developments. They have not set up the golden calf of quantity production nor have they neglected for a moment the proper devotion to maintenance. And they do not chase any will o' the wisp of "permanent roads."

City Pavements in China—What can be called roads do not exist outside of the immediate vicinity of the cities of China.

A brief inspection in Shanghai revealed streets in good condition though practically wholly of macadam.

FIG. 1—OX-CART AND AUTOMOBILE BOTH TYPICAL OF CEYLON TRAFFIC

Some have been treated with bituminous material. The maintenance is excellent but the methods are antiquated in instances. One repair gang was seen using as a roller a stone cylinder, pulled by 21 coolies on the draft-ropes.

Canton has few paved roads or streets as we know them. In fact but few roadways for wheeled traffic have been opened up in this curious city. The recent demolishing of the old city walls is leaving some strips of ground for development into streets, but the public highways of Canton are mainly only narrow alleyways between the shops. They are from 4 to perhaps 10 ft. wide, paved with slabs of stone, and usable only by pedestrians and "chairs" carried by coolies.

Rickshas use only the few streets available for them and consequently their employment is over a very limited area. Further, the roughness of the unpaved streets renders riding in wheeled vehicles most uncomfortable and only warranted by their greater speed. The coming of the automobile is tending to bring about some road developments. Even if some roads shall be built, however, the problem of their maintenance is a most serious one. The translation of funds into roadways can be conceived, but no one who knows conditions in China can conceive the raising of funds for road maintenance after construction and then the securing of the work from these funds. Possibly a toll-road company might be operated successfully, assuming a stable government to exist in any section, but the reputations of Chinese officials for "squeeze" prohibit any hopes for good roads in China from public official sources.

FIG. 2—TYPICAL TRAFFIC IN ADEN

Hong Kong's streets and roads are well paved with bituminous surfacing, mostly penetration macadam. In both Shanghai and Hong Kong steam-rollers were seen but even in Hong Kong the stone cylinder pulled by man-power was at work on repairs. While the types and methods of road work in these cities seem rather primitive, the good results everywhere noticed bear witness to the excellence of the work done even in these ways.

The wheeled traffic in China is light, but the use of the motor car is rapidly growing and already a considerable number are evident in Shanghai and Hong Kong, with a few in Canton.

In the Malay Peninsula—The roads of the Federated Malay States are apparently sufficient for their traffic and are well maintained. They are frequently of water-bound macadam and in some cases treated with bituminous material. The macadam is excellently laid and in the moist climate well maintained under what we would call light traffic, mostly rickshas, ox-carts, and passenger automobiles. The heaviest of the last are buses carrying eight or ten persons.

The macadam is of the English type, quite thick, say 8 to 10 in. or even 12 in., frequently with a sort of Telford base, and is well consolidated by steam-rolling. The bituminous treatment is generally carpeting the consolidated and completed macadam with hot bituminous material and grit after the road has been opened to traffic.

A section of old macadam that was really worn out was seen undergoing resurfacing. The new macadam layer was being placed at least 8 in. thick on top of the old roadway and steam-rolled with the aid of water to

FIG. 3—MAINTENANCE GANG REPAIRING WATERBOUND MACADAM IN JAPAN

bind it. Traffic was then turned onto the new surface for a period after which the traffic was again diverted, the surface thoroughly swept and cleaned even by using hand scrapers to remove the last vestiges of adherent matter, and the hot bituminous material was evenly applied and swabbed onto the roadway surface. A coating of sand was then brushed evenly over all and the traffic was readmitted. The results were excellent.

In another place near Singapore some minor repairs were being made to a bituminous roadway as follows: The depressions or chuck-holes in the old macadam were loosened by hand-picking to a depth of about 2 in., with fairly vertical edges, and all the old material was cleaned out. Fresh metal, which had been previously coated with bituminous material, and of which piles existed along the edges of the road ready for use, was then placed carefully in the holes and conformed to the adjacent road-surface by raking and tamping, and this patch was then coated with sand and the traffic permitted on it. Again the results were excellent.

It may be noted that the above described patching is identical with work noted by the writer in Leamington, England, in 1908 and that the same care seems to be taken with small details in Malay road work that is evident in the good work done in England and France. It may be that this carefulness underlies the success of what some might now call antiquated methods in meeting the demands of traffic developments during the past fifteen years.

In the city of Singapore there are many excellent streets. They are wide, well-located, and generally well-surfaced. Bituminous material prevails and it is understood to be largely used in the more superficial methods. Some mixtures have been laid, and the writer had the pleasure of meeting the local representative of our old friend, The Barber Asphalt Co., which is engaged in introducing that standard sheet-asphalt pavement to the Malay States with some success.

One stretch of cement-concrete pavement was seen being laid in Singapore. The construction was truly British—substantial to say the least. It was reinforced near both the top and the bottom, in both directions, and the two layers of reinforcing rods were united by vertical wires or rods. Possibly there were to be also diagonals but they were not in place at the moment. Evidently openings through this pavement were not contemplated soon nor was any surfacing to the concrete apparently provided for.

In the smaller places such as Kuala, Lumpur and Penang, bituminous surfaces in excellent condition prevailed for the streets, and waterbound macadam, equally good, outside except possibly on some of the more popular routes, which were surface-treated with bituminous material.

Ceylon—Traffic around Colombo is extraordinarily varied in character. Rickshas, Rolls-Royce cars, racing-sulkies drawn by one trotting-bullock and a two-wheeled prairie-schooner type of carts drawn by a pair of diminutive oxen, tin-Lizzies and regular steam-lorries from Hold Hengland pulling one or two trailers, a few horses, both saddle and draft, with electric trolley cars on rails are all to be seen on the streets or roads adjacent to this beautiful city.

Again the bituminous-surfaced roadway prevails and is everywhere in good condition. In one wide street a strip of stone blocks along each side next to the curb furnished a roadway for the slow moving animal-drawn traffic. Out in the country some waterbound macadam roadways are in excellent condition.

The maintenance of all the roadways seems promptly and well done. Apparently the use of bituminous surface-treatments is gradually but steadily extending.

The methods used here are those before described for the Malay States but perhaps the tools and machinery or means used in the Ceylon work cover even a wider range. Steam-rollers are numerous. With them work sprinkling wagons or carts consisting of a cylindrical iron tank holding perhaps 150 or 200 gal. of water and drawn by a pair of miniature oxen with their native driver almost always squatting on the pole. Workmen, with their curious long-bladed hoes, scrape the stone free from piles along the roadway into flat scoop-like baskets and carry it to the holes to be patched. One pair of workmen squatted beside a hole some 2 ft. square pack the new metal into it with their hands and sift through their fingers the old material just taken

FIG. 4—JAPANESE MAINTENANCE MAN FILLING A CHUCK HOLE

from the hole, in that way obtaining enough fine material for binding the patch.

The carrying of materials for road work in baskets at each end of a pole across the shoulders of men and women is not quite as common as in Japan but nevertheless prevails even with the bullock-carts seemingly everywhere at work.

The coolie-drawn stone roller was not evident around Colombo but another novelty to American eyes is to be seen in the shape of a stone cylinder drawn by an elephant. Possibly the combination of tamping and rolling effects thus secured is peculiarly beneficial. At any rate the most critical would be pleased with the present roads of "beautiful Ceylon's Isle."

Aden a British Outpost—Here the few roads are British waterbound macadam, well built and well maintained. The steam-roller is again a familiar object but the vehicle traffic is less familiar to American eyes. The most striking vehicles are camel-drawn carts. These seem numerous about the town, in fact they predominate though passenger motors are plentiful.

A curious sight were the road-sprinklers skillfully slopping water from leather bags, slung by a strap over their shoulders, onto the roadway to lay the dust.

Japanese Roads Inadequate—For the traffic of the past, peculiar to its locality, the roads of Japan have undoubtedly sufficed. For their present traffic they are made to answer, extravagantly, probably, in many instances. For the future, the existing roads cannot be considered "good" from the angles of economy, sufficiency or satisfaction to their users.

In the main the roads are too narrow for modern

traffic, too crooked, and too crudely surfaced. In such cities as Kyoto, Osaka, Tokyo, Yokohama, and Kobe many splendidly wide streets exist, but, except in the last two or three places named, scarcely any paving of a modern type is evident. The surfacings, even in the cities, are a sort of macadam made of gravel (or broken stone) without proper rolling and with an excess of fine material to bind the metal. The result is the familiar old one of a soft muddy or dusty road that ruts easily and wears into "chuck-holes" readily.

The maintenance of the more important roads and streets is very good. Apparently labor is plentiful, for a maximum amount of hand work is employed. Gangs are seen constantly at work patching the chuck-holes with broken stone or gravel and spreading fine material over the loose stone so that it may bind down under the traffic.

The writer was fortunate enough to observe such a repair gang at work on The Bund (the waterfront street) of Yokohama one rainy day, and the photographs show the picturesque workmen in their straw rain-coats, some of their implements, and methods.

Some of the men are picking off the bunches in the macadam surface; others are moving stone in a two-wheeled barrow or cart from a large pile alongside the roadway to smaller piles more frequently placed within it (as far as the photos go these latter workmen are "off stage"); others are taking the stone from the small piles to the holes in the roadway in wooden trays. The picture of the single man shows him using the tray and filling a hole. This gang worked industriously and intelligently without argument or unnecessary conversation, which seems worthy of note.

Tokyo has one main street with some good wood-block pavement. Kobe has considerable good bituminous pavement, chiefly of penetration type, as has Osaka.

The street railways, which seem to be astonishingly numerous and popular, in the cities mentioned, are of the "double trolley" type and up-to-date, except that the cars are too small for the crowds they carry. The railway areas are generally well paved with rectangular slabs of stone about 4 in. thick, closely jointed, and from 12x18 in. to 18x30 in. in area. These pavements are generally kept in excellent condition even where the adjoining roadways are of the macadam above described.

In Tokyo some modern road machinery was noticed such as an asphalt roller, a macadam roller, and an elevator with spiral fins or vanes at the base for loading metal from piles on the ground. On the other hand, in Nara a section of road was being repaired and the broken stone was being rolled or consolidated in place by the traffic plus the operations of a stone cylinder about three feet in diameter by four feet long hauled back and forth by five oxen hitched tandem to it.

Wood Preservative in Bored Holes

Marine borers cannot be repelled from piles, poles or other timbers by filling bored holes with a solid preservative. Tests have been made by George M. Hunt, Forest Products Laboratory, as reported in *Wood Preserving News*, on longleaf sap pine specimens 2 ft. long and 6 to 8 in. in diameter bored with 1½-in. holes along the axis. About ½ lb. each of three chemicals, lead nitrate, sodium fluoride and arsenic were tightly corked into the specimens. After 14 months in salt water at Pensacola, Florida, inspection disclosed that the specimens were riddled by shipworms.

Making Meter Maintenance Pay Big Dividends in Texas

INCREASED income from a water-works plant from meter maintenance is seldom looked at from the dividend standpoint and in consequence the figures given below, of the results obtained at Cleburne, Tex., are of particular value. J. W. Hockaday, superintendent, water and sewer department, read the data at a meeting of the Southwest Water Works Association.

Referring to the table, two changes took place in 1917, more meters were installed and more money was spent in maintenance. All of the increase in revenue is credited to meter maintenance because the records show that the efficiency of the plant was not kept up, in fact it fell for several years. Attention is called to the fact that new meters installed do not need maintenance the first years of service. The record for 1919 shows new changes, higher efficiency and increase in revenue with a falling off in pumpage.

TABLE—RESULTS IN REVENUE DIVIDENDS FROM MAINTENANCE OF METERS IN CLEBURNE, TEXAS

Date	Million Gallons Pumped	Meter Maintenance Cost	Number of Meters	Return On Each Dollar Paid Out For Maintenance	Total Revenue	Increase in Revenue
1916	218	$134.52	1,000	none	$43,533	
1917	219	201 30	1,350	$4.00	44,359	$826
1918	226	207.00	1,600	5.00	45,359	1,000
1919	213	749.60	1,775	4.25	48,529	3,170
1920	271	104.14	1,950	loss	44,945	—3,584
1921	291	2,235 38	3,256	7.00	59,044	15,009
1922	219	3,476.26	3,303	6.75*	64,718	5,674

* Of this amount $1.75 was for increased revenue and $5 for decreased operating expense.

As in all cases where changes are made, new complications show up and the operators in 1920 were in a quandary. With an increase in revenue and a decrease in pumpage, the future looked bright, but what disappointment came when at the close of the year the pumpage had taken an airplane trip, while the revenue had gone on a long, long toboggan slide. Rejoicing satisfaction had been turned to disappointment and chagrin. It was determined not to install any more meters. It was figured that while the flat rate prevailed, the revenue was more and the pumpage less than with meters, therefore the conclusion was easily reached and the meters were condemned. This policy is shown by the small amount of money spent to maintain the meters. It was not known that this lack of maintenance was the cause of the whole trouble. Nor was it realized that the meters installed several years previous were slowing up, and that the meters recently installed needed investigation to learn if they too were under-registering. Anyway, the trouble was charged to the meters; practically nothing was done to maintain them and no more meters were installed.

In the first six months of the following year the system was completely metered and a meter maintenance crew was organized; in the last six months of the year $2,235 was expended for meter maintenancce. A marked change took place in the revenue column. Confidently entering the year of 1922, the greatest sum yet was spent for meter maintenance. The end of 1922 showed an increase in revenue of $1.75 for every dollar put into maintaining the meters and a remarkable decrease of $5 in operating expenses.

Possibly this paper should stop right here but the above is not all the story. When efficiency was at the lowest point, it was clearly seen by those who know the situation that the water supply was fast failing. The officials began to cast about for another water supply, and talk of a large bond issue was indulged in. The raising of the efficiency brought this department from a losing to a paying proposition, so that now this same department can swing a bond issue in such a way that it will not cost the people one cent for a new water supply. It is the right thing to install meters, but the battle has just begun then. The meters must be maintained.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Connecting New 60-M.G.D. Pump Sections To An Existing Wet Well

IN CONNECTING two new 60-m.g.d. steam turbine-driven centrifugal units of the Springfield Avenue pumping station, Chicago, to the wet well, a shaft was sunk directly under the pump and a tunnel, 15 ft. long, was driven to the existing pump well. Before work started on the tunnel a sluice gate was set in the old well on a block of concrete over the location of the outlet of the proposed tunnel. With the gate shut the tunnel could then be driven, lined and all connections made without unwatering the wet well which had to be kept in service for the other pumps.

DRILL-HOLE SCHEDULE FOR SUCTION TUNNEL, SPRINGFIELD AVE. PUMPING STATION

Note the close spacing of "primers" and the rows of "helpers." Holes were drilled 24 in. deep but only about 18 in. was peeled off at a time.

On account of the close quarters and the proximity to the pumping machinery above, only small shots in closely spaced holes in the tunnel heading could be used. The 1¼-in. holes were drilled by jackhammers, 2 ft. deep and about 12 in. apart, with four rings in the top half and three rings in the lower half. The photograph of the heading was taken after the last shot had been made and shows the drilling just before starting to use bull points to break through the last foot back of the sluice gate. About the same spacing was used for shooting except for the four holes between the two rows of five "primers" each, outside of which are the rows of "helpers" (four each). Sixty per cent dynamite in 1-in. sticks was used and peeled off about 18 in. at a shot. The bellmouth pump sections were concreted into the shaft over the end of this tunnel making a sealed connection 9 ft. below low water surface.

A sidelight in operation developed shortly after starting these new units in the way of complaints regarding fish in the mains. In winter the screens in the crib in the lake supplying this station are lifted because of difficulty with ice. With the centrifugal pumps the fish came through unharmed and appeared at hydrants and faucets. A rectangular screen cage 6½ x 9½ ft. in plan, 40 ft. high, with the four sides covered with ½-in. mesh No. 12 gage bronze wire screen, was built of angles and plates in the well over the end of the upcoming tunnel. Spring plates 8 x 12 in. long were riveted to the angle at the base of the cage to effect a tight joint. The velocity through the screen at the rated capacity of the station, 120 m.g.d., is 1.2 ft. per second. The wider screens weigh 2,000 lb. All ice is melted by the time it arrives at Springfield Avenue, but the fish do not disappear and it requires one man continually netting them out of the screen chamber. Formerly they undoubtedly went through the pumps and appeared, if at all, as "fish chowder."

The installation of the new pumps is under the supervision of Alex Murdoch, city engineer.

Water Increases Delivery Radius for Gravel Handled in Chutes

IN FINISHING up some of the fills placed in connection with the Ballantyne Pier at Vancouver, B. C., the contractor found it expedient to bring the material in on barges and to unload it by means of a grab bucket also on floating equipment. Part of the area to be filled was out of reach of the boom on which the grab bucket operated and the contractor therefore constructed a hopper or small bunker within convenient reach of the grab bucket boom and at such a height that a chute or flume could be led from the hopper on a 1 to 2 grade to the farthermost point to be filled.

From equipment on hand, a pump was rigged up to deliver water through a 3-in. hose into the lower end of the bunker through a nozzle directed downward into the head of the flume. Material already on the job, chiefly "leftovers," was used for constructing the hopper and the flume, and the lower end of the latter was arranged to be shifted conveniently so as to facilitate even distribution of the fill.

As the fill sloped directly into the tidewaters, there was no drainage problem and the pump was allowed to run continuously. Under this program, as fast as the material was dumped into the hopper it was carried rapidly down the flume to the desired position in the fill; in fact, a much flatter grade could have been used had this been necessary.

The contract is held by the Northern Construction Co. of Vancouver, of which William Smaill is chief engineer.

Carrying Heavy Loads Over An Old Wooden Bridge

By E. C. Seibert
Lieutenant, C. E. C., U. S. Navy, U. S. Veterans' Hospital, Gulfport, Miss.

During the progress of 5,000 marines from Quantico, Va., to Gettysburg, Pa., last summer, a bridge over Tom's Creek was encountered near Emmitsburg, Md., which was of interest to the officers for the primary reason that it held up the progress of the 3-mile train (supplies, ordnance, equipment, etc.) because of its inadequate strength. Further, it was of a fast disappearing type, so old as to be curious. It is a statically indeterminate truss-and-arch combination of approximately 66-ft. span, with a shingled gable roof and with covered sides, forming a through bridge. According to a native, its age is 80 years. It is built of white pine, which, above the floor system, is in a very fair state of preservation, considering its age, its chief defect being the presence of numerous small shrinkage cracks in places. However, the west arch has been broken a few feet from the north abutment, the floor system is badly rotted, and much of the roof and siding has disappeared.

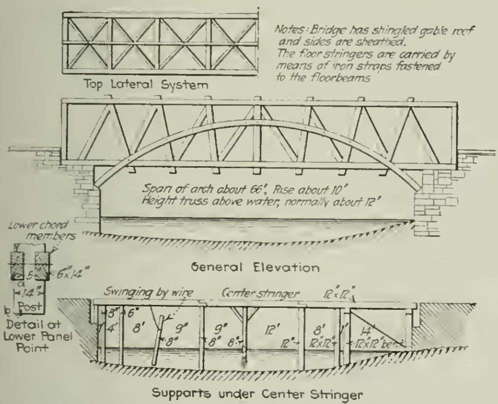


FIG. 1—OLD WOODEN BRIDGE AT EMMITSBURG, MD.

The bridge has been kept standing by the placing of a bent about 14 ft. from the north abutment (near the crack in the arch) and by several posts under the middle stringers, as shown in the drawing. These crude repairs, in effect, converted the bridge into a hybrid of trestle, truss, and arch. According to signs on the bridge, the maximum load allowable is 8,000 lb. This was being exceeded daily. When any load heavier than a touring car passed over, the deflection of the bridge was very noticeable, amounting to several inches in some places. The maximum deflections were reached when the "floating" props under the stringers came up hard against the creek bottom. Upon the advent of the marine train at the bridge, some of the lighter loads were allowed to pass, and part of the train laid by until a portion of the engineer company hastily put in some 8 x 8-in. props, wedged in place. The heaviest loads (tanks, tractors, mounted shops) were detoured several miles over a wrought-iron bridge.

On the return of the marines from Gettysburg, the above-mentioned detour having been by rains rendered practically impassable for the heavy equipment, an engineer company was sent in advance of the main body, and in 6 hr. completed the bracing shown in the view, enabling the entire train to pass with safety.

FIG. 2—TRUSSES SUPPORTED ON POSTS TO CARRY ARMY TRAIN

The members of the bridge are connected by wooden pins, except at the points of intersection of the arches with the trusses and at the intersections of the top laterals, where hand-made iron bolts are used. At the panel points the posts run between the two timbers constituting the chord, which are mortised into the post, thereby making the strength of the joint dependent upon the shearing strength of the timber along the planes *a*, *b*.

The portals of the bridge are architectural in character, of simple, classical lines. The bridge is a good example of an honest product, the combination of good craftmanship and wonderfully excellent materials. The writer has never seen recently produced timber which in his opinion would live half as long as has the pine in this old bridge, under similar conditions of service.

Steam Shovel Used to Break Up Tough Wood for Own Fuel

During the coal strike early this year which threatened to cut off certain Cuban industries from their supplies, a steam shovel was impressed into service to break up, for its own uses, a species of native buckthorn. No ordinary axe will cut the wood, so G. R. Buchanan, manager of the Cape Cruz Co., of Ensenada de Mora, rigged up the shovel in such fashion that the gang of laborers available was not able to feed the shovel fast enough.

Using an old mill coupling with an 18-in. square opening to take a wedged-shaped broken piece of 17-in. mill shaft, a hammer was rigged to operate in leads made of lengths of old rails. The shovel bucket was used to hold down the ends of the sticks so that they would not fly up when being broken.

With this arrangement 13,054 tons of buckthorn were broken into cordwood lengths at a total cost (which included reloading into cars and unloading into storage piles) of $26,065, or a trifle less than $2 per ton.

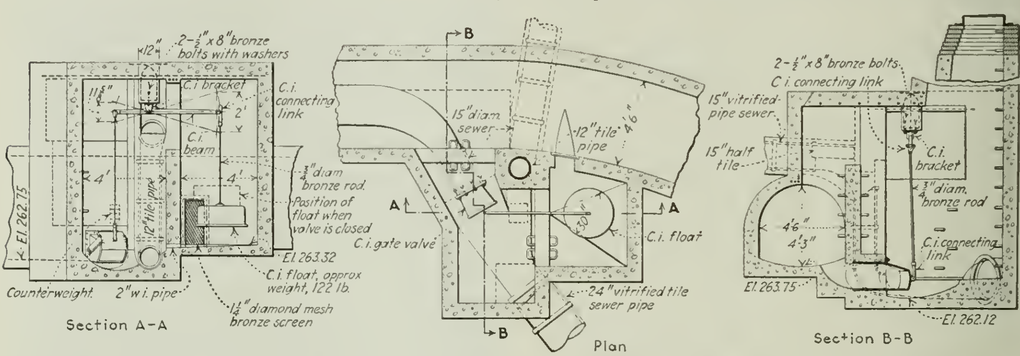
The information from which this item was written was supplied by the Marion Steam Shovel Co., Marion, Ohio.

Automatic Sewage-Flow Regulator for Intercepting Sewer

By H. S. Philips
Engineer of Sewer Design, Hamilton, Ont.

A SEWAGE-FLOW regulator to prevent excessive discharge to an intercepting sewer during storm periods has been designed for the Barton St. trunk sewer, Hamilton, Ont. The drawing shows a 54 x 63-in. cunette sewer with a 54 x 51-in. overflow to the Kenilworth Ave. storm sewer and a 24-in. intercepting sewer; also an overhead 15-in. sanitary connection from the Kenilworth South combined sewer, brought to one chamber to avoid duplication of manholes.

The cunette is designed to carry 1½ times the maximum dry-weather flow when the drainage area is fully developed. This flow will discharge through the normally open regulating gate until the volume increases so that it overflows the berm. As the flow passes the screened orifice, it is diverted to the float chamber, which causes the float to rise and gradually close the gate.



WALKING-BEAM TYPE OF SEWAGE-FLOW REGULATOR FOR INTERCEPTING SEWER AT HAMILTON, ONT.

The float chamber has been placed downstream so as to avoid, as much as possible, the offensive deposits which would be formed if the float were placed in the dry-weather flow channel.

The regulator is of the walking-beam type, and consists briefly of a segmental gate valve and a float of the diving-bell type, entirely of cast iron and bronze. The float is 30 in. in diameter and 13 in. high, of ¼-in. metal reinforced by ribs. A lead and a bronze washer are used at the joint between the float and rod, which necessarily has to be airtight. The float is constructed of cast iron in preference to brass or copper on account of the leaks which develop in these sooner or later. The instability produced by the center of gravity of a bell of uniform minimum thickness being above the center of gravity of the liquid displaced is met by partial suspension of the float from a rigid point as high as possible above the bell. The float is counterbalanced by weights on the gate-valve rod, added as required.

The cast-iron gate valve and fittings are of conventional design, having cast-iron faces with ¼-in. clearance, and the gate arms are fitted with bronze bearings. The connecting arms are of ¾-in. bronze rods with a cast-iron link holed for different adjustments on the float side. A simple universal joint of cast iron with bronze tube bushings is placed on the gate connecting rod.

The screen to the float chamber is made up of ⅛-in. diameter bronze wire on a 1¼-in. diameter diamond mesh with a ¼-in. diameter bronze frame, and is secured to walls by a ½-in. diameter bronze clamp.

From Job and Office

Hints that Cut Cost and Time

Large Relief Map Used to Lay Out Logging Railway System

IN PLANNING the woods operations of the Long-Bell Lumber Co. in Washington a topographical map was first made of a 133-sq. mi. tract of land on which the timber stands. Three duplicate relief maps were then made up on a vertical and horizontal scale of 200 ft. to the inch. Different colors were used to indicate different densities of stands, aerial cables were located by threads between pins, and threads on small tacks indicated projected railroads. Telephone lines, roads and other features of the development were also shown. In this way the relief map has proved a great aid in visualizing the scope and plan of the operations. Of the three duplicate maps one is to be kept at the woods headquarters as an aid in visualizing operations, the second will be kept at company headquarters to aid in projecting work in advance, and the third will be sent to the eastern headquarters of the company.

About 250 men were employed in making the field survey. Parallel lines were run through the entire tract, 440 ft. apart in a north and south direction, and, in addition to the section lines, east and west lines were run through to connect quarter-section points. A relief map was made by tracing each 10-ft. contour on cardboard and then cutting the cardboard to the outline of the contour. Each square mile was built up separately, the cardboard sections being glued together on a one-piece wooden base whose lower surface was an assumed datum below the lowest elevation in the tract. When all the sections were assembled the resultant map of somewhat irregular shape occupied an area 25 x 36 ft. The plotting of the notes and the assembling of the sections kept occupied a corps of about 25 men for six or seven months.

From Job and Office

For Contractor and Engineer

Simple Formula Solves Vertical Curves

By Stanley J. Nichols
Civil Engineer, Troy, N. Y.

Recent park work on which I was engaged involved extensive use of vertical curves. Textbook

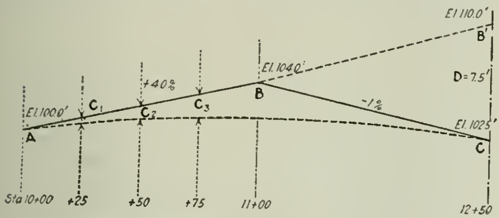


FIGURE FOR SOLVING VERTICAL CURVES

methods of computation proved rather tedious, so the following analytical formula was developed.

$$c = \left(\frac{d}{L}\right)^2 D$$

where c is the offset; D, the distance from the P.C. to the point of offset; L, the length of curve, and d, difference in elevation of the P.T. and the point B'. Then

$$c_1 = \left(\frac{25}{250}\right)^2 7.5 = 0.075$$

$$c_2 = \left(\frac{50}{250}\right)^2 7.5 = 0.300$$

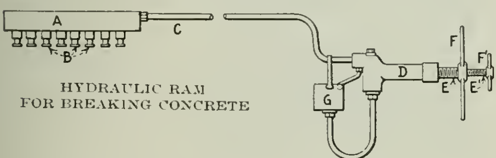
$$c_3 = \left(\frac{75}{250}\right)^2 7.5 = 0.675$$

In this case the offsets are subtractive, the curve elevations therefore being found by subtracting them from the elevations along the tangent line.

Breaking Up Old Concrete by Hydraulic Pressure

By Major Johnstone-Taylor
Lymm, Cheshire, England

Removal of old concrete is often difficult and costly work. Use of hammer and wedge is slow and laborious. The work is often in a confined or populous area and the use of explosives might be dangerous, or even prohibited. Hydraulic power can often be turned



HYDRAULIC RAM FOR BREAKING CONCRETE

to good account in this direction through the medium of a simple tool, the hydraulic mining cartridge.

Referring to the sketch herewith: pressure cylinder A has fitted to it, rams B. It is connected by steel pipe C to pump D. The plungers of the pump are operated by screws E and E', to which are attached handles F and F'. The tank G holds about a quart of water, cylinder A and piping being first primed. After this is done pressure is applied by the large handle and screw and final pressure by the small handle and screw.

The average pressure obtainable is 4 tons per square inch, and the machines are made with five, six and eight rams, the largest size, which is 4 in. in diameter and has eight rams, can exert a pressure of 240 tons. This pressure is used to split up the concrete or other mass into large blocks.

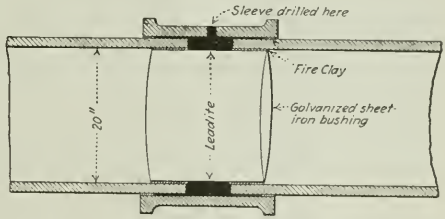
To operate a hole is first drilled. For a 4-in. machine this would be a 4-in. hole, some 36 in. deep. Into this is inserted the tool, the faces of the rams bearing on little plates of $\frac{3}{8}$-in. flat bar. It will be seen that the tool itself is very simple, but it requires machining from very strong material.

The arrangement of the pump shown here is not binding; provided sufficient pressure is available it can be obtained from a high-pressure hydraulic supply if handy, or from an ordinary hand-pressure pump of the type used with tire and axle presses. Generally speaking, however, a pressure of from 3 to 5 tons per square inch is required.

Repairing 20-in. Water Main With Sleeve That Was Too Small

By McKean Maffitt
Superintendent Water-Works and City Engineer, Wilmington, N. C.

In setting a 20-in. valve in a main we made the mistake of cutting our nipple pieces too short so that when we went to put on the sleeve there was a space of 7 in. between the ends of the pipe. To further com-



BUSHING AND LEADITE USED TO MAKE UP FOR TOO SHORT NIPPLES AND TOO SMALL SLEEVE

plicate matters the only sleeve that we had in stock was so small that it would barely slip over the pipe, not leaving enough space to get a yarning iron in.

The water was off, the pipe was cut, and something had to be done and done at once. This is what we did:

A bushing of heavy galvanized sheet-iron was made with an outside diameter of 20 in. and a length of 12 in. This was slipped inside the 20-in. pipe so as to bridge the space left between the ends of the pipe (see sketch). The space between each pipe end and the outside of the bushing was filled with fire-clay, the sleeve having been forced back for the purpose. The sleeve was then driven back to position and a 1-in. hole was drilled through its middle. The outside spaces at both ends of the sleeve were filled with fire-clay and the remaining space was poured with leadite which made a filler between the ends of the pipe and between the sleeve and pipe and gave us a watertight joint.

The only trouble we experienced was in getting the sheet-iron bushing to fit and in moving the sleeve over the pipe. The sleeve fitted so tightly that we had to use a sledge in driving it along the pipe.

Suspended Track Solves Overburden Disposal Problem

OVERBURDEN covering clay deposits being worked by the Adel Clay Product Co., of Adel, Iowa, is being disposed of easily and inexpensively through the use of the suspended track pictured herewith. To handle the overburden, which ran to an average depth of 14 ft., with men and teams was considered too expensive, so the structure shown here was constructed.

The loaded dump car runs over standard track from the clay pit to the point where the waste material is to be deposited. Here the track is carried out over a ravine by means of two 1½-in steel cables, 640 ft. long, that run to a tower 40 ft. high and are securely guyed. The ties that carry the suspended track are swung 30 in. below the main cables through the use of hangers;

DUMPING EARTH FROM SUSPENDED TRACK

these maintain the center of gravity below the cables. A bumper is provided to stop the car at the right point. The car weighs about 5 tons and handles a load of about 10 tons. One difficulty in tightening the cables was met by providing a four-lug clamp to hold the turnbuckles; a bent tube is used for turning them.

The former cost of about 30 cents per yard for disposing of this overburden has been reduced through the use of this device to a small fraction of that figure.

Repairing Leaks in Concrete Tank When Subjected to External Water Pressure

By R. W. Horne
Fay, Spofford & Thorndike, Consulting Engineers, Boston, Mass.

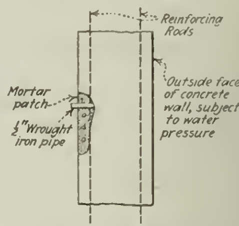
ABOUT three years ago the writer served as resident engineer upon the construction of a concrete fuel oil storage tank of about 2,500,000-gal. capacity. This tank was constructed in made land where it was subject to hydrostatic pressure from tide water, the head of water at high tide amounting to 15 to 20 ft. Inspection of the tank previous to filling it with oil showed a few instances where tide water was leaking into it. As there was to be no special waterproofing treatment of the concrete other than the use of a 1:1½:3 mix throughout, it was very important that all leaks be made absolutely watertight.

In repairing the leaks the method followed was to cut away the concrete to a depth of 2 or 3 in. in the vicinity of the leak until the vein through which the water entered was definitely located. The area over which the concrete had been cut away (sometimes amounting to 3 or 4 sq.ft.) was then repaired with a rich mixture of mortar made with quick-setting cement.

From Job and Office

Hints that Cut Cost and Time

It was soon found that in order to get a tight patch it would be necessary to relieve the water pressure from the fresh mortar until it had "set up"; otherwise the leakage was certain to find an outlet through the patch.



SECTION THROUGH CONCRETE WALL AND MORTAR PATCH

The additional precaution was therefore taken to relieve the water pressure by the use of pieces of ½-in. wrought-iron pipe a few inches long, which were plastered into the patch adjacent to the leakage vein, thus giving leakage water a free outlet through the pipe and obviating all chance of hydrostatic pressure upon the patch. When the patch had become thoroughly set, the opening through the pipe was tightly calked with lead wool, thereby effecting a patch which was certain to give no further trouble.

These patches were made in various parts of the tank which has now been in service for about three years without showing any evidence of further leakage.

Dish-Pan Reflectors Are Effective and Economical

USE OF galvanized-iron dish-pans as reflectors for illuminating night work on the Big Creek project of the Southern California Edison Co. has been most successful. Around the power house site or in the tunnel camps where a permanent location is possible the dish-pans are simply nailed to some convenient post or structure after having been wired for the desired number of sockets.

PORTABLE REFLECTOR FOR LIGHTING NIGHT WORK

The type shown in the illustration is for portable use along the penstock line. In this case the dish-pan is bolted to a 7-ft. length of ¾-in. steel rod, the lower end of which has been sharpened. A reflector of this sort served by a flexible cord can be moved about as desired and thrust into the earth at any convenient point. Two to four 150-watt lamps in this reflector give a broad beam of good light. The cost is very low and when bent or otherwise damaged the dish-pans can usually be bent back into shape and made serviceable again.

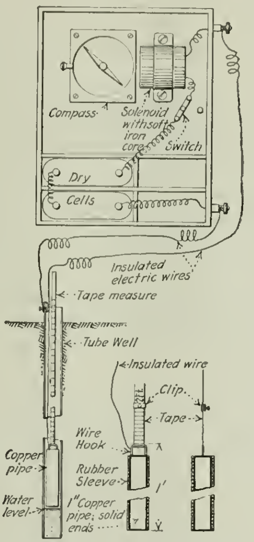
From Job and Office
For Contractor and Engineer

Pocket Electrical Device for Measuring Water Depth in Wells

By J. M. C. Corlette
Water Supply & Sewerage Board, Newcastle, New South Wales, Australia

Determination of water level in wells and pipes has been achieved in various fashions, but the simplest, perhaps, that the writer has seen is described in the following paragraphs. This device was used in accurately determining water levels in 1½-in. pipes sunk into sand beds from which water was being drawn by pumping.

It consists of a small pocket compass, a couple of dry cells ordinarily used in small cheap pocket electric torches, and a solenoid made by winding fine insulated wire on a cotton reel. One terminal from the cells is connected by insulated wire and a clip to the pipe in which the depth has to be ascertained. The other is connected through the winding of the solenoid to a suitable contact plate which can be lowered down the pipe, being kept insulated from the walls of the pipe. It is suspended by insulated wire and a measuring tape.



ELECTRICAL SET FOR DETERMINING WATER DEPTH

In taking levels the box carrying the compass is placed so that the needle of the compass lies transversely to the axis of the solenoid. On lowering the contact a current flows through the solenoid at the instant the water is reached and the magnetization produced results in a vigorous "kick" of the needle of the compass.

The cells used were about 3 x 2½ x ¾ in., and one was found to be sufficient, though two in series are shown, and they last at least three or four months, with fairly constant use.

The type of contact terminal can, of course, be varied from that shown herewith. One used successfully consisted of a piece of hardwood in the side of which a groove was made to house the insulated wire which continued to its end where it was soldered to a smoothed half-penny piece. It is necessary for the terminal contact to have a fair surface area to get good results.

If the compass is luminous it will be more handy for night work.

The apparatus as used was only roughly made up but gave accurate results over a long period. It would be easy to make it up in compact form to fit the pocket.

Stone-Filled Cage for Protecting Bridge Piers.—A method of protecting bridge piers from underscour which John B. Leonard of San Francisco has used effectively for a number of years is the construction of a stone-filled steel cage around the pier. Railroad rails are driven around the pier about 15 ft. out, and 18 in. apart. Usually these rails are about 20 ft. long. The space inside the rails is filled with niggerheads or any available rock that has rounded corners—sharp rocks have a tendency to wedge and defeat the purpose of the arrangement. When scouring action begins, the smaller rocks, which are always put in first, move toward the affected portion of the cage and effectively prevent the scouring action from getting inside the line of the rails. At the top of the cage, where there may be considerable movement of the filling, the individual stones are too large to pass between the rails. The smaller ones used in the lower portions of the cage are held by the weight above.

Precast "Brick" Lintels—In a building in lower New York City, where building alterations necessitated changes in the positions of windows, lintels, made of precast concrete pieces, were used. The concrete was colored with a pigment to simulate the color of adjoining brick. Joints were cast in the concrete and, after the lintels were placed, pointed with mortar to match the old joints. As the walls where those precast lintels were used were not bearing walls the concrete pieces did not have to have any particular structural strength, though it would have been possible to reinforce them properly if they had been subjected to stress imposed by a bearing wall. Saving in time and labor by using the precast lintels was considerable.

Inexpensive Circular Tank Forms—On a job involving the installation of two 6-ft. water tanks, 30 ft. long, in New York City, the contractor devised a unique method of fitting circular formwork used in placement of concrete forming the supporting walls at either end of the tanks. Plates cut to proper radius were made up of scrap black iron of about No. 18 gage, four or five of these plates forming the required circle. The form boards were cut with square ends nailed to the studs in such a manner that the space between the square end of the form board and the outside of the tank was not over 2 in. The sheet iron pieces were tacked to the inside of the form. The only fixed dimensions on the sheet metal were the 2-in. width at the narrowest portion, and the radius to fit the tank. *Contractor's Atlas* reports a saving of $4 a yard in the placement of concrete with such formwork.

Steel Bars Tie Curb and Gutter to Pavement—In order to secure true line and pleasing finish, and at the same time the structural strength resulting from constructing concrete curb and gutter integral with the pavement, the engineer in charge of paving at Libertyville, Ill., has employed unusual means. The curb and gutter have been constructed first, but with ½-in. round steel bars set in the curb at 3-ft. centers and projecting perpendicularly to the street axis about 9 in. Holes were drilled through steel forms to accommodate the tie bars which effectively tied curb, gutter and pavement together. An additional advantage lay in the fact that curb and gutter could be laid in advance of pavement. A more complete account of this feature of paving construction is contained in a recent issue of *Municipal and County Engineering*.

Abandoned Adit Used As Powder House—An adit that was being driven to tap the tunnel on the Skagit project, now under construction to augment the water supply of Seattle, had to be abandoned, after advancing 160 ft. This was because of the formation encountered, which consisted of large boulders so loosely thrown together that a man could crawl through the air spaces between them ahead of the heading. After discovering that a strong cold draft came out of the abandoned adit all summer long and that it was free from dampness, a powder house was built in the adit entrance and has been found most satisfactory.

Controller Regulates Water Flow Through Pressure Filters

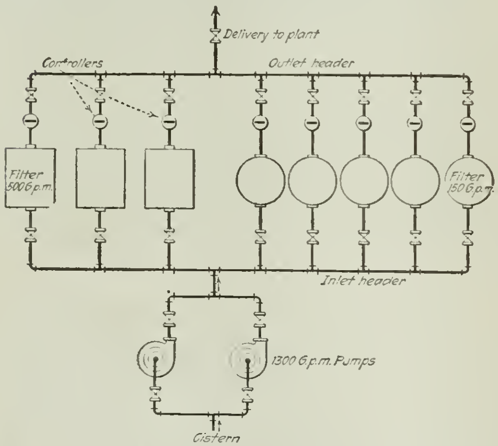
Device Reduces to Safe Capacity Water Passed Through Each of Eight Filters—Process of Filter Washing Also Improved

By C. C. Brown
Los Angeles, Calif.

A DEVICE for automatically regulating the flow of water through pressure filters was designed last year for use in a large Western industrial plant and has since been working very satisfactorily, entirely correcting the serious trouble that was the incentive for developing the device.

At the plant referred to there are five small and three large filters connected in multiple between an inlet and an outlet header, as shown in the accompanying plan. The inlet header is supplied with unfiltered water by two 1,300-g.p.m. centrifugal pumps and the outlet header delivers filtered water to the plant through a 12-in. line. The three large filters have an area of 160 sq.ft. of filtering surface and a capacity of 500 g.p.m., while the smaller units have an area of 50 sq.ft. of filtering surface and a capacity of 150 g.p.m.

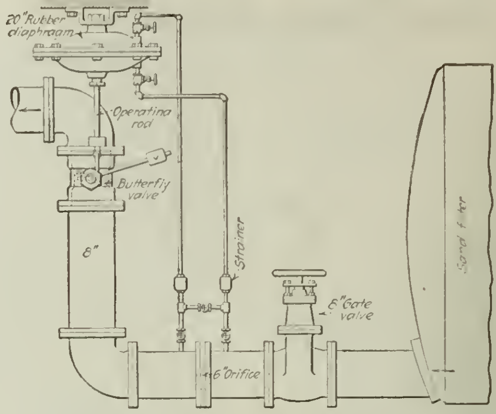
The original installation made no provision for equalizing or pro-rating the flow through the individual filters and as the demand for filtered water was about equal to



ARRANGEMENT OF PUMP AND FILTER UNITS

their combined capacity, a large part of the flow passed through those filters that constituted the most direct route between inlet and outlet. This overburdened the units nearer the center and slighted those at the ends. Water was therefore forced through the centrally located filters at a rate greatly exceeding their normal capacity of 3 gal. per square foot of filtering surface per minute. Tests showed that some of the filters were operating at over 500 per cent rating and not only was the material in the filter beds disarranged, but sand was even driven out into the distribution system.

Another factor which undoubtedly made the trouble worse was the method of washing the filters. Washing was done by cutting a filter out of service, opening the



ELEVATION OF DEVICE FOR CONTROLLING FLOW

Control is effected by closing or opening of the butterfly valve by movement of rod attached to rubber diaphragm in middle of chamber, two parts of which are connected by pipes to trailing and leading sides, respectively, in the filter effluent.

waste valve, and turning filtered water through it in the reverse direction for a period of ten minutes. This wash water was taken from the filtered water line which was under a pressure of 100 lb. per square inch. The valve through which this washing water was admitted to the filters was "cracked open" only far enough to maintain a pressure on the filter side of 15 lb. per square inch. No doubt this method produced a jet action which tended to disarrange the graded material in the filter bed.

The problem, therefore, was two-fold: (1) to control the flow through the filters so that each unit would deliver at the maximum rate but could not be forced to a capacity beyond the safe limit, and (2) to provide means of safely and effectively washing the filters.

Automatic control of the flow was accomplished by the regulating device shown in the accompanying sketch. It consists of a counterbalanced butterfly valve operated by a rod attached to a rubber diaphram. The diaphram is in a chamber from the upper side of which a pipe leads to the trailing side of an orifice disc in the filter effluent pipe line. A pipe from the leading side of the disc taps the lower side of the diaphram chamber. As the flow through the orifice increases above a predetermined rate, the diaphram draws up the operating rod and moves the butterfly valve toward the closed position until the flow is cut down to normal. For a decrease in flow the reverse action takes place. This device is said to have successfully maintained the flow in all filters within 2 per cent of the desired quantity.

To provide means of washing the filters without danger of any jet action, a tank was installed at a height above the filter floor sufficient to produce a pressure of 15 lb. per square inch on a dead filter and of sufficient capacity to supply the flow of washing water desired for one filter for 10 minutes with the valve wide open. This storage tank was filled up slowly between washings, thus reducing the large washing demand, and the actual washing operation was not harmful to the filter beds nor did it tax the peak capacity of other filters.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Wants New Word for Concrete Aggregate

Sir—Several years I have urged the use of some other word instead of "aggregate" for the stone element in concrete mixtures. "Aggregate" in the dictionary is defined as "the whole"—not a part. Why not coin a word like "copards," meaning co-partners of cement and sand.

W. D. BROWNING,
Mechanical Engineer.

Memphis, Tenn.,
August 28, 1923.

Simplified Formulas for Eccentric Heel Joint of Truss

Sir—The formulas given by Camillo Weiss in the article "Trapezoidal Portal and Eccentric Heel Joints," in your issue of Aug. 30, p. 339, offer a satisfactory solution of a problem frequently occurring in practice and all too often neglected. For their further simplification, however, I would like to suggest the approximation $l_1/I_1 = l_2/I_2$ instead of $l_1 = l_2$. This makes $M_A = M_B$, thus greatly simplifying the use of the equations in actual design. The results will not be as accurate in some cases, but considering other uncertainties any great accuracy is not warranted, nor is it necessary for design purposes.

Incidentally, I notice that in the article the expressions for M_A ad M_B in the first two cases in which they occur are interchanged, by error.

WALTER H. WEISKOPF.

New York City,
Aug. 31, 1923.

Under Pressure and the Apishapa Earth Dam

Sir—I believe that the following line of reasoning has not been considered by hydraulic engineers and may account for some failures of dams and levees. The failure of the Apishapa earth dam, described in your issue of Aug. 30, p. 357, may or may not have been due to the thing I have in mind, but it is significant that the dam failed when the pool was not full nor even up to the load of the spillway; also that it leaked some time before the failure, and the leaks were stopped and the trouble apparently remedied.

When a leak occurs in the downstream face of an embankment, or on the land side of a levee, the most natural thing to do is to stop that leak by compacting the soil. It is just this process that has given rise to greater leaks and to failures. When the surface soil is compacted, the leaks may be stopped for a while, but a condition is set up by the compacting of the soil in a superficial way that is apt to create a greater menace than the loss of the water that may be trickling through the leak.

I refer to the thing that has caused the failure of so many masonry and concrete dams, namely, under pressure—the accumulation of a water head under a block of masonry or concrete that, with the horizontal pressure on the upstream face, lifts the block and either allows the water to flow under it and wash away the soil beneath or overturns the block, with the result that the dam fails. A large number of dams have failed from this cause, because they were not wide enough at the base to stand against the combined pressure.

The menace in the case of an earth dam is an accumulation of water pressure under a shell of compacted earth that is sufficient to lift it. Once lifted there is exposed a softened mass of soil to which the water has had access, and which that water has rendered semi-liquid. The exposure of this semi-liquid material, and its free vent, results in a leak of greater consequence than the one previously discovered and rolled or tamped to cause it to seal up.

Compacting or paving a surface where water with a head is apt to accumulate under the surface is fraught with great danger. Leaks discovered in such surfaces need special treatment. They should be dug out and the course of the water traced to its source, if possible. Or some sort of sub-soil compacting should be employed, something that will not produce an impenetrable shell for water to lift.

EDWARD GODFREY.

Pittsburgh, Pa., Sept. 1, 1923.

An Irregular Standard

Sir—In *Engineering News-Record*, Sept. 6, p. 372, "An Irregular Standard," 4th line from the bottom of the paragraph, reads: "one may be curious to know." If he wants to know very bad, he might look up "Life of George Stevenson," and find that the old coal pit tramways of about 100 years ago, for which George Stevenson built his first "locomotive engines," had 4 ft. 8½-in. gage; which thus came to be perpetuated; and isn't bad, as you say.

CLEMENS HERSCHEL,
Civil and Hydraulic Engineer.

New York City,
Sept. 7, 1923.

Measurements by Eighths of an Inch

Sir—Recently the plat of a survey in the vicinity of New Orleans was referred to me for interpretation. The sketch showed a front dimension, with notation as follows: 63.11.3', the lot being subdivided into two plots with dimensions as follows: 31.11.5' and 31.11.6', respectively. On first glance it would appear that the last digit represents thousandths of a foot. Another engineer was authority for the interpretation that the notations, in order, represent feet, inches and *tenths* of an inch. A summation of the dimensions however, bears out the writer's conclusion that the dimensions are noted as feet, inches and *eighths* of an inch.

Still more recently, a survey from the same locality, bears the dimension 52' 6" 7"'. Is the writer correct in interpreting this dimension, as before? Secondly, are these notations peculiar to certain localities, or are they merely characteristic of the individual engineers preparing the plats?

If there exist systems of notation in various parts of the country differing from the widely accepted standards, a summary of them might be of interest to engineers having to do with data from widely separated localities.

ERIC FLEMING,
Civil Engineer.

New Brunswick, N. J.
Aug. 12.

[The foregoing letter was sent to one of our southern correspondents who gives the following information.—EDITOR.]

Sir—In reply to your letter of August 28 enclosing letter from Eric Fleming, I would say that the dimension 31.11.5' and 31.11.6', as well as the dimension 52'6"7"' would be interpreted in this vicinity as meaning, respectively, 31'11$\frac{5}{8}$", 31'11$\frac{6}{8}$, and 52'6$\frac{7}{8}$". It is common experience to find dimensions given in this manner in the old notarial records.

It might be interesting to note that in a circular issued some time ago by Grandjean, Daney & Waddill, surveyors of New Orleans, the following explanation of surveying terms used in the South is made:

"The lands of Louisiana while a French colony were first surveyed by *arpents*. Spanish rule maintained this standard of measurement and our laws yet prescribe that plats of surveys shall indicate measurements in French as well as in American measure.

"The *arpent* is the old French lineal measure comprising 30 *toises* of 6 ft. each of the City of Paris. Its true equivalent in American measure varies according to different authorities from 191 ft. 9$\frac{3}{4}$ in. to 191 ft. 10$\frac{3}{4}$ in. but is considered as 192 ft., or 2909 chains by the U. S. Government."

This same circular contained a table giving French feet and their U. S. equivalents, the French foot being 1 ft. 0 in. and 6 *lines* (formerly *lignes*) long or 1 ft. and $\frac{6}{8}$ of an inch.

DONALD DERICKSCN,
Head of the School of Civil Engineering,
Tulane University.

New Orleans,
Sept. 6, 1923.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Contract for the Installation of 110 miles of automatic train control system between Camden and Atlantic City on the Philadelphia and Reading R.R. has been awarded to the Union Switch & Signal Co., of Swissvale, Pa. The first contract is for $300,000 and the complete work will require $500,000. It is believed that this is only the second case in which a whole division is to be equipped with automatic train control.

The Alaska Mineral Development Co. has applied to the Federal Power Commission for an extension of one year on its preliminary power permit in order to enable it to modify its plans to suit the requirements of the Bureau of Fisheries. The company, which is affiliated with the Guggenheim inter-es s, had submitted plans for a power development on Bradford Canal in Alaska, but the original plan conflicted with the fishing interests.

The Pike Rapids Power Co. has received a license to construct a hydro-electric power plant on the Mississippi River near Royalton, Morrison County, Minn. A dam 42 ft. in height and a power house will be constructed just above the Minneapolis, St. Paul & Sault Ste. Marie R.R. bridge. The project will have an ultimate capacity of 24,000 hp. for use in pulp mills and iron industries.

The War Department Announces that there will be a public hearing held at the County Court House, New Brunswick, N. J., at 2 p.m. daylight saving time, Wednesday, Sept. 26, in the matter of the proposed New York Bay-Delaware River section of the intra-coastal waterway. All interested parties are expected to attend and for the purpose of accuracy of records persons having important facts and arguments to present are requested to submit them in writing. Maps showing the location of the proposed canal and the estimates are on file at Room 604 Army Building, New York City.

As a Result of the Dissension between the American and Canadian groups of the Ottoman-American Development Co., arbitrators have decided that Rear Admiral Colby M. Chester and his associates will withdraw from the development company upon payment by the company of $300,000 within 90 days of the award. The Chester group will, however, retain a 10 per cent interest in the Ottoman-American Exploration Co., a subsidiary of the principal corporation. With the withdrawal of the Chester group from the development company, Col. K. E. Clayton-Kennedy, a Canadian engineer, will be the principal representative of the company in the field. Engineers of the company were due to sail for Turkey this week.

Anthracite Miners and Operators Agree on Contract

Agreement on the principles of a contract which is to run two years, and which grants to the miners a 10 per cent wage increase and the eight-hour day, provides for a thorough study of the industry and acknowledges the right of labor to bargain collectively, was made by anthracite operators and miners in a conference in Harrisburg, Sept. 8, as a result of a series of conferences called by Governor Pinchot, of Pennsylvania. The tentative contract was taken before the full scale committee of the United Mine Workers of America, which body ratified it. A tri-district convention is to be called Sept. 17, and upon ratification of the contract by that convention work in the hard coal fields is expected to resume within 48 hours.

Miners agreed at this time to drop insistence upon the check-off on union dues and the operators agreed to give up temporarily at least the demand for arbitration.

Statement of the miners is to the effect that the new contract, which will be in force until Aug. 31, 1925, is the best that the industry has ever seen, so far as they are concerned.

Samuel D. Warriner, spokesman for the operators, asserted after the conference that mine owners were relieved that a settlement had been made, but that he did not believe a wage increase was justified at this time. However, he added that it was not the desire of operators to take the "responsibility of a protracted suspension in the face of Governor Pinchot's proposal."

Philadelphia City Council Stops Arch Street Subway Work

By action of the Philadelphia City Council, funds for construction of the subway in Arch Street have been withdrawn. This action stops work under the contract awarded by the city on July 27 to the Keystone State Construction Co. for $1,198,555. The action of City Council was taken following a message from the mayor pointing out that so long as the money was available he felt compelled to go ahead with the work.

The Arch Street subway was a portion of the "delivery loop" in the business section of the city, included in the transit plans voted upon in 1917. A few months ago the City Council withdrew the funds provided for the subway in Broad Street, and then mapped out new plans for comprehensive transit development in the city. The Arch Street subway is not included in the new plans, and the action of the Mayor under the conditions was very much criticized.

The present action of withdrawing funds after the contract has been awarded may make the city liable for damages for breach of contract, but no such action has been instituted.

Weeks Suggests Eliminating Gorgas Plant in Ford Bid

Detroit Manufacturer Confers With Secretary and Coolidge—Revised Offer Might Be Acceptable

Washington Correspondence

Henry Ford has taken under consideration a suggestion by Secretary of War Weeks that he amend his bid for a long-term lease of the Muscle Shoals hydro-electric project so as to eliminate from this offer acquisition of the Gorgas steam plant on the Warrior River.

Mr. Ford, accompanied by his son and engineers who have handled the negotiations for Muscle Shoals in his behalf, conferred Sept. 6 with Secretary Weeks and also with President Coolidge. Other than that the suggestion would be taken under consideration, there was no formal statement.

The Alabama Power Co., acting under the terms of the contract between it and the federal government when the Gorgas steam plant was extended by the government during the war, has notified the War Department formally that it desires the government to vacate this property and has offered to pay $3,000,000 for that portion of the plant which was built by the government. According to informal statements of high officials of the administration, this price is considered fair.

Amendment Once Rejected

During the months of discussion in Congress regarding the disposition of Muscle Shoals, during which the Ford offer attracted outstanding attention, Mr. Ford declined on several occasions to amend his proposal so as to exclude the Gorgas plant. His desire evidently is to have an auxiliary steam plant where coal may be obtained the cheapest, and Gorgas is located at the mouth of mines on the Warrior River. It has been pointed out, however, that coal could be floated down the Tennessee River to an auxiliary plant at Muscle Shoals itself at low transportation cost.

From the fact that a conference on this subject was held with Mr. Ford at the request of government officials, it is generally believed in Washington that if Mr. Ford were to amend his offer so as to eliminate the Gorgas plant, the administration probably would throw its influence towards acceptance of his bid.

Gage Changing on Provincial Ry.

Changing the gage of the Prince Edward Island Railway from 3½ ft. to the standard gage of 4 ft. 8½ in. is progressing rapidly. It is being accomplished by laying a third rail outside the narrow gage rails to provide for the operation of both standard and narrow gage equipment over sections of track connecting subdivisions having different gages.

Dr. Karl Imhoff Visiting America

Dr. Ing. Karl Imhoff of Essen, Germany, well known for his work in connection with the two-story sewage settling and digestion tank that bears his name, arrived in New York on Sept. 9 for a two weeks' stay. He will visit a few sewage-works in the East and in Chicago and vicinity.

Morris Knowles Heads Pittsburgh Zoning Appeals Board

Morris Knowles, consulting engineer of Pittsburgh, has been made chairman of a three-member commission, to which may be appealed decisions of the superintendent of the Pittsburgh Bureau of Buildings in the matter of zoning law interpretations. The board is empowered to reverse or affirm, wholly or in part, any requirement or determination appealed from, in order to obtain conformity with the zoning ordinance.

The board also is given power to interpret the provisions of the ordinance in cases in which the street layout actually on the ground varies from the street layout shown on the zone maps, in such a way as to carry out the intent and purpose of the zone maps.

Mr. Knowles, who, as chairman of the board, will receive $4,500 a year, is to serve until Jan 1, 1924. The other two members will receive $4,000 a year each.

North End Bridge in Springfield Destroyed by Fire

Special Correspondence

The North End Bridge, connecting the city of Springfield and West Springfield, Mass., and having an estimated replacement value of $500,000, was completely destroyed by fire Sept. 8. It was built in 1878 and was of the Warren type, containing 5 spans, and the first steel highway bridge in the locality. The fire, which it is believed started from a burning cigarette, was given great impetus by the fact that floor joists were tar-coated timbers supporting creosoted wooden block paving. Burning gas from a broken main hastened the bridge's destruction. Within ten minutes three spans had been entirely destroyed and inside of an hour two of the remaining spans had fallen. Firefighters first drew water from a hydrant at a point where the pressure was so great as to burst hose lines. At another point the pressure was too low to be of great service. The falling of high-tension wires also made the firefighting difficult.

The bridge had been repaired and strengthened repeatedly. In 1909 some floorbeams were strengthened and reconstruction work was done on the two end spans. Three years ago a new floor was laid, some steel replaced by stronger members and $25,000 was spent in general repair work by the Springfield Electric Railway Co. The maintenance of the bridge has been mainly borne by the city of Springfield and the town of West Springfield. The opening of the new Hampden County Memorial Bridge last year was designed to relieve the North End bridge of much traffic, but the general opinion prevails that a bridge on the site of the North End bridge is indispensable. An inquiry has been started into probable cost of a new structure. The City Planning Board advises a wider bridge be provided than the old.

Engineer Wins Capital Prize in Traffic Problem Contest

Arthur S. Tuttle, chief engineer of the Board of Estimate of New York City, won the first prize of $1,000 offered by various national vaudeville circuit managers for the best suggestion for relief of New York City traffic congestion. The $1,000 prize, together with one of $300 and another of $200, were offered in connection with the recent Silver Jubilee sponsored by Mayor Hylan.

Mr. Tuttle's proposals include relieving the section adjoining 42nd St. by making all north and south streets one-way streets and introducing the block system of traffic control; continuing Riverside Drive from 72nd St. to the Battery as an express highway or as an elevated structure with occasional ramps to the street; and arcading sidewalks so that the present entire width of congested streets be made available for vehicular traffic.

American Construction Council To Hold Annual Meeting

The annual meeting of the American Construction Council is to be held in the Engineering Societies Building, 29 West 39th St., Friday, Sept. 21. No details of the program are yet available, but it is certain that important matters confronting the construction industry with respect to labor supply and unemployment will be discussed. The Council is co-operating with local building congresses in investigating these problems as well as making a survey of apprenticeship needs.

D. Knickerbacker Boyd, Philadelphia, has been appointed to the recently-created office of executive vice-president, and Dwight L. Hoopingarner, Cleveland, has been made executive secretary.

To Study the Power Resources of Pennsylvania

The State of Pennsylvania has organized a survey board to be known as the Giant Survey Board for the purpose of studying all the available sources of energy within the state and to outline the best methods of utilizing them. The survey will be in charge of Morris L. Cooke, formerly director of public safety in Philadelphia. Other members of the board include Attorney General Woodruff as vice-chairman, Major Robert Y. Stewart as secretary, W. D. B. Ainey, chairman of the Public Service Commission, George H. Ashley, state geologist and Robert H. Fernald, director of the Department of Mechanical Engineering at University of Pennsylvania.

The study will include the possibility of development of power at the mines and the economies to be effected through the recovery of the byproducts from the coal so used. It will also study the question of transmission with special reference to the requirements of small communities and farms, with the idea of putting these people on the same basis as city dwellers as far as power is concerned.

It is hoped that the cost of power will be materially reduced by the proposed large scale production through the reduction of transportation charges on coal and the elimination of waste.

Public Buildings Bill Again Before Administration

Congressional Committeemen Present Coolidge Views on Construction of Federal Buildings

Washington Correspondence

While the situation in the construction industry has eased according to reports to governmental agencies, in so far as over-ordering of materials is concerned, there is no change in sight sufficient to alter the attitude of the national administration toward a wide-spread program of construction of federal buildings.

Chairman Langley and Representative J. Will Taylor, of the House Public Buildings Committee, recently presented to President Coolidge the views of the majority of that committee that an omnibus public buildings bill with an appropriation of at least $100,000,000 should be enacted early in the life of the next Congress. While admitting the need for more adequate facilities for federal departments in various cities, it is understood that the President indicated opposition to an omnibus bill under conditions which exist at present. This was the view also of the late President Harding, and it is the view of Secretary of Commerce Hoover and of Secretary of the Treasury Mellon.

Proposal Killed Last Season

A proposal for an omnibus buildings bill was killed in the last Congress by opposition from the administration and the same fate appears to be awaiting any similar proposal in the incoming Congress, next Winter at least.

It is understood that President Coolidge agrees with Secretary Mellon who recently asserted that there is imperative need for several buildings in Washington to house branches of the various departments, some of which are now occupying wooden buildings erected as temporary structures during the war and which are rapidly falling to pieces. There is considerable doubt, however, that a building program for the federal government in Washington would be approved by Congress unless it went hand in hand with a considerable program of construction outside of Washington.

It may be possible to secure consent for the passage of a bill authorizing construction in Washington and in a number of other cities, but without carrying an appropriation for the work, actual construction to be held up as a pool for the stimulation of the industry when private contracts become slack. There are a number of conflicting ideas to be reconciled even in a plan of this character, however.

St. Louis Engineers Ask Voice in Expending Huge Sum

The St. Louis section of the American Society of Mechanical Engineers has recommended that an engineer be employed to serve the Citizens Supervisory Committee charged with the administration of the $88,000,000 municipal bond issue recently voted by the City of St. Louis, Mo. The engineers point out that practically all of the work involved by the bond issue is composed of engineering problems, yet not a member of the Citizens Supervisory Committee is an engineer.

Work Forms Commission to Make Reclamation Study

Seven Prominent Men Including One Engineer Invited To Serve on Body

The formation of a fact-finding commission to investigate the whole system of Government methods in reclaiming arid and semi-arid lands by irrigation was announced Monday by Secretary of the Interior Work. Invitations were sent to seven citizens of national prominence asking them to serve as members of the commission and conduct an intensive study of the problem. They are: Julius Barnes, president, U. S. Chamber of Commerce; Oscar E. Bradfute, president, American Farm Bureau Federation; James R. Garfield, former Secretary of the Interior; Elwood Mead, consulting engineer and author of works on irrigation and reclamation, Berkeley, Calif.; former Governor Thomas E. Campbell of Arizona; former Governor David W. Davis of Idaho, Commissioner of Reclamation; and Dr. John A. Widtsoe, former president of State University and State Agricultural College of Utah.

Text of Invitation

The letter of invitation sent Monday by the Secretary of the Interior is as follows:

"The purpose of this letter is to invite you to serve with six other men having national confidence, on a fact-finding commission, to make an intensive study of the policy, application and operation of Government methods of reclaiming arid lands by irrigation, which has become a matter of national concern.

"It is generally reported that relatively few of the original settlers on projects now remain on them as water users. One hundred thirty-four millions of Government money have been expended. Fourteen millions have been returned and six millions are due and unpaid as of Dec. 31, 1922 to which must, very soon, be added computations for the present calendar year.

"Time extensions for payment of both construction and maintenance charges have been asked which, if granted, would multiply deferred annual payments, it is feared, beyond the ultimate ability of the settler to pay, entailing probable loss of his home and to the Government the loss of the investment.

"The purpose of this inquiry, in which I very much hope you may participate, is to have the processes of administration of this trust reviewed by men of affairs applying their best thought to this important governmental agency.

"Reclamation has done much toward the development of the west, but it now clearly requires to be adapted to existing conditions, so that its future success may be achieved and the possibility of home ownership be assured to settlers.

"Your commission will, of course, be provided with suitable offices, necessary data and the courteous assistance of the Bureau of Reclamation.

"As the work progresses, you will be supplied with itemized statements and complaints coming in, of which I must take cognizance, and which may serve to indicate the direction the commission may be prompted to take in its inquiries.

"Although only recently charged with the responsibility of reclamation, I am not a stranger to the irrigation of arid lands, but prefer, however, not to suggest procedure and would not expect to advance opinions to this commission unless requested, asking only that the questions may be treated with open publicity and that I may transmit your report to Congress."

California Allots $10,000 Toward San Pablo Dam Survey Fund

The United States Reclamation Service has made an allotment of $20,000 toward the surveys of the proposed dam across the lower end of San Pablo Bay, which is an arm of San Francisco Bay, and related work, contingent upon an equal amount being provided from other sources. On Aug. 31 W. F. McClure, state engineer of California, announced that $10,000 will be contributed by the state toward this work. It therefore remains for a committee recently created by the Sacramento Valley Development Association to secure the remaining $10,000.

The proposed dam is expected (1) to solve the salt water problem in the lower reaches of the Sacramento River; (2) to afford a large fresh water harbor free from tidal effects; and (3) to provide a highway route across the bay at this point.

Uniformed Crossing Watchmen Command Respect

Due to the flagrant disregard of the warning of crossing watchmen at Youngstown, Ohio, the Erie Railroad Co. has had its crossing watchman appointed as a regular member of the police force of the city and properly uniformed as such. Under this new arrangement he has been able to demand the respect of automobile drivers on the highway the same as any traffic policeman with the result that there have been no more accidents due to disregard of his orders, nor have the crossing gates been broken as they occasionally were previously. The plan has been so successful that other railroad companies are now considering it for use in similar locations.

Detroit Engineering Society Acquires New Home

In early October the Detroit Engineering Society will hold a house warming in a clubhouse which has but recently been acquired. Alterations are now being made on the house, which is a large residence located at 478 Alexanderine Ave., West. Acquisition of the property is the result of a plan definitely outlined a year ago providing for the purchase and equipping of a house for about $65,000, and the incorporation of the society. The society was incorporated in early June of this year.

In order to care for increased service which the society will offer in its permanent and enlarged quarters E. L. Brandt has been engaged as managing director. Mr. Brandt is a civil engineering graduate of the university of Michigan and spent one year with the American Bridge Co., 15 years with the Michigan Central R.R. at Detroit and a year as assistant secretary of the American Association of Engineers at national headquarters.

$175,000 More Asked for Lake Worth Bridge

A bridge across Lake Worth, to connect Palm Beach and West Palm Beach, originally estimated to cost $200,000 will cost $450,000, engineers have reported to the board of county commissioners. The county commissioners have authorized a call for bids for the purchase of $175,000 worth of bonds to provide the remainder of the money needed to complete the bridge.

An eastern engineering firm made soundings of the formation under the lake and estimated the base rock as not thick enough to support the bridge. The rock broke under the weight of piers and sections of the bridge that collapsed eighteen months ago. More complete data as to the foundation caused engineers to agree that many piles would have to be driven; this course was adopted and was one of the reasons why a larger cost will be necessary.

The legislature had authorized the county commissioners to issue the $175,000 additional bonds for which bids will be asked.

C.P. Ry. Completes Two Surveys Across Rocky Mountains

Montreal Correspondence

Four Canadian Pacific Ry. survey parties which have been working in the Rocky Mountains during the past season have, according to press despatches, about completed their work and are now preparing their reports.

It is understood that these parties have been studying two possible routes across the Canadian Rockies with the idea of extending the Edmonton, Dunvegan and British Columbia Ry. from its present terminus at Spirit River in the Peace River country in Alberta to some point on the Pacific Coast.

One of these proposed routes runs due west from Spirit River across British Columbia to a point on the Portland Canal north of Prince Rupert. The second route goes west from Spirit River to Pine Pass in the Rockies and then due south along the Parsnip River to Prince George on the Grand Trunk Pacific and thence south down the Fraser River to connect with the Pacific Great Eastern Ry. at Quesnal, a distance of 380 miles, with a possible 55-mile connection between the southern end of the Pacific Great Eastern and the C.P.R. near Vancouver.

The construction of either line would be a great engineering feat and the proposal is interesting from that point of view but from the point of view of present practicability either seems unnecessary and it is doubtful whether the C.P.R. is seriously considering any such undertaking. There are at present three transcontinental railways across British Columbia which give the greater part of the prairie provinces access to the Pacific ports. The only section that is not so served is the Peace River country, but it is a new country which could not support a railway to the coast. For the present its traffic can be handled eastward through Edmonton. In the future when the traffic offered is greater than the present routes can handle then some such new route to the Pacific will be of real practical interest.

Employment of Engineers Active in Central States

Salaries on West Coast Lower Than Elsewhere—Pay Averages Given for Various Services

Employment conditions affecting engineers are most active in the central and southern states, particularly in the highway, railroad, municipal and building fields, according to the employment service of the American Association of Engineers. In the East and Northeast, conditions are not quite as active but there is a healthy demand for technical services around New York, Boston and Philadelphia, although Boston in comparison is dull. Engineering employment in the western states is sufficiently active to take care of practically all engineers residing in that section of the country.

Engineers in West

The West Coast and Southern California seem to be the mecca for a large number of engineers. High grade men are working for beginners' salaries either because they want to be there or are forced there on account of illness in their families. The A.A.E. Chapter secretaries in California have an oversupply of applications on hand for all classes of positions. However, a fair demand exists for electrical, telephone and architectural engineers but it is rather dull for the structural, concrete, municipal, highway or general construction engineers. Engineers wishing to enjoy the healthful climate of Southern California must, in a measure, be content with a lower salary than secured elsewhere. Practically no assistance can be given eastern men to locate positions in that district unless they go out there to be on the ground when a vacancy occurs.

Average of Salaries

From the best information available from a wide variety of sources covering the entire country, the average engineering salaries per month at the present time are as follows: Tracers, $125 to $150; detailers, structural, mechanical, and electrical, $150 to $215 (a few companies have paid for special short time jobs as high as $250 a month for experienced detailers); designers on all classes of work, $225 to $300, with a few engagements at $325 and $350 where the men were able to take care of squads; estimators, $300 to $350; rodmen and levelmen, $125 to $160 (this includes highways, the municipal field and railroads); instrument men, $150 to $175 (where some responsibility was required such as chief of parties, $175 to $240); assistant engineers, $225 or more depending on responsibility or class of work; map draftsmen, $150 to $200; surveyors, $160 to $190; research engineers, $175 to $250; construction engineers, $200 to $325; superintendents of construction, $275 to $500; resident engineers, $200 to $300 depending on class of work; industrial engineers, $200 to $500.

Salaries for engineers such as building superintendents and mechanical engineers vary with duties and company. For temporary positions, the average is about 20 per cent more than the figures given which are on permanent appointments.

Philadelphia Engineers to Confer on Stream Pollution

A conference will be held at the Engineers' Club of Philadelphia on Oct. 16, afternoon and evening, at which time pollution of streams, especially with reference to pollution by industrial waste, will be the chief topic of discussion. Representatives from the national, state and city governments, and several of the industries most interested in the subject will be present. Papers will be read and discussed by a number of engineers who are recognized authorities and are thoroughly conversant with the subject.

The complete program with the titles of papers and names of speakers will be ready before Oct. 1, and will be sent, together with an invitation to attend the meeting, to any engineers or industrial executives who may desire to be present and take part in the discussion.

Gen. Marshall Elected Head of Quartermasters' Association

Election of R. C. Marshall, Jr., of Washington, as president of the National Quartermaster's Association at the recent meeting in New York is expected to bridge the breach in the membership which was threatening the success of the organization as to whether control should be vested in the regular army officers or in the civilian group.

Gen. Marshall was induced to enter the contest only after being urged to become a compromise candidate. While he is now a civilian, holding the rank of brigadier general in the Reserve Corps and being a member of the contracting firm of Marshall and Maddox Co., Washington, and general manager of the Associated General Contractors of America, for many years Gen. Marshall was an officer in the regular army and served as head of the construction division of the Quartermaster Department during the war.

Gen. Marshall defeated Major Gen. William H. Hart, Quartermaster General of the Army, who was proposed for re-election.

Grand Canyon Survey Reaches Bright Angel Trail

The U. S. Geological Survey party making a trip through the Grand Canyon of the Colorado in boats has arrived safely at Bright Angel trail, Grand Canyon National Park, having traveled 90 miles without serious accident. This party, which consists of ten men headed by Col. C. H. Birdseye, started on Aug. 1 in four specially constructed lifeboats from Lees Ferry, Arizona, to complete a topographic survey of the Grand Canyon as far as Boulder Creek, Arizona, a distance of 310 miles.

The party is provided with a radio receiving set built especially for use in the Grand Canyon, and notwithstanding the predictions of radio experts that it would be impossible to receive radio messages while traveling in the bottom of Grand Canyon, Col. Birdseye reports that he is in daily receipt of messages broadcasted from Los Angeles, Salt Lake, and Chicago.

The party expects to complete its work early in November, but will send out reports of the progress made on reaching Basstrail about Sept. 10, Supai Creek Sept. 20, and Diamond Creek, Oct. 15.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; Annual Conference, Chicago, Sept. 27-28, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga., Nov. 12-16.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Meeting, Washington, D. C., Nov. 13-15.

The Iowa Section, American Water Works Association, will meet Oct. 24, 25 and 26 at Iowa State College, Ames. Preceding the meeting of the water-works section the fifth conference of sewage operators in Iowa will be held Oct. 22 and 23.

Personal Notes

George H. Frederick, for thirteen years connected with the Department of Public Safety of St. Louis, Mo., and formerly chief inspecto of building, resigned Aug. 31. His successor has not been appointed. Mr. Frederick will be associated with Edward M. David, house movers, St. Louis.

A. M. Barton, Sacramento, Calif., has been promoted from assistant engineer of the California State Reclamation Board to chief engineer of the board, succeeding Peter R. Gadd.

C. E. Foss, chief engineer of the New Brunswick Power Commission, and for many years an engineer on the construction of the Canadian National Railways, Transcontinental and Valley branches, has resigned and will live in New Hampshire.

J. G. Gwyn, for a number of years chief engineer of the Denver and Rio Grande R.R., has been retired under the pension provisions of the road. He is succeeded by A. O. Ridgway, his assistant, and chairman of the safety committee. Mr. Ridgway has been with the Denver and Rio Grande continuously since 1908, serving a year as acting engineer of bridges and buildings, then becoming assistant chief engineer. Previous to 1908 he served other Western roads in an engineering capacity, though shortly after his graduation from the University of Kansas he joined the Denver and Rio Grande engineering forces, acting first as instrument-man, then as assistant division engineer and later as acting division engineer.

C. S. Macalla, recently vice-president and general manager of the Virginian Power Co., Charleston, W. Va., and vice-president of the Coalburg Col-

liery Co., Ronda, W. Va., has been made vice-president and general manager of the Penn-Ohio Power & Light Co., Youngstown, Ohio. Mr. Macalla is a graduate of Lehigh University and for several years was connected with the General Electric Co. for whom he organized a new factory in Rochester, N. Y., and with the Washington Power Co., Spokane, Wash., where he was for five years vice-president and general manager.

J. C. McLeod, division engineer of the Oregon state highway department, and C. H. Whitmore, market road engineer of Oregon, have resigned to accept positions in the state highway department of California. Mr. McLeod will have his headquarters in Sacramento, and Mr. Whitmore has been assigned to San Francisco.

J. S. Sawyer, resident engineer at Springfield, Ore., for the Oregon State Highway Department, has been appointed a division engineer, succeeding J. C. McLeod, resigned; and J. H. Scott has been appointed engineer in charge of market roads in Oregon, succeeding C. H. Whitmore, resigned.

Dorr Co., engineers, New York City, announce the removal of their Scranton, Pa., office to the Miners Bank Bldg., Wilkes-Barre, Pa., the better to serve the anthracite field. John Griffen will still be in charge of this branch of the company.

Capt. C. W. Lowman, of Carman, Man., who since 1919 has been on the engineering staff of the Manitoba government in charge of road improvement work, has gone to Colombia, South America, to take charge of railroad engineering for the Tropical Oil Co.

M. H. Ferguson, of Toronto, has been appointed resident engineer of Port Hope, Ont.

Charles D. Vail, railway and hydraulic engineer for the Colorado state public utilities commission, Denver, Colo., has been appointed manager of parks and safety for the city of Denver. Mr. Vail is a graduate of the University of Illinois; worked for the Union Pacific Ry. and Oregon Short Line Ry. on surveys, shop construction, division control and railway construction; and later served as assistant engineer of the city water department of Butte, Mont.

Obituary

Julius Pitzman, pioneer of subdivision planning in St. Louis, Mo., died in that city Aug. 31 at the age of 86 years. Having at 16 years of age come to America from Germany, Mr. Pitzman studied civil engineering under his uncle and as early as 1857 he was chief of the county surveyor's office at St. Louis. He served in the Civil War in the Union army, as first lieutenant of engineers and later on General Sherman's staff as captain of engineers, and was wounded at the first siege of Vicksburg. After the war he returned to his post as county surveyor at St. Louis. He laid out Forest Park, Carondelet Park and O'Fallon Park for St. Louis, and also prepared plans for many subdivisions of the city. He was president of the Pitzman Company of Surveyors and Engineers.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

To Curb Profiteering in Lumber for Japan

Manufacturers Oppose Granting of Five-Day Options to Exporters—3,750,000,000 Ft. Needed

Steps are being taken by the Pacific Coast lumbermen, the National Association of Lumber Manufacturers announced today, to prevent the distress of the Japanese people being exploited by speculators. Through R. F. Hammatt, secretary-manager of the California Redwood Association, the directors of the Douglas Fir Exploitation & Export Co., an exporting company of Pacific coast sawmill companies, wired the National Association as follows:

"We believe that inasmuch as a number of exporters are working for five-day options on large amount of lumber for Orient we should not put it in power of speculators to hold up the unfortunate people of Japan but should co-operate with those who are raising funds to relieve their sufferings. We have still approximately 40,000,000 ft. for Japan and it is unanimous opinion of meeting that we should grant no options nor accept any business until we know more about the situation."

In this connection the Red Cross national headquarters at Washington, D. C., authorizes the statement that it is acquiring for immediate shipment 9,000,000 ft. of lumber, half at Portland and half at Seattle, and that 6,000,000 ft. of this amount has been donated by two lumber companies. While there are reports of inquiries from Japan for large quantities for purchase, the Red Cross is not involved.

Requirements Estimated

The West Coast Lumbermen's Association, of Seattle, has wired the National Association that it is estimated that the rebuilding of the wrecked portion of Japan will call for the enormous amount of 3,750,000,000 ft. of lumber. This is more than all the mills of Japan could produce in a year and a half, but is not much more than a normal month's output of American sawmills. The 40,000,000 ft. referred to in the above dispatch represents unfilled Japanese lumber orders with the mills of the export company at the time of the disaster, the ordinary lumber exports from the United States to Japan being in large volume.

Outside of British Columbia the United States is the only available source of supply for Japanese lumber requirements. The sudden addition of 3,750,000,000 ft. to the current demand, especially if accompanied by the granting of options to speculators, might result in the absence of precautions that are being taken in the establishment of excessive prices for the lumber needed by Japan at this time. It is believed that the mills will concentrate on filling pending Japanese orders and also those arising from the emergency, deferring as much as possible a portion of the domestic and other export business.

Use of Steel Reinforcement for Concrete Roads Increases

The use of steel in the building of concrete highways in the United States has made rapid strides during the last few years. Expenditures for reinforcing material are now running into several millions of dollars annually, while in addition much of the equipment used in road building is also made of steel, adding considerable to the benefits derived by steel manufacturing companies as a result of the modern methods of highway construction.

Practically every state is now using steel reinforcing materials for the building of roads, with several, including Pennsylvania and California, using it to a greater extent than others. Data compiled by the U. S. Bureau of Public Roads shows that in 1921, the latest year for which official figures are obtainable, for 1,350 federal-aid projects involving 7,480 miles of road at a total cost of $112,325,302, reinforcing steel for bridges and road slabs was used at a cost of $2,375,966. This shows that the cost of the reinforcing material was 2.1 per cent of the total cost of the road.

This amount was divided as follows: Structural steel, $976,571; expanded metal, $50,619, and reinforcing rods, $1,348,806. The figures have not been subdivided to show the percentage of material going into structures and road surface. Also, much steel is being consumed in the erection of metal signs, sometimes mounted on steel pipe or angle rods, which are replacing the wooden sign on the nation's highways.

Motor Vehicle Production

Demand for motor vehicles is holding up well, as indicated by production totaling 348,733 cars and trucks, as reported to the directors meeting of the National Automobile Chamber of Commerce held in New York Sept. 6.

Surveys indicate that fall prospects for both cars and trucks are better than last year. In Georgia, Illinois, Michigan, Nebraska, and parts of the Northwest August business was reported as better than July, though in the majority of the states the demand was reported as slightly less.

The increased production was 6.7 per cent over July and 28 per cent in excess of August, 1922. Last year the August increase over the preceding month was 10.8 per cent. The previous high August record was 272,744 cars and trucks in 1922.

The monthly output of motor vehicles for 1923 as compared with 1922 is as follows:

MOTOR VEHICLE PRODUCTION 1922-23

	1922	1923
January	91,109	243,104
February	122,366	276,467
March	172,720	354,319
April	219,558	382,001
May	256,219	393,193
June	289,011	377,759
July	246,607	327,102
August	272,589	*348,733

* Estimated from carload shipment reports.

Simplified Practice Conferences To Be Held

A final conference of clay products manufacturers, distributors and consumers, looking towards an elimination of excess sizes and varieties, will be held with the Division of Simplified Practices of the Department of Commerce, Oct. 22. On Oct. 19 a final conference of hollow-tile interests will be held, while on Sept. 26, the final conference of the Prepared Roofing Association and allied interests is scheduled. A preliminary conference of garden hose producers and distributors will be held Sept. 14.

Equipment Dealer's Staff Safe in Japan's Earthquake

The Allied Machinery Co. of America, New York City, has received advice by cable from T. G. Nee, president of the Horne Co., Ltd., of Japan, that the entire head office staff of the organization in Tokyo is safe. The exact status of the merchandi e stocks and of the records of the business in Tokyo has not yet been determined. Less than one-third of the company's stock is carried in Tokyo. None of the thirteen branches of the company in Japanese territory was affected by the recent disaster. The Horne Co., Ltd., is, therefore prepared to continue its business of nearly twenty-five years standing as distributor in Japan of American manufacturers of machine tools, industrial and construction machinery, building materials and allied lines. The Allied Machinery Co. of America, with which the Horne Co., Ltd., is affiliated, will continue to handle the affairs of the latter in this country.

Construction Equipment Exported

Domestic exports of construction equipment during June have been announced by the Department of Commerce as follows: 23 power shovels valued at \$83,490; 12 cranes at \$14,198; 394 hoists and derricks (except mining) at \$63,450; 61 concrete mixers at \$46,728; 504,329 lb. of "other road-making equipment" at \$64,245; 1,186,390 lb. of miscellaneous construction equipment at \$87,954; 27 conveyors at \$13,351; 192 centrifugal pumps at \$49,455; 599 steam pumps at \$109,711; 2,358 "other power pumps" at \$176,179; and 727,019 lb. of "other pumps and pumping machinery" at \$246,962.

Three of the power shovels, at \$18,553, went to Canada, one at \$12,130 to Peru, one at \$10,110 to Cuba.

Road Show Exhibitors Meet

A meeting of the Board of Directors of the Highway Industries Exhibitors Association was held Sept. 7 at the office of President S. F. Beatty, Austin Western Road Machinery Co., Chicago. Charles M. Upham, state highway engineer of North Carolina, recently appointed manager of the road convention and show, was present at the directors' meeting to discuss with the representatives of equipment and material manufacturers plans for the exhibit in the Coliseum, Chicago, next January, to be held during the annual meeting of the American Road Builders Association.

To Pave Around British Cenotaph with Rubber Blocks

Noise of London traffic at the cenotaph, Britain's war memorial at Whitehall, has led to special means for insuring silence at the spot to which thousands from all parts of the Empire make a pilgrimage. The surrounding area is to be laid with rubber pavement, the cost of the blocks, estimated at \$30,000 being paid for as a gift to the country by Rubber Roadways, Ltd. The superficial area of the strip to be paved with rubber is 1,500 sq.yd., stretching right across the Whitehall carriageway and extending half way to Downing St. on the Westminster side and an equal distance towards Charing Cross. Each block weighs nearly 5 lb. and measures 8x4x3 inches.

Japanese Restoration

Washington Correspondence

While the earthquake disaster in Japan undoubtedly will bring an increase of orders to American firms for building materials, it is not believed by those familiar with Far Eastern affairs that there will be any tremendous flow of such orders. This prediction is based upon the fact that most of the buildings in the devastated area were constructed of wood and in all probability will be replaced by wooden structures. Some slight increase in orders for structural steel may be looked for, it is believed, but not in sufficient volume to affect to any great extent the market for these commodities.

Under the conditions with which Japan will attack reconstruction of the destroyed areas of her Empire, with many of her subjects thrown out of normal employment and hence available for labor, one economist has pointed out that in all probability reconstruction can be accomplished at much less cost than if the same amount of building were to be done piecemeal and under normal conditions.

Contractors Urged to Select Standard Equipment

The Associated General Contractors of America is urging its members to choose their construction equipment in accordance with the recent standards for concrete mixers and wheelbarrows approved by the Joint Committee on Construction Equipment, which has held several meetings recently in Chicago and Detroit.

Manufacturers are given until 1925 to dispose of the non-standard equipment they now have in stock. The bringing of standard equipment into general use, it is pointed out, will have been accomplished long before the end of the coming year. Equipment of the standard type approved will carry name plates showing authorization by the Associated General Contractors and eventually none but mixers and wheelbarrows of the standard type will be available on the market. Name plates to be placed on equipment conforming to the recently announced standards soon will be available to manufacturers.

It is suggested by the contractors' organization that the elimination of unnecessary types or sizes of equipment will reduce the manufacturing overhead and consequently should be reflected in equipment prices.

American Machinery Gains Favor in Japan

Notable Changes in British and American Positions Shown by Commerce Department Figures

AMERICAN machinery manufacturers interested in obtaining a broad view of happenings in their respective lines in Japan will find useful figures compiled recently by the U. S. Department of Commerce, and taken from the Japanese customs statistics. A graphic analysis of these figures by the Industrial Machinery Division of the Department shows the comparatively insignificant part played in this business by the United States in the earlier years; the phenomenal growth of American participation in certain lines with corrresponding waning of the British volume; and the subsequent regaining of lost ground by the British in some cases. In many lines the American manufacturers are holding their own and even increasing their hold, though the British have regained their former prestige, to a large extent in those lines where the original machinery installed was British and the repairs and replacements were of necessity British.

In the earlier years the British controlled the market but in the first part of 1915, owing probably to the war demands on British manufacturers, their participation in this business fell to a negligible quantity, while the American participation took a sharp upward trend. The point of especial interest, the Commerce Department states, is that in the post-war years the British have been unable to regain their former supremacy.

In 1913 the dominant position in the imports of each class of machinery into Japan was as follows:

British	American
Steam engines, boilers, and fuel economizers;	Knitting machinery.
Steam and water turbines;	Gas compressors.
Gas, petroleum and hot air engines;	Blowing machines.
Pumping machinery;	All other machinery.
Cranes;	
Metal or woodworking machinery;	
Paper making machinery;	
Power hammers;	
Spinning, weaving, and tissue finishing machinery;	
Capstans, etc.;	
Hydraulic presses;	
Blocks and chain blocks;	

This comparison shows clearly that the British held the control in the majority of items, their percentage to the total being 48.4, as against the American percentage of 8.7. By 1920 the situation had altered until the British percentage was only 20.6, compared with the increased American percentage of 51.4, and the specific classes of machinery were as follows:

British	American
Steam engines;	Steam turbines and boilers;
Gas, petroleum, and hot air engines;	Water turbines;
Spinning, weaving, and tissue finishing machinery;	Pumping machinery;
Fuel economizers.	Cranes;
	Metal or woodworking machinery;
	Paper making machinery;
	Knitting machinery;
	Capstans, etc.;
	Gas compressors;
	Blowing machines;
	Hydraulic presses;
	Pneumatic tools;
	"All other machinery."

Business Notes

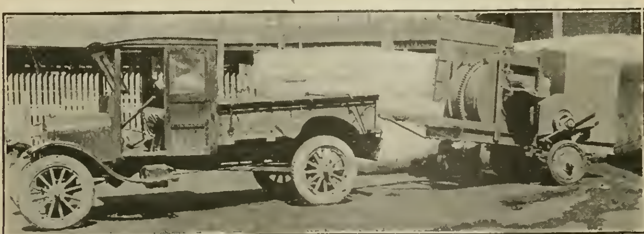
Graver Corp., East Chicago, Ind., manufacturers of water softeners, filters, tanks and general steel plate construction, announces the following changes in its district sales offices: The office formerly located at Los Angeles has been discontinued and the Water Works Supply Co., 536 Call Building, San Francisco, will represent the company in the State of California. The Seattle office has been discontinued and the States of Washington and Oregon will be in charge of H. K. Mead, 409 Board of Trade Building, Portland, Ore. The Philadelphia office has been discontinued and L. C. Holmes, 918 Buchanan St., N.W., Washington, D. C., will have charge of sales in that district.

George A. McClellan, recently county engineer of Harrison County and stationed at Marshall, Texas, and previous to that state division highway engineer, is now district engineer for the asphalt sales department of the Texas Co. He is located at Dallas. O. F. Reynaud has been appointed district engineer of the asphalt sales department of the Texas Co. at Houston. Mr. Reynaud is a civil engineering graduate of Texas A & M College.

Equipment and Materials

Trailer Mounting for Mixer

To relieve contractors of the necessity of loading a concrete mixer onto a motor truck when moving from one job to another the Marsh-Capron Co., Chicago, has developed a trailer mounting for its 1-bag Universal mixer which can be towed behind a truck traveling at 25 to 30 miles per hour. The rear axle is equipped with large springs to reduce vibration. As shown in the accompanying illustration the front end



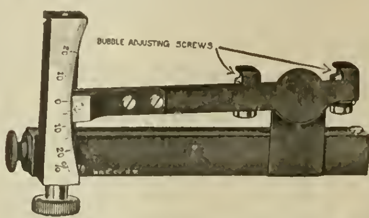
of the trailer is equipped with a double-wheeled swivel castor which is raised clear of the ground during towing and rests on the ground when the mixer is in service so that the outfit may be moved about as readily as with a four-wheel mounting.

The steel disk wheels have 3½ x 24-in. solid rubber tires, and turn on 5-in. Timken bearings on a 1⅞-in. heat-treated automobile axle. The springs are of the best automobile truck design, silicon manganese steel, 9 leaves ¼-in. thick by 2-in. wide, 32 in. long overall. The front castor has two roller type wheels, each 3½ in. face by 15 in. diameter; the castor wheels are carried in a heavy cast steel fork, with the pivot pin integral. The triangular tongue is built up of 3½ x 2½ x 5/16-in. angles, with 2½ x ⅜-in. braces. It has a heavy steel clevis riveted to the end, for attaching to trucks, and hand grips besides.

Reflecting Hand Level

A reflecting hand level, intended primarily for use on surveys of roads and railways, but adapted also to the same purposes as any clinometer where the slopes are not greater than 11 deg. 15 min. above or below the horizontal, has been developed by the Keuffel & Esser Co., New York.

Its essential parts are a movable



arm carrying a bubble tube, a graduated limb and a prismoid reflector. It is named the Fallis reflecting hand level.

The bubble tube is large and has adjustment devices similar to those on the bubble tubes of a surveyor's transit. The graduated limb is set perpendicular to the line of sight and is graduated in per cent of grade up to 20 per cent above and below the horizontal. The length of the limb permits direct graduation to single per cents, and the spaces being large, it is possible to estimate to the nearest 0.2 per cent.

The movable arm, which carries the bubble and pointer, is operated by means of a tangent screw, whose head is at the base of the graduated limb. Hence, the bubble may be brought slowly and uniformly to the center of its tube, instead of, as in the Abney level, requiring a direct operation of the hand in positioning and clamping it. The location of the limb and tangent screw at the sighting end of the instrument permits the use of both hands in directing it steadily upon the mark while bringing the bubble to the central position.

All of these features, the manufacturers claim, make possible a considerable degree of precision in measuring slopes and gradients up to 20 ft. rise in 100 ft. of horizontal distance. The instrument is equipped with a narrow prismoid reflector, so located that the field of view appears on both sides of the reflected bubble.

Publications from the Construction Industry

Formwork for Flat Slabs—Blaw-Knox Co., Pittsburgh, in a 20-p. bulletin, describes and illustrates its metal forms for flat-slab concrete construction, including details of shoring, panels, columns and walls, and outlines the advantages of the use of metal forms. The Blaw-Knox service in the use of these forms includes a rental price on steel forms, erection schedules and a service man to aid in installation and quotations on forms erected in any part of the country.

Asphalt Joint Fillers—Minwax Co., Inc., New York City, has issued a 4-p. illustrated pamphlet on its asphalt joint fillers and calking compounds, including cements for expansion joints of various kinds, calking rope and fillers for grooves and cracks. Points to be followed to secure successful use are also outlined. Drawings illustrate the use of the product in such typical cases as sidewalk expansion joints, bridge expansion joints, block paving joints, spandrel wall expansion joints, and flushing grooves at curbs.

Rail Welding—Metal & Thermit Corp., New York, has issued a 72-p. illustrated booklet bringing up to date the subject of thermit rail welding. Detail instructions are given for making improved rail welds. For this purpose apparatus has been developed including the self-luting mold box and a new lightweight double burner preheater. Results of rail bending and drop tests are given. The pamphlet concludes with a discussion of the theory of rail joints.

Rock Crushers—United Iron Works, Inc., Kansas City, Mo., features its portable and stationary rock crushers in a recently published bulletin. The capacities range from 6 to 35 tons of material per hour. The crushers are of the jaw type, requiring for operation from 6 to 20 hp. Several illustrations show the crusher at work on road construction, together with auxiliary plant in the form of bucket elevators, screens and bins.

Pine Floors—Southern Pine Association, New Orleans, is distributing a 16-p. illustrated booklet containing detailed directions for the laying, finishing and care of Southern pine floors in commercial buildings, private homes, theaters, banks, schools, armories, and factories. The booklet is entitled "Beauty Plus Service in Floors."

Steel Wheels—Geneva Metal Wheel Co., Geneva, Ohio, features its steel wheels for all kinds of portable outfits, except automobiles, in a newly issued 29-p. illustrated booklet. The wheels are of both light and heavy design for construction equipment such as wheelbarrows, concrete mixers, crushers, tractors and trailers, portable pumping plants, wagon loaders, etc. The wheels are constructed in a variety of diameters and tire widths.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Production and Materials Stocks in Nine Cities

Iron Output Lower—Production of Other Materials Increased—Unfilled Steel Bookings Dropped 496,100 Tons

Iron and Steel—August pig-iron output totaled 3,435,000 tons as against 3,678,000, for the month preceding, a decrease of over 6 per cent.

Steel ingot production, however, reached 3,508,347 tons during August, compared with 3,350,829 for the preceding month, a gain of nearly 5 per cent. Compared with one year ago, the August steel output gained over 54 per cent according to the American Iron and Steel Institute.

Unfilled steel tonnage, on books of the U. S. Steel Corp., Aug. 31, totaled 5,414,663 tons, compared with 5,910,763, July 31 and 7,403,332 on Mar. 31, 1923.

Lumber—Production is proceeding at about 10 per cent above normal as against 7½ per cent, one month ago. Shipments are a trifle under, and orders slightly over, 100 per cent of normal production, according to the National Lumber Manufacturers' Association. Production, shipments and demand, all increased materially during August. One year ago, however, production just touched normal, with shipments nearly 90 per cent and orders, 92½ per cent of normal production. The following table shows lumber movements during the four weeks ending Aug. 25, compared with the preceding four weeks:

	Four Weeks Ending Aug. 25 Ft. b.m.	Four Weeks Ending July 28 Ft. b.m.
Cut	1,095,378,957	1,010,866,675
Shipments	936,731,282	887,243,878
Orders	879,684,526	808,465,374

Cement—Reserve stocks, throughout the entire country Aug. 1, totaled 8,076,000 bbl. as against 8,433,000, for the corresponding period in 1922, according to the Geological Survey. Production, however, totaled 74,940,000 bbl. for the first seven months of the current year as against 58,475,000, for the same period last year. Shipments reached 75,938,000 bbl. for the first seven months of 1923, compared with 61,879,000, for the same months in 1922. Compared with this time last year, the cement situation is one of increased production and shipments with a slightly smaller reserve stock on hand.

Brick—Report of the Common Brick Manufacturers' Association of America, as of Aug. 1, shows 179,574,000 burned brick on hand, at yards throughout the country, compared with 153,487,000 on July 1. Orders on books decreased 13 per cent in month. The drop in unfilled orders is purely seasonal, and leaves a better reserve of both burned and unburned brick than was available a month ago, but represents a decrease of 2 per cent under the amount on hand Aug. 1, 1922.

Los Angeles—Sewer pipe stocks normal. No shortage of lime or cement; mills active and constantly increasing capacity. Steady demand for brick, tile and structural steel being met promptly. Enough native asphalt for requirements. Large lumber supplies at harbor.

Denver—No surplus of hollow tile and sewer pipe at present. About 5,000,000 brick in dealers' yards. Lumber stocks trifle below normal.

Minneapolis—Lumber reserves in Twin City field reported close to normal; probably 50,000,000 to 60,000,000 ft. in yards, which is slightly below par for season. Stocks of lime, cement, brick and tile continue ample.

Detroit—Plenty of sewer pipe in sizes up to 36 in.. Cement scarcity reported on nearby road contracts; no actual shortage in city. Ample warehouse stocks of lime. Large brick reserves in local yards. Tile deliveries require several days where large quantities are involved. Lumber yard stocks normal.

Chicago—Sewer pipe stocks low; deliveries take 24 hr. Hollow tile reserves below normal; deliveries require one week to ten days. Sand and gravel shipments in two to three days. Other materials in good demand and plentiful.

Cincinnati—Plenty of sewer pipe, asphalt, lime, brick and hollow tile. Cement scarce. Fair supply of lumber in dealers' yards.

New Orleans—Stocks of Southern pine still below normal; other building materials ample.

Atlanta—About fifty cars each of lime and cement; seventy-five, of asphalt and from four to six cars of structural steel on sidings. Sewer pipe and hollow tile deliveries take from four to five days. Plenty of brick and lumber.

New York—Considerable quantities of brick from Germany and Holland reported to be coming into this market. Thus far, the importations have had no effect upon the price of the domestic product. Except for slight shortages in sewer pipe and steel plates, the building materials market in this city faces no danger of scarcity.

Freight Car Loadings Smash All Previous Records

All previous records were eclipsed in the loading of revenue freight during the week of Aug. 25, according to figures made public last week by the Car Service Division of the American Railway Association. The total for the week was 1,069,932 cars. This exceeded by 28,888 cars the previous record which was established during the week ended July 28 this year, when 1,041,044 cars were loaded. This also exceeded by 51,393 cars the record of 1,018,539 cars established in the fall of 1920, and which stood until this year. The total for the week of Aug. 25 made the tenth week this year that the million-car mark has been exceeded, and in six of the ten weeks the total exceeded the record established in 1920.

Despite the fact that loading of revenue freight for the week of Aug. 25 was the greatest in the history of the nation, the railroads on Aug. 23, the latest figures available, had nearly 75,000 surplus freight cars in good repair and immediately available for service, while on the same date the car shortage reported amounted only to 7,690 cars.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Common brick, Denver, 5,000,000); time required for delivery of carload lots to city job, example: (Sewer-pipe, Atlanta, 4 to 5 days); and stocks on hand in general terms, example: (Cement, Cincinnati, scarcity):

	Los Angeles	Denver	Minneapolis	Detroit	Chicago	Cincinnati	New Orleans	Atlanta	New York
Sewer pipe	Stocks normal	No surplus	Ample	Plenty, sizes up to 36 in.	Stocks low; del. 24 hr.	Plenty	Abundance	Del. take 4 to 5 days	Shortage
Cement	No shortage; mills active	Enough	Sufficient	Stocks decreasing	Stocks in good shape	Scarcity	Dealers' stocks large	About 50 cars	Mills supplying city steadily adding to daily capacity
Lime	No shortage	Plenty	Enough	Warehouse stocks ample	Plenty	Ample	Plenty	About 50 cars	Market well supplied
Common brick	Demand met promptly	5,000,000	No shortage	Local yards well stocked	Heavy reserve of burned brick	No scarcity	Enough to fill requirements	Plenty	Considerable quantities of German and Dutch brick in market
Hollow tile	Meeting demand	No surplus	Requirements met	Dealers' stocks moderate	Below normal; del. 1 wk. to 10 days	Enough	Ample	Del take 4 to 5 days	Shipments meeting demand
Lumber	Large supplies at harbor	Trifle below normal	60,000,000 ft. in yards	Yard stocks normal	Dealers' stocks in good shape	Fair supply in yards	Improved during month	Plenty pine	Time of delivery good
Asphalt	Enough for requirements	Sufficient	Plenty	Enough in stock	....	Plenty	No market	About 75 cars	Heavy reserves in N. J.
Structural steel	Little delay in deliveries	....	....	No shortage	Mill shipments exceed bookings	Fair stocks of fabricating materials	....	About 4 to 6 cars	Low stocks of plates in warehouses

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 143 to 158, are the following:

Hotel, New York, N. Y., G. F. Pelham, archt. and engr., $2,000,000.

Hotel, Ashland, Ky., for Buckingham Hotel Co., $1,325,000.

Home and infirmary, Louisville, Ky., for St. Joseph's Infirmary, $1,000,000.

Apartment, Philadelphia, Pa., for 13th and Locust St. Realty Co., $1,000,000.

Hotel, Duluth, Minn., for C. Schroeder & Sons, Milwaukee, Wis., $1,000,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 143 to 158, are the following:

Bridge, Solano to Contra Costa Counties, Calif., to Duncanson-Harrelson, San Francisco, $4,500,000.

Hotel, Seattle, Wash., to Grant, Smith & Co., $4,000,000.

Bridge, Charleston, S. C., to Sanford & Brooks, Baltimore, Md., $1,067,466.

Home and infirmary, Buffalo, N. Y., to H. Schenk, Erie, Pa., $1,079,000.

Breakwater, Toronto, Ont., to R. Miller & Sons, $1,030,000.

Building Active in St. Louis

Building permits aggregating $2,371,005 were issued by the St. Louis Building Department during August, bringing the year's total to $25,705,355 or approximately $500,000 more than for the whole of 1922. In August, 1922, a total of 1233 permits for $2,206,670 were issued. The past month's total shows a slight falling off compared with July when 1393 permits for $2,906,463 in work were issued. Of the August permits 974 were for new work valued at $1,940,935 and 666 permits for repairs costing $430,470.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Sept. 6; the next, on Oct. 4.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4 00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.00
Structural rivets, 100 lb.	4 40	4 75	4.90	3.75	4.25	5.40	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3 54	3.50	3 80	3 20	3 45	3.85	3.65	4.10	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	+45%	45%	47%	53–5%	36%	33.2@42.2%	35%	—47.23
Cast-iron pipe, 6 in. and over, ton	+63.60	+60.00	63.00	60.20	60.50	69.00	62.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.70@2.80	3.00	2.25	2.20	2.50	2.84	2.63	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	1.89	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.83	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	—61.00	40.00	52.25	+58.50	+44.75	+44.25	—38.00	+29.00	70.00
Lime, finishing, hydrated, ton	18.20	22.50	22.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	2.35	1.50	1.50	2.70	2.10	2.80	10.00
Common brick, delivered, 1,000	23.65	—11.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	.115	.0724	.0816	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	—.1263	.102	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	—.95	—.98	—1.10	1.14	—.99	—1.09	1.16	.86	—1.22
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.50@.55	.35@.50	.50	.50@.62½	—.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.56). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.23; 6-in., $119.

Changes Since Last Week

Firmer tendencies in lumber and cast-iron pipe and a decided downward trend in linseed oil, characterize the current construction materials market.

Although pine timbers dropped $2 in New York and Douglas fir, $3 per M. ft. in San Francisco, during the last two weeks, fir advanced $1 in Minneapolis and Seattle and $1.50 in Denver, while pine rose $2 per M. ft. in Chicago.

Owing to heavier flaxseed receipts, raw linseed oil dropped 2c. in Atlanta; 3c. in New York and Minneapolis; 4c. in Dallas and 16c. per gal. in Denver, during last two weeks.

Gasoline is reported selling in Seattle at 16c. per gal.

The iron and steel situation may be briefly outlined as follows: Pig-iron prices stiffer owing to slowdown in production. Structural steel demand growing; lessening in car material requirement. Unfilled plate tonnage high. Tank plates and bridge material fairly active. Price of plates and shapes steady at $2.50 per 100 lb., Pittsburgh; premium of $2 per ton required on early deliveries in many instances. Bars firm at $2.40 base

Cement continues to maintain its price stability; few changes being noted. Fordwick, Va., mill, however, quotes to contractors, in carload lots, f.o.b., without bags, at $2.20 as compared with $2.10 per bbl. one month ago.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

Volume 91 NEW YORK, SEPTEMBER 20, 1923 Number 12

No Structural News from Japan

JAPAN continues to be cut off from the rest of the world except for some stories which the local reporters consider to have "human interest" and the necessarily colored impressions of those survivors who got away after the first few minutes of the shocks. Efforts are being made by this journal and others to assure an adequate statement of the effect of the earthquake and fire on the modern structures of Tokyo and Yokohama but it will probably be some time before such accounts emerge from the destruction. Meanwhile, from the scattered information available it is becoming increasingly probable that those structures designed to meet the tremors characteristic of the island have, on the whole, justified their design.

Who Gets the Dollars?

FACTS about the coal industry far more accurate and elaborate than ever made public or even known are in the possession of the Federal Coal Commission. They are being issued gradually, partly, it may be assumed, in order to gain continuous publicity but largely because of the difficulties in the actual preparation of the data in understandable form. Some day the whole story will possibly be available in book form so that one with sufficient time and interest may be able to discover why coal costs so much. Just now, however, the consumer is floundering in a sea of statistics sure only of one thing—that coal will be no cheaper. Cannot the commission particularize more than it has? Cannot it state whether royalties are too high, or at least how high they are, and whether wholesaler and retailer are making more today than the average increase of commodities since the price rise began? We have a statement of the wholesalers that their net profit in 1921 was six-tenths of a cent per ton. This sounds so ridiculous that it requires official answer. If in the turnover in which someone makes more money between mine mouth and cellar bin than it costs to mine the coal and pay its capital charges the wholesaler makes less than a cent a ton, who is getting all the rest of the money. The public wants to know.

An Act to Restrict Engineering

THE State of New York will not help a boy to get an engineering education. That, in effect, is the result, apparently just discovered, of the engineers license law that went into effect in that state last month. New York is very generous with scholarships, five worth each $100 a year being annually awarded in each assembly district. In the past many of the boys winning these awards have studied engineering at one of the several engineering schools in the state, and have gone out to become successful engineers. Beginning this year, however, no more scholarship holders will study engineering because of a clause in the enacting law which states that no scholarship "shall include professional instruction in theology, *or in any profession, admission to the practice of which shall require a license from the state.*" Nobody seems to know why the law includes this general professional exclusion, but it should be noted that it operates almost exclusively against the engineer, because law and medicine—the other licensed professions—either require post-graduate courses or can be taken as undergraduate electives in the regular arts course, with some subsequent time for which the scholarship would not be applicable. On the other hand engineering courses are all plainly labeled as such and are almost exclusively undergraduate with small opportunity for election from an arts course. The advocates of licensing never foresaw any such ridiculous restriction as this. Surely some effort should be made to amend the law so as not to discourage the study of engineering.

Marking Road Routes Through Chicago

TOURISTS more frequently lose themselves in large cities than in the country where the main traveled road has fewer competitors to engage the drivers' eye. Picking the proper streets through Chicago has always been a difficult and more or less dangerous procedure, for the through-route connections just inside the city limits have rarely been maintained in passable shape nor has there been any kind of marking within the city limits at all comparable with the average downstate county seat. All this is to be changed. Many of the connections have been repaired this season. As for signs, state highway engineers, county and city officials held a conference recently and decided on a generous sprinkling of uniform aluminum markers along the accepted routes, a zero point at Michigan Avenue and Jackson Boulevard from which mileage for all the radiating roads will be computed and a series of large direction markers. Many another large city could well afford a few dollars for signs of the same type as used on the official highways outside its limits for the satisfying familiarity of the recurring uniform signs is one of the most assuring welcomes the stranger gets from a city through which he drives.

Contractors Need Rail Records

IRREGULAR rail deliveries are an outstanding cause of rehandling materials on construction operations. Railways have the cunning custom of bunching materials cars, coming from several directions to a single consignee, at some convenient transfer point and then delivering them as one trainload. A contractor has for example track and unloading facilities for ten cars a day. For two days he gets no cars from the railway and the next day he gets twenty and his sidings and

unloading equipment are overwhelmed. To escape demurrage charges and the clamor of the railways, backed by the public service commissions, to release open-top cars for coal shipments, cars are, in such contingencies, unloaded where they stand and the materials are rehandled to the regular storage piles or warehouses or to the operation. This is not an imaginary case. There are few highway contractors who cannot cite one or more and generally several instances of bunched deliveries, with all the related consequences, during the present season. Arising out of this situation is one great gain. Contractors are keeping accurate records of car supply, shipping time, deliveries, and unloading periods. By doing this they are not only learning the causes of irregular deliveries and how they may be lessened, but they are helping to do away with the old subterfuge of "unloading delays" behind which the railways have been accustomed to shelter themselves against complaints of slow and irregular shipments of construction materials. A contractor who can support his complaint of poor service or defend himself against a charge of holding up cars by slow unloading with complete shipping records is in a very advantageous position before a public service commission.

Blocking Water Power Use

PRODUCTION of electrical energy by water power has a hard road to travel with the public. There is a deep-seated impression that it costs very little to develop water power and that it is only some inexcusable lethargy on the part of financiers and engineers that has prevented its complete supplantal of steam power. At the same time, in curious contrast to this, every effort to develop water power is met by violent opposition by the same type of mind that wonders at its slow progress—an opposition apparently grounded on the theory that all power developers are foes of the people who in some way are going to make money out of the public domain and resources without recompense to the public and with the greatest possible damage to natural beauty. In New York State today a typical case has arisen in the opposition by a group, who may with no derogatory intent be called "nature lovers," to a constitutional amendment permitting 3 per cent of the Adirondack state lands to be used for power purposes. Unless such an amendment is adopted the cost of transmission of power from the upper rivers to the power using centers will be prohibitive. Furthermore, only 3 per cent of the land is to be so used and that under the regulatory control of the state. And yet the pamphlet issued against the amendment could not be more violent if a group of medieval robber barons were contemplating forcible occupation of the whole of the state. Evidently we are going to be forced to an even higher cost of fuel than that we now enjoy before the serious need of power development is going to be appreciated.

Rehandling Construction Materials

MATERIALS are too frequently rehandled on most construction operations. It takes time and labor to place and then remove to another place sand and stone and lumber and steel. This is a lesson which has been more thoroughly learned in manufacturing than in constructing. To carry most construction materials through the processes absolutely necessary to transform them from raw materials to finished structure requires seven or eight handlings. In factory operations the mechanical conveyor is widely used to facilitate these necessary movements of materials. There is doubtless less opportunity for its use in construction but still too much shifting is done by "strongarm" methods. Too often does one see on large construction operations sacked cement, for example, being shifted from cars to warehouse and from warehouse to the mixer or the service trains on men's backs or by barrows when a few sets of roller conveyors would save men and time. It is, however, the unnecessary handlings which most need to be reduced in construction. A material is unloaded from cars and piled only to be shifted and repiled nearer to where it is used. Lumber and reinforcing bars are unloaded into piles and then sorted out and repiled according to lengths and sizes. Illustrations could be repeated endlessly. Each handling of a construction material which thus does not advance its fabrication into structure is a non-productive expense. Contractors need to study more than they always have done, ways of eliminating these non-productive expenses. No thought is had that the automatic methods of turning out Ford cars can be applied to the operations of road building or bridge erection, but nevertheless it would help to cheapen their materials handling operations if contractors would give some study to factory processes.

Buffalo's Garbage Disposal Predicament

HOW far even our larger cities are from handling garbage disposal in a proper engineering manner is strikingly illustrated by the way Buffalo has dilly-dallied with its local garbage disposal problem for several years past and the predicament in which it now finds itself in consequence. In but one detail did the city authorities act effectively; they do have to their credit the calling in of a competent sanitary engineer for advice on garbage disposal bids but they delayed doing this until after bids had been received on such very open specifications that the engineer called in was compelled to spend much time and go into extensive calculations in order to reduce the bids to a comparative basis.

Although this engineer's report had been before the commission council at Buffalo for months past, and endorsed by the city street commissioner and by the council commissioner in whose department garbage disposal falls, the commission has not acted upon these recommendations. Meanwhile, as has been perfectly apparent for a considerable time past might happen, the city has been ordered by the court to shut down its garbage piggery on allegations that it is a nuisance. This order was to become effective Sept. 15 but the city authorities have secured a hearing for Sept. 26 on an application for a modification of the order and in addition have taken steps to carry the order to a higher court. It is to be expected that the complainants against the piggery will press for shutting it down and that if the court grants the city relief, it will be only because of sympathy for the city in its predicament and because if the plant were closed nuisance might be caused to a far larger number of Buffalo people as a result than would be caused to the relatively few people near the piggery if it were kept in operation.

The Buffalo example is so flagrant a one of failure by a city to see that garbage disposal must be handled

as an engineering problem if grave complications and possible large and unnecessary expense are to be avoided that we present to our readers a condensation of the very exceptional report on the Buffalo bids prepared by H. P. Eddy. The specifications on which bids were asked were so vague and so lacking in the many requirements necessary to make the bids comparable that, as one of our tables shows, revised estimates of cost for a 200-ton plant were far in excess of the proposals; in one case nearly four times as large. Additional calculations were required before Mr. Eddy could reach conclusions as to which method of disposal, among those offered, seemed most desirable. Before reaching this point, Mr. Eddy found it advisable to eliminate entirely all of the bids for garbage disposal by incineration. He also found it necessary to double the city specification allowances for the size of a plant for treating uneaten garbage and hog manure in case a piggery was decided upon.

In passing it may be noted that what will perhaps be to most engineers a matter of great surprise is that after careful consideration Mr. Eddy concluded that in case feeding to hogs were to be adopted, it would be wise to provide a disposal plant for the residue one-half of the daily capacity of the total estimated amount of garbage collected.

The most valuable of all the advice Mr. Eddy has given to the city of Buffalo in this matter, if only the city will heed it—and it is advice that every other city in the country confronted with garbage disposal problems should take to heart—is that the city should decide on some one scheme of disposal, have complete designs made, and then obtain bids for the construction of a plant of that type and size and none other. This is directly opposite to the general practice of American cities. City authorities generally do not put the matter of garbage disposal in the hands of their own engineering force or of competent consulting engineers, have a plan designed and specifications drawn and then ask for bids, all on such a basis of site, size of plant, contract guarantees, test requirements and total annual charges, as will make it possible to compare the bids received understandingly.

Few, if any, cities—and none we hope as large as Buffalo—would think for a minute of asking bids for a pumping station or a filtration plant, to name only two kinds of engineering work, on such vague specifications as those on which the Buffalo garbage disposal bids were based. How indefinite these specifications were may be seen in part from our abstract of Mr. Eddy's report. Had the council commission of Buffalo attempted to award the contract on the basis of comparative bids received—and many another city has done just this sort of thing—it would almost certainly have been sadly disappointed in the results that it would have obtained when it came to count up the actual cost of installing the plant and the total annual charges.

Finally, we regret to have to say that some cities which confine their request for bids to one general type of means of garbage disposal improve upon the Buffalo specifications in degree only; that is, although they may eliminate utterly different methods of doing the same sort of work, they provide neither adequate detailed specifications or contract guarantee and acceptance tests that will indicate with any certainty what the plant will really accomplish in daily operation.

It is high time that our cities make some change in their methods of treating garbage disposal. It is to be hoped that after its present experience, Buffalo before again advertising for bids will follow Mr. Eddy's advice as to definite plans and specifications for one type of plant. Judging from reports of commission council proceedings since Mr. Eddy's report was submitted, the commission council has not yet seen this matter in its full and true light.

General Service Equipment Economies

PROCEDURES which have almost the characteristics of principles of plant engineering were followed in planning the construction plants for the Delaware River Bridge anchorages described in this issue. The conditions of the specific problem at Philadelphia and the lines of reasoning which naturally followed need not be repeated. Outstanding from the details are: (1) Selection of plant units to permit interchange of duties; (2) provision for intra-operation mobility of these units, and (3) consideration of their future utility. All these are ideas of an economic significance which reaches beyond any specific piece of construction work.

Specialization of construction equipment has proceeded so far and produced such great economies that when large volumes are involved it requires a wrench to separate our minds from the thought that necessarily large-capacity special machines are the universally logically selection. In the Delaware River Bridge anchorages there was a large volume of excavation to be removed, and a larger volume of concrete to be put in place. Considering volume alone either the excavation or the concrete placing warranted large-capacity special equipment. It was not adopted for sound economic reasons. Alternation of excavating and concreting operations made the output capacity and speed of special machines of no benefit. This is a condition which frequently prevails in construction operations; the aggregate volume of each kind of work is large but the volumes which can be accomplished as continuous operations are small.

Again, as at Philadelphia, the alternations of operations are frequent in many construction processes. On the bridge anchorages excavation, concrete placing and a period of rest for the concrete to harden was the succession continuously repeated. The only plan by which equipment can be kept busy under such conditions, which incidentally are common in many classes of construction, is to keep it moving from one structural unit to another. This requires intra-operation mobility which exceeds mere ability to move the equipment units easily and approaches a continuous circulation of equipment, such as on the anchorage work was provided by interconnecting tracks, locomotives and traveling cranes.

General service equipment met the conditions better than could any special equipment however superior that might be under conditions which permitted its full efficiency. Furthermore it possessed a greater salvage value. It was usable plant for future operations of great variety. With this we have a summation of values which the contractor should appraise carefully in outfitting a construction operation—ability to shift from one duty to another and from one point of operation to another and, finally, salability as second-hand equipment.

Anchorage Construction Plant, Delaware River Bridge

**Sequence of Changing Operations Handled by Mobile Units on Overhead Track System
Transport by Scows Solved Problem of Limited Land Area for Storage**

BUILDING the anchorages for the Delaware River Bridge called for careful planning of the construction plant. The structures and their location were closely alike, the quantities were large, the kinds of work varied and the main processes had to be performed alternately. Combined with limited working room and congested means of transportation except by water, these conditions made plant layout a serious consideration. The contractors met the situation by installing (1) a loading and unloading station and a concrete mixing plant on the river front, (2) a service railway on trestle from the river front installation to the anchorage site, and (3) an overhead crane-track and service-track system covering the anchorage site. This arrangement was approximately duplicated for the two anchorages.

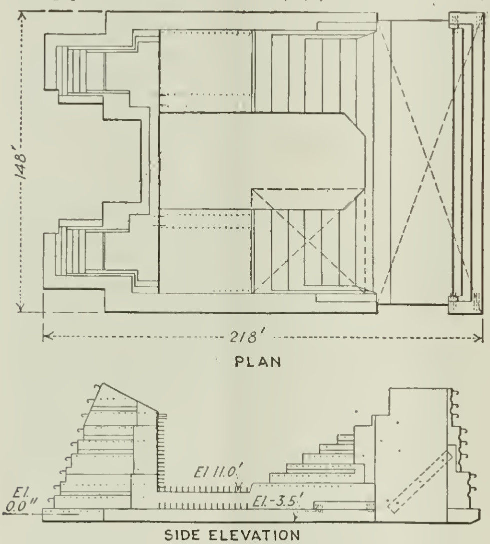


FIG. 1—PLAN AND ELEVATION OF ANCHORAGE SUPERSTRUCTURE

Anchorage Structure—In general design the anchorages are alike. Each consists of a superstructure, Fig. 1, approximately identical and of a substructure of reinforced-concrete caissons filled with concrete. There are ten caissons for each—two rectangular and eight circular. The quantities in the two superstructures are nearly the same:

Materials	Philadelphia	Camden
Concrete, cu.yd.	29,630	29,930
Reinforcing, lb.	239,000	233,000
Anchorage steel, lb.	2,322,000	2,322,000

In the caisson substructures the differences are greater because the rectangular caissons on the Camden side are larger and their depths to rock are different. The substructure quantities are approximately as follows:

Materials	Camden	Philadelphia
Concrete, cu.yd.	47,000	28,500
Open pit excavation, cu.yd.	1,150	8,000

Combining the two sets of figures the main quantities are as follows:

Item	Camden	Philadelphia
Concrete, cu.yd.	76,930	58,130
Excavation, cu.yd.	48,150	36,500
Anchorage steel, lb.	2,322,000	2,322,000

One fact further requires notice; the caissons are open—reinforced concrete shells and partitions sunk by dredging from the inside and built up as sinking proceeds. Their structural character is shown clearly enough by any of the views.

General Conditions—With the structures and quantities as outlined, the general conditions were as follows:

1. There were to be built on opposite sides of a wide river two structures identical in character and involving approximately the same quantities. The contractor for these structures was also the contractor for the adjacent piers and had plant installed and work well advanced on the piers when the anchorage contracts were secured.

2. There was available on each side of the river a working area not greatly larger than the horizontal projection of the bridge structure between pier and anchorage. The anchorage structures virtually covered the sites purchased for anchorages. Both piers were in the river. On the Philadelphia side the anchorage was inland and between it and the pier the bridge area was occupied largely by a busy waterfront street and approaches to pier sheds and ferries. On the Camden side the anchorage was on the river's edge and between it and the pier was open water.

3. Railway track service to the anchorage sites was not easy to secure on either side but more particularly on the Philadelphia side. There was on either anchorage site no adequate track and storage yard room for materials and supplies or for disposing of excavated material. In contrast the river offered a natural means of bringing in material and taking away spoil, with the advantages of complete flexibility of movement, large cargo shipments and low rates.

From the general conditions it appeared, conclusively, that (1) two similar construction plants were required; (2) the river should be the way for bringing in material and removing excavation and (3) the plant for pier and anchorage should be combined as far as practicable. With these general conclusions reached, the operations which the plant would be required to perform came up for consideration.

Controlling Operations—Obviously the controlling processes were (1) removing excavated material from the anchorage emplacement and (2) putting concrete into the anchorage structure. Incidental to excavation and producing and placing concrete were the operations of handling forms and reinforcing steel and of

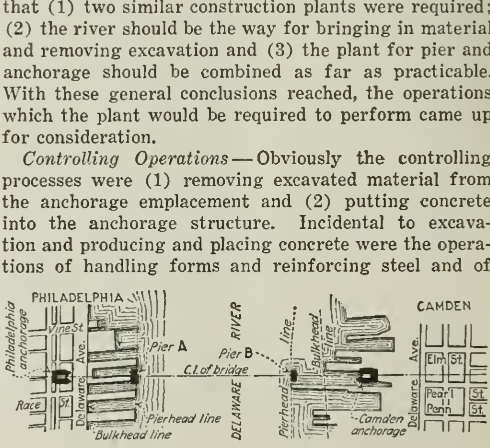


FIG. 2—LOCATION PLAN OF PIERS AND ANCHORAGES

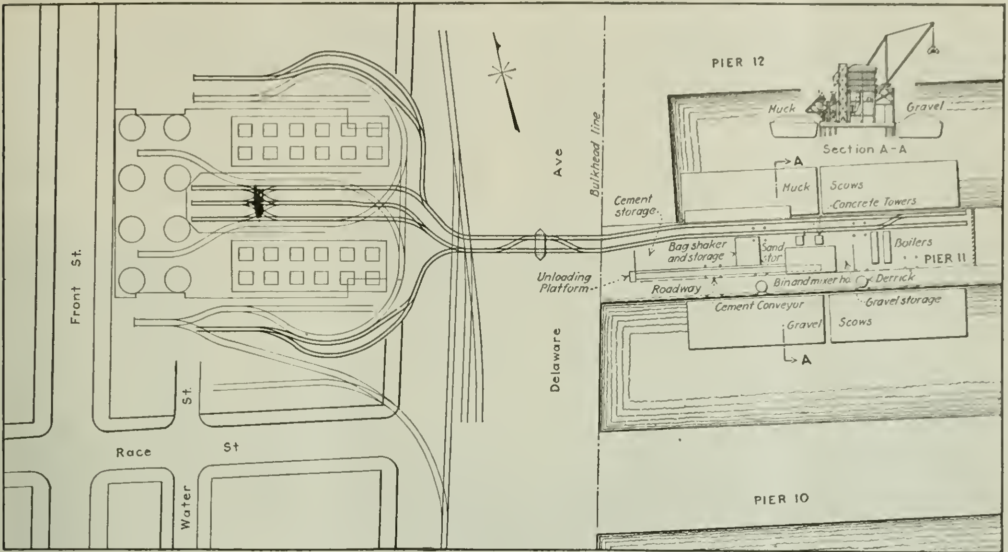


FIG. 3—DETAIL PLANT PLAN FOR PHILADELPHIA ANCHORAGE

installing the anchorage steel, and finally, miscellaneous materials handling. Analysis of the several operations brought out a number of facts affecting plant selection and arrangement.

The excavation did not call for the quick handling of large volumes. About seven-eighths of the yardage had to be taken from caisson wells and in the case of the large caissons, with numerous wells, removal had to be divided evenly between them all. This made the process necessarily slow. There followed then the necessity of accumulation in piles or of holding shipping units some time in receiving the load; and as has been pointed out there was no room on the anchorage sites for either procedure. In the same way, concreting any particular caisson unit was a slow process—each lift of a few feet required only a moderate yardage, had to harden and get strength and the caisson had to be lowered before another lift could be concreted. To get output, then, in either excavation or placing concrete, it was necessary to put all the caissons under way and to shift work from one to another so as to keep both operations practically continuous.

Plant Planning—Plants had been installed for building the bridge piers. Each consisted of bins, mixer, hoist tower and chutes and equipment for unloading scows and for loading excavated material into scows.

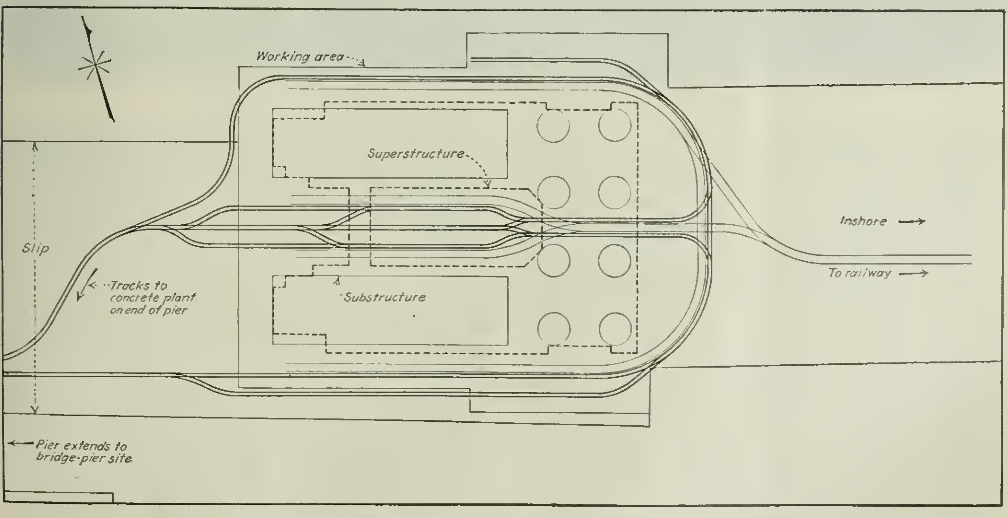


FIG. 4—DIAGRAM TRACK PLAN FOR CAMDEN ANCHORAGE

Both were located on the ends of shipping piers reaching outshore to points close to the bridge piers (Fig. 2). Substantially the same equipment units and plant functions were necessary in building the anchorages. It was, therefore, planned to trestle from the pier plants to the anchorages and over the anchorage sites as shown by succeeding drawings and views; to lay elevated service and crane tracks on the trestle, and to install locomotive cranes and narrow-gage locomotives and cars.

In general the plan was the same for both anchorages. or other materials either in single carloads or in train loads of as many cars as may be needed.

Extension of the services of the pier construction plants to the work of anchorage construction supplemented the flexibility of the trestle outfits. By water materials could be received and spoil removed with almost complete independence in respect to time or volume. There was no problem of storing material on the construction site. By the trestle also the streets were kept clear of contractor's traffic.

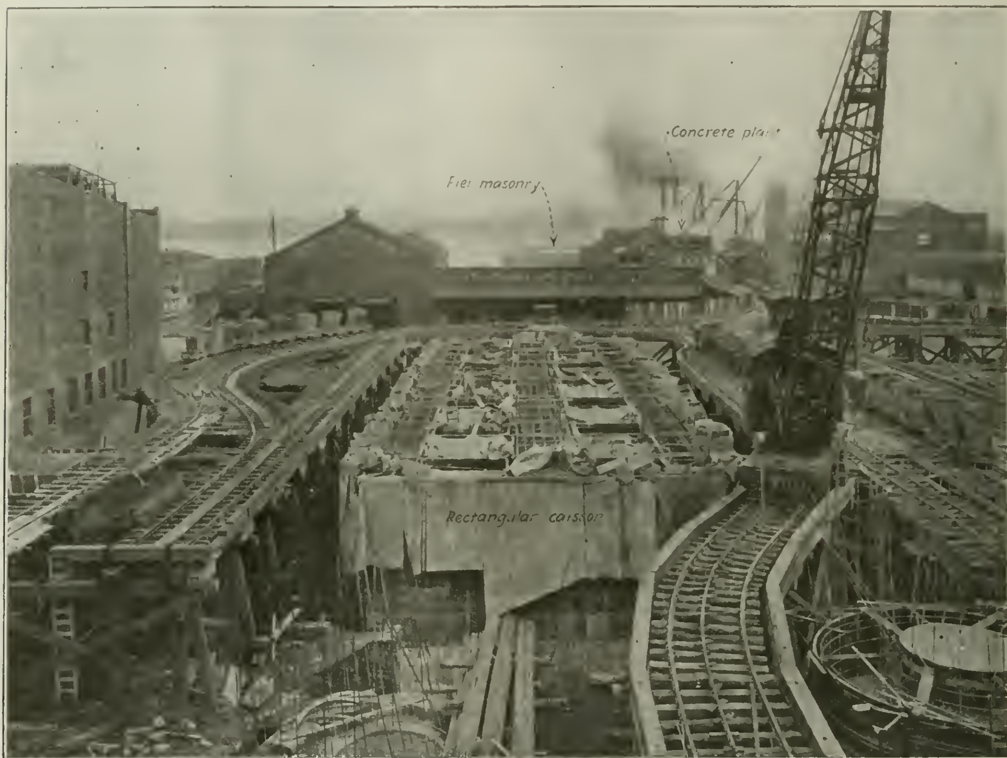


FIG. 5—PHILADELPHIA ANCHORAGE, NORTH CAISSONS, LOOKING EAST

Fig. 3 shows the complete layout for the Philadelphia operation. Here there was no possible access to the anchorage from the rear and access to the elevated track system is by a ramp from railway tracks on Delaware Ave. On the New Jersey side the only approach to the anchorage site was from the rear and here the incline to the elevated track system was built as indicated in diagram by Fig. 4. Figures 5 and 6 are views of parts of the two anchorage plants during caisson sinking—track system, equipment and structure are clearly indicated. The track system is so arranged that every part of the anchorage structure is put within reach of a locomotive crane and a service train. Indeed almost complete flexibility has been secured, as shown by:

1. The cranes can excavate with clamshell, place concrete, shift forms, handle reinforcement and anchorage steel equally well and they can be grouped and scattered as the operation requires.

2. The service trains can handle concrete or spoil

Construction Methods—Methods of construction are interesting chiefly in connection with sinking and seating the caissons and they are not completed and are a subject for separate consideration. As affecting plant, construction is a sequence of changing operations. For example excavation proceeds from inside a caisson until the shell has gone down a certain distance and then excavation is discontinued so that the caisson can be built higher. This is the entirely different process of concrete construction, including form erection and placing reinforcement and concrete, followed by an interval of idleness while the construction is getting strength. Then excavation is resumed. Repeated for ten caissons distributed over an area 148 x 218 ft., these operations call for constant shifting of duties. The case will be the same in superstructure construction where placing concrete will alternate with the processes of very precise erection of anchorage steel. The requirements, it was considered, were best met by a plant of many units

which could be separated or combined as desired, providing a substantial freedom of movement.

In operation the arrangement has been successful. It has been possible to keep the caissons progressing quite uniformly and so to schedule procedure that there is little idle plant time. Another economic feature is that, with the exception of some of the steel form units, there is hardly an item of plant which is not of general usefulness in construction operations of numerous kinds.

Directing Organization—The construction of the Delaware River Bridge is in charge of a board of engineers of which Ralph Modjeski is chief engineer and George S. Webster and Laurence A. Ball are members. Clement E. Chase is principal assistant engineer and M. B. Case is senior resident engineer. The contractors are the Keystone State Construction Co., and Holbrook, Cabot & Rollins Corp.

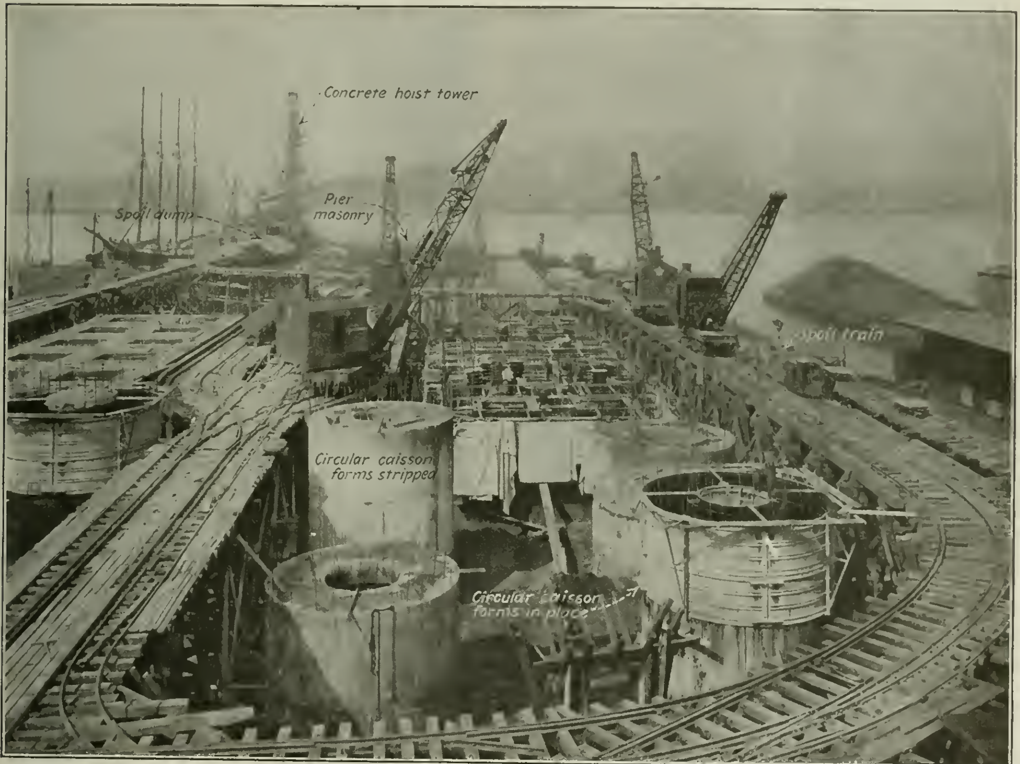


FIG. 6—CAMDEN ANCHORAGE LOOKING WEST

New Concrete Ties Used in India

The Northwestern Ry. of India has made exhaustive tests of a new type concrete railway tie patented by a Delhi consulting engineer, says a recent report to the Department of Commerce from the Calcutta vice-consul. Use of the tie on 50 miles of track near Delhi has been so satisfactory that 70 more miles are to be similarly equipped. The tie consists of two concrete blocks joined together by a tiebar, the rails being fastened by means of a screw or dog spike driven into wooden plugs, treated and compressed, inset in the concrete block.

Sanitary Engineering on the Cotton Belt Ry.

UNDER THE heading of "Activities of Sanitary Engineer" the annual report of St. Louis Southwestern Ry. contains the following statement on malaria control work:

"Malaria control work conducted by this department was continued throughout the year with success. The distribution of quinine in prophylactic doses was extended to track employees on 831 miles of the operated mileage.

The effectiveness of this method of malaria prevention is evidenced by the fact that only 24 section men were admitted to the hospital suffering from malaria, compared with an annual average admittance from this class of employees of 259 prior to the inauguration of malaria control. During the year a total of 98 malaria cases were treated at the company hospital.

This is a decrease of 504 compared with the average number treated during the four years prior to malaria control. Through the influence of this department the cities of Pine Bluff, Ark., and Hillsboro and Wells, Texas, inaugurated a malaria control campaign, and the interest of other cities and towns has been maintained through malaria essay contests conducted in the schools and through contact with educators and city and public health officials."

Concrete Pipe Irrigation System Delhi Settlement

Million Feet of Pipe Being Laid by California State Land Settlement—Buried Sand Traps and Other Features Described

By John R. Jahn
Irrigation and Land Settlement Engineer, Berkeley, Calif.

THE CONCRETE pipe irrigation system at Delhi, near Merced, Calif., has many interesting features and is effecting marked economies in operation. Although there are but 8,500 acres in the settlement there will eventually be in use a million feet of pipe ranging in size from the 30-in. mains to 8-in. laterals. This is being laid in units of some 250,000 ft. per year, keeping ahead of the allotment of the land to settlers. The system is complete from the diversion structures for the gravity water supply, at the canals, and the

FIG. 1—COVERED THREE-COMPARTMENT SEALED GATE CHAMBER

Boiler plate covers compress square hemp packing by means of stud nuts. Two of the screw gates do not show in this view

pumping plants, through the main distributing pipe lines and division boxes to the alfalfa or orchard valves on the field laterals. Water is distributed among the five hundred farm units by two or three water tenders.

The ground surface at the colony consists of gently rolling ridges and swales—about 40 per cent being above the elevations which could be supplied economically by gravity from the existing canals of the Turlock Irrigation District. The soil is a fine sand and canal seepage losses are high. These features, together with the increased economy of application of water and the saving of land for farming, led to the adoption of concrete pipe.

In designing the system a topographic survey was made of the land and contour maps were drawn having a scale 1 in. = 100 ft. These maps were in half-section (320-acre) units and showed about six elevations per acre with 1-ft. contours. These sheets were reduced by pantograph and combined to form a key map having a scale of 1 in. = 800 ft., with 5-ft. contours. The subdivision design was made on a basis of topography by aid of the detail sheets and was transferred to the key map. The distributing mains were laid out on this key map to serve every farm unit from at least one connection.

These main lines generally serve some areas which are above the gravity supply. Pumps are used: (1) to boost the gravity supply to the higher levels; or (2) to lift it from wells or from the Merced River. The main lines are so looped, and controlled by gates, that one area may obtain water from another and different sections be supplied either by gravity or pressure.

The concrete pipe is made in an enclosed plant having air tamping machinery for sizes of 18 to 30 in. and a Brubaker pipe machine for sizes of 6 to 16 in. Among the novel features of this plant are the Lowden overhead carrier for moving the pipe on trays from the Brubaker machine to the curing yard, and the Skinner overhead spray system for keeping the pipe moist while curing. The inclosed plant protects the pipe against the extreme temperatures of summer and winter.

The pipe is laid in trenches cut to sufficient depth to have at least 18 in. of earth cover. For 18-in. pipe and smaller, the excavation is done by hand on a piecework or per foot basis. A power excavator is used for the larger pipe. The pipe is laid by contract, the contractor furnishing the laying materials with the exception of sand. The settlement district hauls the pipe and distributes it along the prepared trenches. The pipe is laid, joints banded with mortar and backfilled to a depth of 3 in. over the pipe by the laying contractor. The remainder of the backfilling is done by hand or with stock on a piecework or footage basis.

The following unit costs per completed foot of line are used as a basis for estimates:

Size of Pipe, Inches	Price per Foot, Cents
8	33.4
10	41.8
12	55.3
14	70.8
16	83.7
18	109.0
20	155.6
24	192.5
30	303.6

The maximum pressure head on any main line is 45 ft. but there are many instances of pressure heads which range from 20 to 40 ft. In 1920 it was the practice to place electrically welded rings of No. 6 steel wire (⅙-in.) within the pipe shell for reinforcement but the difficulty of centering these properly led to the adoption of other methods. The pipe to be used under pressure heads greater than 15 ft. are now wrapped outside with rings of No. 2 (¼-in.) steel wire at the ends and center of each joint. By twisting the loose ends of the wire together the concrete of the shell is put in slight compression. These rings are covered with joint mortar for protection against rust. Another form of reinforcement that has been used consists of strips of ¾-in. square mesh screen, 8 in. in width, encircling the pipe and encased in banding mortar. These bands are spaced 50 to 100 ft. apart on a pressure line to guard against extensive longitudinal ruptures. No pipe smaller than 14 in. is reinforced nor is any used on low pressure lines of larger sizes.

Among the special appliances developed in the construction of this pipe irrigation system attention is called to four types of structures: (1) Sealed gate chambers; (2) capped stands; (3) buried sand traps; (4) overflow syphon spills.

Sealed gates and capped stands are constructed in the pipe-making plant and moved by trucks to the field. They are complete with screw gates installed and have inlet and outlet pipe nipples for connection to pipe lines. The sealed gates have from one to four screw gates on their four inside faces while the capped stands seldom have more than one, which is placed over the

inlet port. The object of these enclosed gate chambers is to provide cutoffs without high, open gate chambers, since they are often used where the hydraulic grade line stands 30 ft. or more above the ground surface. The capped stand differs from the sealed gate in that it is built up of sections of 18-, 20- or 24-in. concrete pipe, while the sealed gate requires collapsible inside and outside forms. The sealed gate has a cover of ¼-in. boiler plate, held down by nuts on ½-in. bronze bolts. A ring of ⅝-in. square hemp packing between the plate and the concrete body makes the chamber watertight. The screw gate stems pass through stuffing boxes which are acetylene welded to the boiler plate covers. Installed, the tops of these sealed gates are about even with the ground surface and the gate stems, which are of ¾-in. wrought-iron pipe with special T handles and stand 2 to 3 ft. above the surface. A sealed gate with one 12-in. and two 10-in. screw gates, costs complete and installed about $60. Access to the gates may be had at any time by closing the inlet gate and removing the nuts from the bolts which hold down the cover.

FIG. 2—CAPPED STANDPIPE BEFORE BACKFILLING

The capped stand was developed by Ernest Fortier and has proved very satisfactory. It has a good appearance in the field. A special ring form joins the cap and the stand. Hemp packing is used here and compression is obtained by screwing down nuts on the four rods which reach from a spider in the base up the outside of the pipe to a similar spider in the top. The cost of one of these, with a 12-in. gate, is about $35, installed. There is usually enough space between the valve stem and the stuffing box to allow trapped air to escape although some have been built with automatic air-vent valves.

Buried sand traps are used to remove sand from water which is pumped from the wells. Their advantage over those of the usual vertical type is that the water does not have to be lifted above the level of the ground surface to function. Ten feet or more of 24- or 30-in. pipe is laid horizontally 18 in. below the ground surface. Pump connection is made above the center line at one end and the sand flushing port is at the bottom of the other end. The discharge to the main line is taken from a riser in the sand trap 7 ft. or more from the pump connection and has a cutoff screw gate in the sealed gate chamber to allow water to pass on through the main line when desired. A standpipe of 10- or 12-in. galvanized-iron pipe relieves water surges. The economy of this type over the usual vertical chamber in which water is lifted over a dividing wall comes from a saving in power. It is estimated that the electric power used in lifting 500 g.p.m. 4 ft. higher than necessary during a seven months' irrigation season costs about $30, which can be saved by the buried chamber type. The cost of this type of sand chamber, complete with flushing screw gate and vertical galvanized-iron surge pipe, is about $200, installed.

A few words may be said concerning the wells of the settlement. The objects of these are to: (1) augment the gravity irrigation supply; (2) serve land above the economic gravity hydraulic grade line; (3) decrease the sizes of main lines; and (4) promote drainage by lowering the ground water table. They are located at strategic points and provide from 500 to 1,000 g.p.m. Suitable water-bearing gravel is found in different strata, the usual depth being 80 to 120 ft. The water table stands at 12 to 25 ft. and the economic draw down of from 25 to 40 ft. depends on the elevation of the ground surface.

The different types of pumps that have been used in the several installations are: (a) horizontal centrifugals; (b) vertical turbines; (c) vertical centrifugals. The latter type is being used for lifting water from the Turlock Irrigation District's canals and is so hung that the pump itself is submerged. All of the pumps are giving satisfaction, the different types being fitted to the different working conditions. Electric power is obtained from the San Joaquin Light & Power Corporation.

The overflow siphon spill and surge pipe, Fig. 3, was developed to protect the pipe lines against harmful increases in pressure, which might be caused by an irrigator closing his alfalfa valves without notifying the water tender. The novel feature is the inexpensive conical cap which connects the riser with the discharge pipe. The discharge pipe conducts overflowing water to safe waste-way. Normally the water stands in the riser at the hydraulic grade line. When the water level rises due to the closing of a valve, the water spills and falls as a simple overflow until a siphoning column is built up, when the discharge increases. The siphon is broken by the 4-in. opening at the point of the cap when the hydraulic grade line drops to that level. Were it not for this opening the siphon would not be broken until the hydraulic grade line fell to a point near the ground surface, thereby wasting water unnecessarily. The action of these siphon overflows is intermittent up to the capacity of the riser. One of these, with a 10-in. discharge pipe, has handled 1,000 g.p.m. without overflowing the open cap.

This pipe irrigation system has in many ways proven its superiority over open ditches. Its first cost is its chief drawback. This amounts to about $36 per acre for the main distributing system, to which the farmers' private lines add about $43. This is advanced

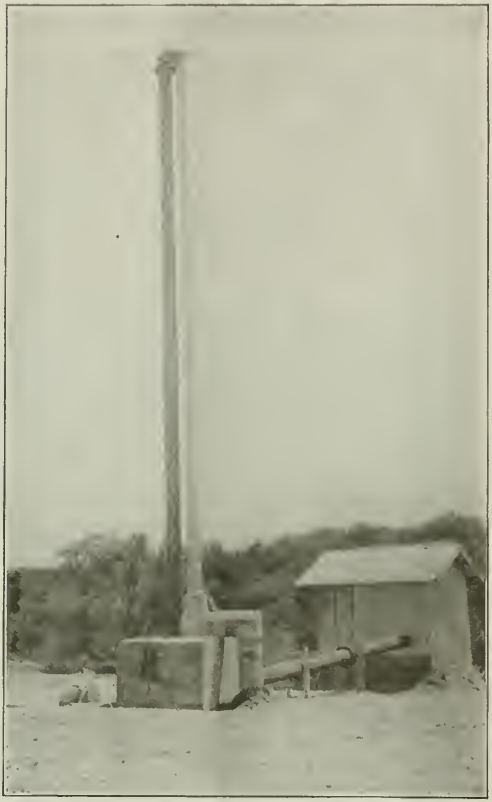


FIG. 3—SURGE AND OVERFLOW SIPHON SPILL, MERCED RIVER PUMPING STATION

the settler by the state but is repaid by him in amortized payments at the rate of about $5 per acre per year, interest being 5 per cent on the outstanding principal.

The Delhi Colony is one of the California State Land Settlements carried out under Dr. Elwood Mead as chief of the division and Walter Packard as the Delhi superintendent. The system was designed and constructed under the direction of Milo B. Williams, chief engineer, assisted by John R. Jahn, Ernest Fortier, Lloyd Brown and others.

Increasing Traffic on Soo Canals

A report by the Dominion Bureau of Statistics of the canal traffic of Canada for June shows how intensively used are the Canadian and American canals at Sault Ste. Marie. In the thirty days there were 3,249 vessels locked through, of 10,069,109 registered tonnage, compared with 2,396 of 7,356,926 tons last year. There were 1,080,720 barrels of flour, 36,457,141 bushels of grain, 9,222,722 tons of iron ore and 3,323,875 tons of coal carried as freight through the canals.

Effect of Curing Methods on Concrete Roads

Tests of Various Methods of Curing Road Slabs to Determine Effects on Wear and Transverse Strength

BY H. J. KUELLING
Construction Engineer, Wisconsin Highway Commission, Madison, Wis.

TO COMPARE field with laboratory conditions this series of tests was run both in the field and in the laboratory using like materials cured in a similar manner so far as practicable. The following methods of curing were selected:

1. Sodium silicate, applied with a pail and old floor brush, coating the entire surface uniformly. As stipulated by the company supplying the material, a mixture of three parts silicate and one part of water was used.
2. Calcium chloride, flake, applied three pounds per square yard of surface. This was applied with a shovel and spread out uniformly.
3. Calcium chloride, granulated, applied three pounds per square yard of surface.
4. Earth covering about three inches thick, kept constantly moist for two weeks.
5. Hay covering, about five inches deep, loose measure, kept moist for two weeks.
6. Straw covering, about five inches deep, loose measure, kept moist for two weeks.
7. No covering on the surface.

For the field operations a road near the city of Madison was chosen as it was reasonably close to the laboratory. The party was equipped with a light truck, scales, balance, thermometers, molds and small tools.

Method of Testing—Six slabs $4\frac{1}{2} \times 8 \times 19\frac{1}{2}$ in. and six 6 x 12-in. cylinders were made from concrete cured by each of the above methods. Only one specimen was made from any given batch of concrete, but a slab and a cylinder were always made from the same batch.

The slabs were made by placing steel molds against the side forms of the road, the slab being removed after the concrete had set and the road form was removed. The holes resulting were filled the next day with standard concrete. After removal the slabs were placed, face upward, upon the adjacent pavement and cured by the same method as the roadway section. The sodium silicate and calcium chloride specimens were surrounded by dirt to prevent loss of moisture from the sides.

The cylinders were filled in sections of one-third, with material taken from different portions of the batch. Each layer was puddled with about twenty-five strokes of a half-inch rod. The top of the mold, after finishing and partially setting, was protected against evaporation by a canvas covering. The pasteboard forms, in which the cylinders were cast, remained attached to the cylinders until the day previous to breaking. They were marked with the identification of the corresponding slab.

The cylinders for the sodium silicate and calcium chloride were protected by dirt to prevent exposure to sun and air. The others were covered with their respective curing agents.

At fourteen and twenty-one days the slabs and cylinders were removed to the laboratory and tested.

Besides making the slabs and cylinders, the field party determined moisture contents, weights, proportions, and consistencies of the materials and resulting concrete.

The party also secured the samples of materials for the laboratory tests. These consisted of a sack of cement, about 250 lb. of fine aggregate and 375 lb. of coarse aggregate, each taken from the stock piles near the mixer at the time the respective field slabs and cylinders were being cast.

On reaching the laboratory with the material samples, colorimetric tests were run on the fine aggregate; the weight per cubic foot of both fine and coarse aggregate was determined after drying; a sieve analysis was run, and briquette tests were made on one part of cement to three parts of fine aggregate. Six slabs and six cylinders were made from each sample of aggregate and cement. For comparison purposes so-called "standard" specimens were made, which consist of a good limestone, a good sand and a mixture of three brands of cement, these materials all being in constant use in the laboratory. Great care was used to make these under as nearly equal conditions as possible, only one slab and cylinder being mixed at a time.

After one day in the molds, the cylinders were placed in the moist closet until the day of testing. The slabs to be cured with sodium silicate and calcium chloride were placed on a platform adjacent to the moist closet. The sides, ends and bottoms of these were sealed with sodium silicate and the top only cured in its respective manner. The slabs to be cured with hay, straw and dirt were placed in the moist closet, covered and moistened daily. The slabs and cylinders which were to have no covering were placed in the permeability room which had an average temperature of about 75 deg. F.

The slabs were withdrawn from the moist closet after 14 and 18 days. The 14-day sets were tested on removal, but the others were allowed to stand three days at room temperature.

The cylinders were kept in the moist closet 14 and 21 days and tested immediately.

In the field, six slabs and six cylinders were made of each method. Three were tested when 14 days old and three when 21 days old. The 21-day period was chosen because it is the standard of the Wisconsin Highway Commission, and the 14-day period was chosen to determine what effect the shorter period of curing had upon the strength results.

Sections cured by sodium silicate and calcium chloride were not touched after having the curing agent applied, which was about twenty hours after pouring. The sections covered with dirt, hay and straw were kept moist for 14 days, the standard Wisconsin practice. Sections not covered were exposed to the normal existing weather conditions, which had an average temperature of 72 deg. F.

The specimens, both field and laboratory, were broken under standard laboratory practice. The cylinders were crushed in a 100,000-lb. testing machine. The slabs were rattled in an abrasion machine quite similar to a standard brick rattler. Six slabs were tested at once, being fastened in like staves in a barrel. One stave was a dummy with slots in it to permit the accumulated dust to escape during the rattler operations. The charge consisted of 150 lb. of small iron shot and 50 lb. of large shot.

The charge was given 1,800 revolutions in a clockwise and 1,800 revolutions in a counter-clockwise direction at a speed of thirty revolutions per minute.

In making the transverse tests, the specimens were supported on rocker bearings over a 17-in. span with the worn side of the slab down. (Slabs were first rattled and then broken for transverse strength.) The table shows the test results.

Results and Conclusions—From this table can be assembled various other tables, such as a comparison of strengths at 14 and 21 days of the various materials and curings; a comparison of field with laboratory specimens as to wear, transverse strength and compressive strength. These tables have all been drawn up, but it was felt that they would make this article too lengthy.

WEAR AND STRENGTH OF PAVEMENT CONCRETE CURED BY DIFFERENT METHODS

Age in Days	Weight Lost, Per Cent	Mod. of Rupture, Lb.	Ult. Str. Cylinders, Lb.	Character of wear in rattler test of slabs
Sodium Silicate Covered (Field Specimens)				
15	6 8	529	1,762	Even. One grooved end
22	7 5	598	1,648	Two uneven. One even
(Laboratory Specimens)				
14	18 3	290	2,381	Uneven One broke
22	16 3	404	2,766	Uneven Two broken
14	15 0	380	1,818	Uneven. Two broken
22	16 8	470	1,844	Uneven One broken
Calcium Chloride Covered (Field Specimens)				
14	10 2	686	1,969	Uneven. One grooved
21	9 4	623	1,873	Uneven
(Laboratory Specimens)				
14	8 5	497	3,164	Uneven
21	12 4	392	2,367	Uneven. One broken
14	16 5	537	1,713	Uneven
21	9 3	481	1,657	Uneven
Hay Covered (Field Specimens)				
20	8 2	418	1,871	Uneven
21	10 5	333	1,867	Uneven
(Laboratory Specimens)				
14	12 2	361	1907	Uneven
21	13 9	360	2238	Uneven
14	12 5	476	1661	Uneven
21	10 7	510	1936	Uneven
Straw Covered (Field Specimens)				
19	7 8	420	2,037	Even
20	8 2	505	2,255	Uneven
(Laboratory Specimens)				
14	11 5	451	1,932	Uneven
21	10 9	490	1,967	Uneven
14	12 7	449	1,553	Uneven. One broken
21	11 4	517	1,546	Uneven
Dirt Covered (Field Specimens)				
17	7 6	593	2,173	One even. Two uneven
21	3 6	609	2,309	Two even. One uneven
(Laboratory Specimens)				
14	8 1	442	2,647	Uneven
21	8 4	559	3,076	Uneven
14	12 3	399	2,082	Uneven
21	11.7	572	1,764	Uneven
No Covering (Field Specimens)				
14	8 9	491	1,992	Uneven. One grooved
21	6.0	441	2,013	One even. Two uneven
(Laboratory Specimens)				
14	19.0	...	2,357	All three broken
21	19 6	...	2,643	All three broken
14	18 7	.	1,787	All three broken
21	18 9	480	2,245	Uneven

Note: In each case the figures are an average of three specimens except where slabs broke in the rattler and the modulus figures represent two specimens or less.

The consistency of the concrete was in most cases drier for the laboratory than for the field mixes. It is felt, however, that the amount of water retained in the field slabs when setting took place was less than the amount retained in the laboratory specimens, on account of the finishing operations and the weather action.

The important effect of the absorption of the subgrade will be appreciated from some laboratory tests which were made in 1921. Half of the specimens were bedded on sand and half made in tight cast-iron molds. These tests show that the slabs with sand bottoms were 5 per cent stronger in the transverse test and lost 5 per cent less in the rattler than the slabs made in the tight molds. Because of these reasons one would expect the field slabs to prove more resistant to wear and stronger in the beam test than the laboratory slabs, a condition which is true in nearly every case.

The field experiments show that the calcium chloride covered specimens give the best results for transverse

strengths in both the 14- and 21-day periods of curing, though closely followed by the strengths of the dirt covered specimens. The latter gave, on an average, a more resistant surface for both periods. Not so marked a difference was noticed between these two types of curing in the laboratory specimens.

In both the field made and laboratory specimens, cured by calcium chloride, the modulus of rupture dropped considerably at 21 days. Because of this rather startling defect some studied consideration should be made before the acceptance of this material as a curing agent.

Where dirt is available, it is preferable to use this material for a curing agent, rather than hay or straw. The latter could be used when dirt is not available.

By no means, as is clearly shown by these tests, should a newly poured surface be exposed to sun and winds.

It is evident from these tests that the concrete had gained sufficient strength to warrant the opening of the road to traffic at the end of fourteen days without possibility of doing injury to the pavement. In cases of extremely heavy vehicles damage might be done, but not with ordinary traffic.

Brick on Waterbound Macadam with Penetration Curb

Construction Methods on Twenty-Mile Texas Road —Curb Work Unique—Ten-Months' Traffic Develops No Defects

By C. H. Henning

State District Engineer, Texas Highway Commission

Methods unusual in character and thoroughness have been employed in building a 20-mile brick road in Eastland County, Tex. This road leading from Granger to Cisco has a waterbound macadam base surfaced with vertical-fiber, asphalt-filled brick, edged with curbs of penetration macadam. It is a federal-aid project, F. R. Sexton being the government engineer

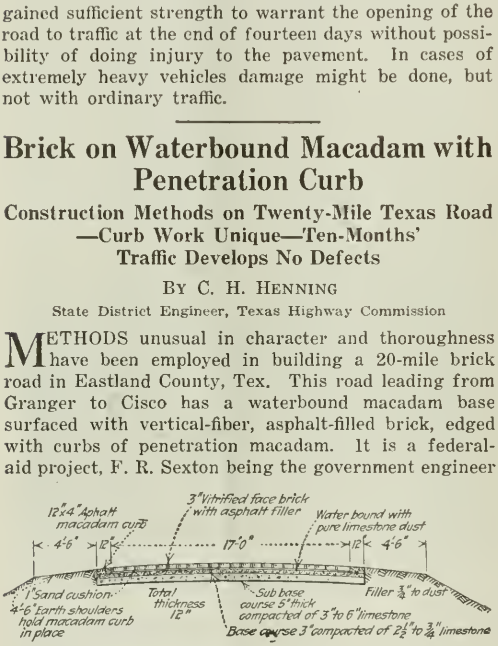


FIG. 1—CROSS-SECTION OF BRICK ROAD WITH PENETRATION CURBS

in charge, and is financed with 45 per cent county funds and 55 per cent state and federal-aid funds.

As shown by the drawing, Fig. 1, the roadway is 28 ft. wide on fills and 38 ft. wide in cuts. The base is 8 in. of thoroughly compacted macadam 19 ft. wide, with a 2-in. crown. Upon this base and a 1-in. sand bedding course is laid a surfacing of 3-in. vertical-fiber, vitrified brick to a width of 17 ft. Asphalt filler is applied, with the thinnest possible coat remaining on the surface, after which coarse sand is applied.

On each side of the 17-ft. brick surface and on top of the remaining foot of 8-in. base a 4-in. asphalt macadam shoulder is constructed. This shoulder is 1 ft. wide and is designed to serve in place of the usual curb. Outside of this shoulder on both sides of the pavement the earth berm, 4½ ft. wide, is brought to grade. On about one mile of the road, and prin-

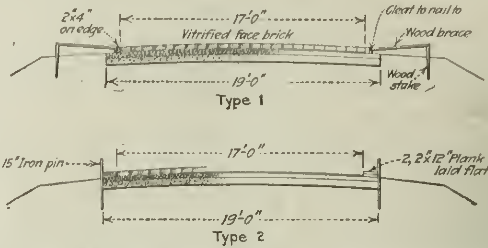


FIG. 2—TWO TYPES OF FORMS FOR SETTING BRICK AND BUILDING CURBS

Braced about every 8 lin.ft. in either case. Templet is pulled along on top of forms to adjust sand cushion, then brick are laid and rolled. The forms are then moved back one foot and asphalt macadam laid, asphalted and rolled. Then the brick are asphalted and covered with coarse sand. Form system No. 2 has proved the better.

cipally at turn-outs and intersections, a 12 x 12-in. concrete curb has been substituted for the asphalt-macadam header.

Base Construction—Among the more interesting features of the construction is the thoroughness with which the macadam base is prepared. The subgrade trench is cut 19 ft. wide, excess dirt being pushed out for earth shoulders. The trench is then rolled until thoroughly compacted, and lined up. Upon this subgrade is placed a course of sledged limestone sized from 3 to 6 in. in such quantities as to make 5 in. after being thoroughly rolled. Upon this is placed a second course of crushed limestone sized from 2½ to ¾ in. in sufficient quantities to make 3 in. after filling the voids in the larger stone and being compacted. Upon this is placed enough fine material (from ¾ in. to dust) to fill all voids in the second course. This application is broomed in dry and care is taken to fill all voids and see that any excess is uniformly distributed.

The whole is then first rolled dry, sprinkled and again rolled until as firm and tight as possible. Upon this a very fine layer (about 2 cu.yd. per 100 sq.yd.) of pure limestone dust is applied and flushed with water and rolled wet until a grout forms in front of the roller in sufficient quantities and of proper consistency to seal all cavities and honey-combed places. Brooms and, in some instances, wood floats are used to secure an absolute grouting of the entire base. After drying for about 48 hours the base is hard enough to hold up a wagon loaded with 5,000 lb. of sand, without showing a wheel mark or horseshoe print.

Wooden forms are then set up on this base 17 ft. apart leaving one foot of base outside on each side. These forms are set to the grade of the finished pavement. Enough sand is then spread to form an approximate 1-in. bedding course. This course is distributed with the templet which conforms to the surface of the finished road. The templet is pulled along on the forms and varies the depth of the bedding course enough to take out any little irregularities there may be in the base. Where variations of more than ¾ in. show up in the base it is raised or lowered enough to allow the cushion to take up the difference. In other words, if the templet runs up on an inch and a half bump it will not ride on the forms even with no sand under it. In such cases the bump has to be cut down enough to allow the templet to ride the form and still have some bedding sand between it and the base. In

FIG. 3—MACADAM BASE BEFORE WATERBINDING WITH LIMESTONE DUST

case of a low spot too much bedding course will show and a little limestone dust has to be added, wetted and hand-tamped until the bedding course is not too deep.

After a short time the crew developed skill to the degree that it could finish the base practically to grade with the use of tees, and very little trouble was experienced thereafter when the templet was put in operation. The faithful use of the templet guarantees a finished surface as good as the average on a concrete base.

Pavement Construction—Two systems of wood forms have been used, the second proving much more practicable and probably the better. The first system, Fig. 2, consists of bracing a 2 x 4-in. timber on edge from the outside by means of wooden stakes driven into the dirt shoulder, the brace running from the stakes to a nailing strip cleated onto the 2 x 4 timber. The second system, Fig. 2, consists of laying two 2 x 12-in. planks flat and driving steel pins against the outside edge to hold the line. In either case the forms are set to finish grade, and it is sometimes necessary either to shim under them a little or, if there is a bump, take the base down a little. This second system gets away altogether from the use of nails and is a little more rigid. While the first cost of lumber is higher, the same plank can be used over and over again until, in the end, it really is cheaper. In either case the forms are braced every 8 ft.

After the forms have been set and the bedding course shaped the brick are set, rolled, inspected and culled. Before the brick are asphalted the forms are moved back a foot on either side, rebraced and the 1-ft. asphalt-macadam shoulder built. First, a 3-in. course of 2-in. crushed stone is tamped in and 1 gal. per square yard of asphalt is applied. This layer is then brought almost to grade with 1-in. crushed stone and again well tamped. Another gallon per square yard of asphalt is applied and the surface is brought to grade with ¾-in. clean limestone chips, and thoroughly rolled with a five-ton tandem roller.

The brick surface is then flushed with asphalt behind the shoulder gang instead of in front. This keeps the forms from getting covered with asphalt when the brick are flushed. To keep the forms clean while pouring the shoulder they are removed after the first course of shoulder rock has been tamped into place. The dirt shoulder is thrown up into place when the forms are removed and the macadam shoulder and dirt shoulder are rolled at the same time. In short, the shoulder and berm are built as nearly as possible in one continuous operation, the idea being to keep them completed just in front of the flush-coat gang on the brick.

After the brick have been properly filled and sanded, all excess forms and material are moved ahead. The road is opened to traffic, and a team outfit comes along bringing all earth shoulders to grade, straightening up ditches, and in general putting on all the finishing touches.

The bricks were hauled and stacked in advance of the brick-laying gang on both sides of the road where possible, and then delivered by hand to the brick setter, each man carrying four bricks at a time. The narrowness of the road made the use of conveyors of little advantage.

It took about twenty teams and ten extra men, a roller, water wagons, etc., to build 600 lin.ft. of base a day in addition to the gang engaged in crushing the rock. Eight teams and eight extra men were kept busy hauling and stacking the brick for a day's work.

FIG. 4—ROLLING BRICK AND BUILDING CURBS

Ten men carried the brick to the setter. There were two batters, three men working on the bedding course, and two teams hauling sand. Ten more men were engaged in filling the brick and constructing the asphalt-macadam shoulder. In addition, an outfit of six or seven teams was kept busy putting on the finishing touches. Work was started Feb. 15, 1922. Three crews, as outlined, were kept busy all of last summer and fall. One crew was worked in 1923.

Some of the road has now been open to traffic for about ten months and if any change can be noticed it is that it is getting smoother. It is stated by users of the road that it is as smooth as a city pavement on a concrete base. There were two connections to city pavements that settled just a trifle where, to meet the grade, a little too much sand was used in the bedding course. This was remedied by building up the base a little and cutting down the depth of the bedding course.

All work was performed under the direction of F. P. Sexton, federal highway engineer, C. H. Henning, state district engineer, and W. R. Eccles, engineer for Eastland County. The construction was in charge of P. B. Keller, superintendent of Smith Brothers, Inc., general contractors, of Dallas, Tex.

Paper Company Completes Power Plant on the Hudson

Unusual Geological Conditions of the Site—Self-loading, Multiple-Arch Dam—864-ft. Spillway—Large Concrete-Lined Canal—Reinforced-Concrete Penstocks, Scroll Cases, and Draft Tubes

FORTY THOUSAND more electric horsepower has been added to the available supply in northern New York by the completion of the International Paper Co.'s Sherman Island hydro-electric development, on the Hudson River near Glens Falls, N. Y. This plant uses the total head between the tailwater elevation of the power plant at Spier Falls and the pond of Champlain Canal Feeder Dam at Glens Falls, an average head of 65 ft. The ultimate installation will be five units of 10,000 hp. each and will utilize at full load a total flow of 7,600 sec.-ft.; but on account of the present unregulated flow of the Hudson River only four units have been installed. Electric current is generated at 6,600 volts and transmitted at 114,000 volts to the trunk distribution system of the Adirondack Power & Light Corp.

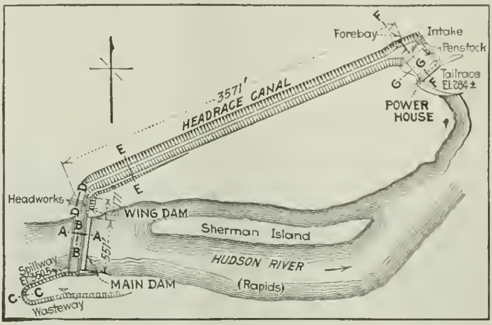


FIG. 1—GENERAL PLAN OF THE SHERMAN ISLAND DEVELOPMENT

The outstanding features of the development are the unusual geological conditions encountered and overcome. The main dam is founded on a bed of boulders and gravel, the headrace canal is excavated through fine sand, and the power house is set in a glacial flour approximating quicksand. It is located just where the Hudson River comes out of the Adirondack Mountains into the broad valley which it follows to the sea. The bottom of this valley is filled with glacial deposits of great depth. The dam is on the edge of this valley just where the steep granite rock slopes of the two peaks that flank the river dip sharply under the glacial bed. The two extremities of the dam are built on this rock and the spillway channel is excavated through it but the main portion of the dam is built on glacial deposits, a firm mass of boulders, sand and coarse gravel of unknown depth.

This formation practically precluded the idea of using a spillway dam across the river or a gravity type reservoir dam, and, as the formation of the south bank (the river here runs east) made it possible to excavate a wasteway channel through the solid rock, it was decided to use a non-overflow, multiple-arch dam across the main channel of the river and to use a gravity type section for the spillway which would be on solid rock.

From the site chosen for the dam to the upper end of the feeder dam pool the river runs in a rapids about

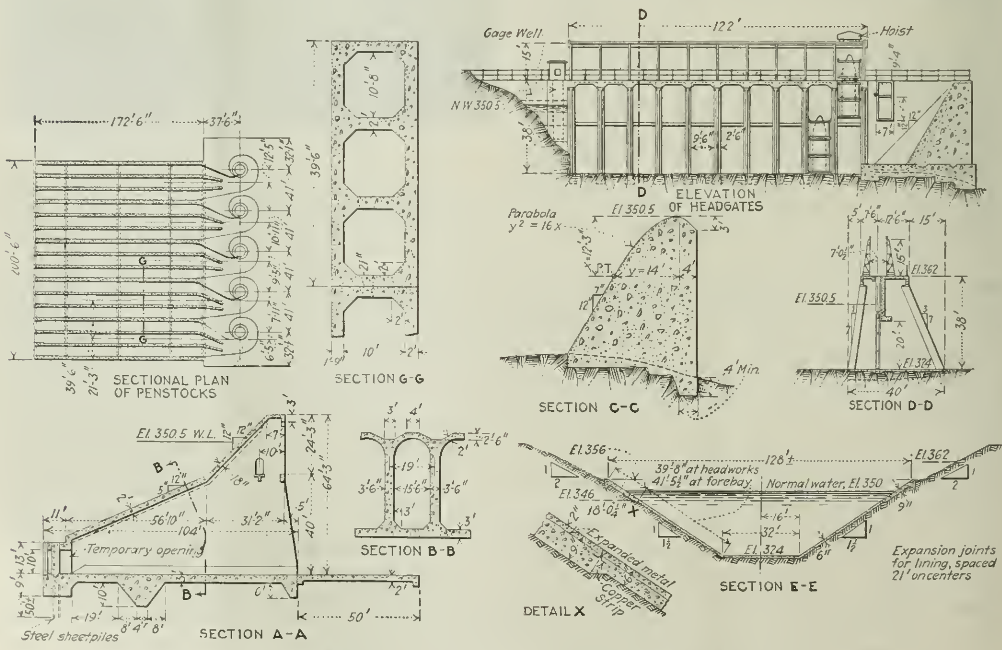


FIG. 2—DETAILS OF THE STRUCTURES OF SHERMAN ISLAND DAM AND CANAL

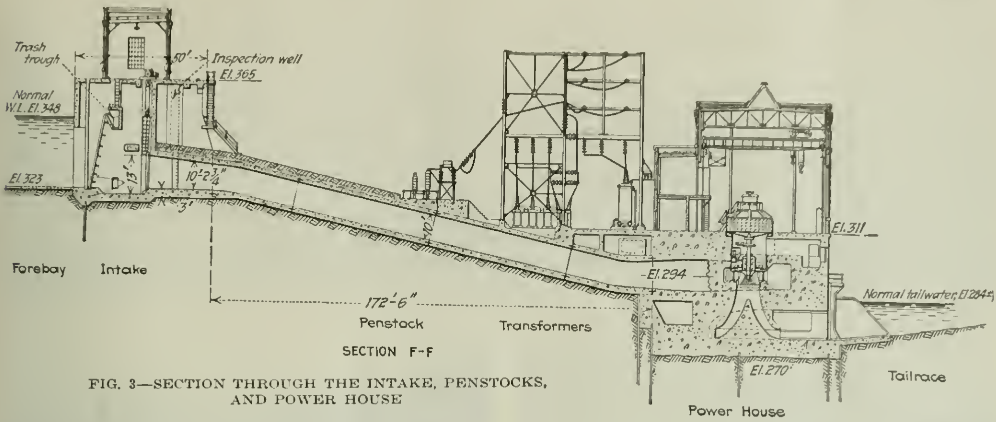


FIG. 3—SECTION THROUGH THE INTAKE, PENSTOCKS, AND POWER HOUSE

3,000 ft. long, falling 19 ft. To use this 19 ft. of head it was necessary to do one of two things, either locate the power house at the dam and excavate a long tailrace channel in the unstable material found underneath the boulder blanket of the river bed downstream from the dam, or carry a canal along in the bank of the north shore and build the power house at the upper end of the pool. The latter plan was adopted as the formation of the bank lent itself to such a development. Fig. 1 gives the general layout of the project.

Details of the Design—The main dam across the river channel is of reinforced concrete, 551 ft. long and has a maximum height of 70 ft. from the bottom of the floor to the walk. It is a multiple-arch type of dam as shown in Sections A-A and B-B, Figs. 1 and 2. The buttresses supporting the arches are placed upon a heavily reinforced floor slab which distributes the weight of the dam over the whole foundation area, thereby reducing the unit load to a safe amount. The decrease in the slope of the back from a 12:12 slope to a 5:12 slope was made in order to increase the weight of water upon the dam and, by the consequent widening of the floor, to increase the contact with the boulder bottom thus gaining more stability against sliding. As an additional precaution, the floor of the dam and the 50-ft. concrete apron below it have been covered with a layer of sand about 20 ft. thick. This increases the weight and also serves as a protection in case of overtopping. Overtopping is, however, highly improbable as the height of the dam above the spillway is such that it would require a flood 50 per cent greater than the record flood of 1913 to overtop it.

FIG. 5—INSIDE OF COFFERDAM NO. 1 SHOWING THE CHARACTER OF THE RIVER BOTTOM

In order to reduce the upward pressure on the dam to an average of not more than 30 per cent of the active head, a double row of Lackawanna steel sheet piling 50 ft. deep was driven along the upstream toe of the dam; and after the dam was completed the bottom of the pool

FIG. 4—GENERAL VIEW OF THE SHERMAN ISLAND DEVELOPMENT
Showing the spillway and main dam at right and top of canal lining from center to left; powerhouse at extreme left.

immediately above the dam was filled with fine sand. Actual measurements of the pressure since the pond was filled show that the pressure is well below the prescribed limit.

The thickness of the arch ring in the main dam is notable. It is only 18 in. in the upper section and 24 in. in the lower section. These shallow thicknesses were used in order to increase the elasticity of the arches and to reduce to a minimum the stresses due to shrinkage and temperature changes.

The spillway is all on solid rock and is of mass concrete of gravity section. It is horseshoe shape in plan to give a weir length of 864 ft., the length required to take a flood of 100,000 sec.-ft., with a margin of 2 ft. below the top of the main dam. The wasteway channel was so designed that under no circumstances would the weir be submerged. There are seven sluiceways through a bulkhead section built into the spillway for use in case it is necessary to partially empty the pond.

At the north end of the dam is a wing dam 171 ft. long of gravity section built on solid rock. It closes the gap between the main dam and the south embankment of the canal and forms the east abutment of the headworks. The west headworks abutment is against the side of the short rock channel that forms the upper end of the headrace canal. The headworks structure is of reinforced concrete built on solid rock and is designed as a dam sustaining a head of 35 ft. It is shown in detail in Fig. 2. The novel feature of this structure is the design of the gates. In view of the fact that they need to be lowered into place only when it is necessary to clean or repair the canal and need not be quick operating when refilling the canal, it was decided to make them as simple as possible and to introduce the minimum amount of obstruction in the channel by making it possible to raise the gates entirely out of the channel when not in use. They are of reinforced concrete with angle irons to protect the edges and make tight fitting joints. Each of the ten gates is made in three sections 7 ft. x 10 ft. 2 in. and 18 in. thick, fastened together by manganese bronze links and pins. The link between the middle and the upper section is slotted to provide a 14-in. opening for filling the canal and for supporting the gate in its raised position. These gates are raised and lowered by a 20-ton electric hoist mounted on a craneway running the full length of the headgate structure. The gage well and the pump well are located in this structure as is a log gate for driving timber through the canal.

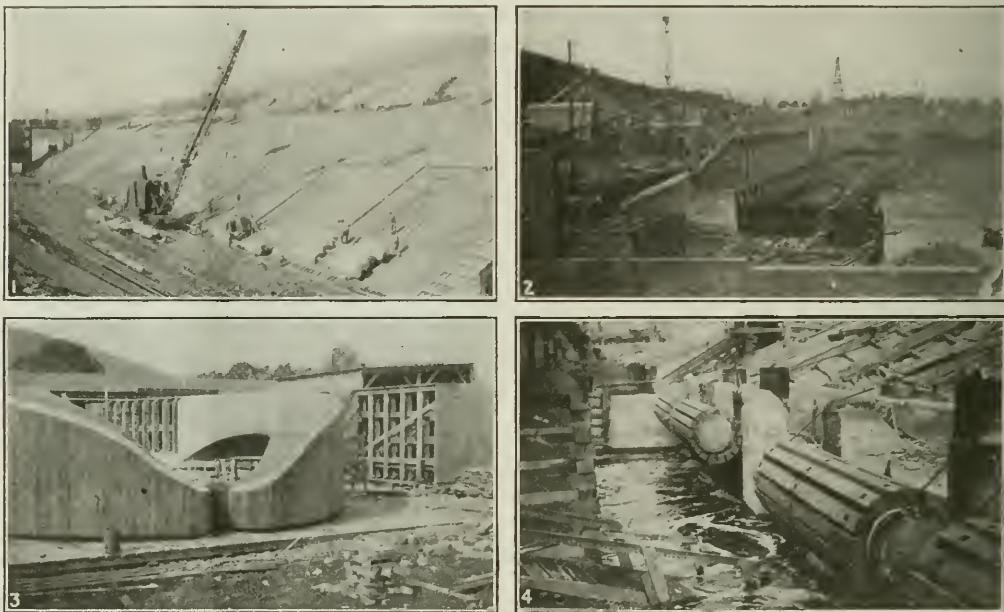


FIG. 6—DETAILS OF THE WORK DURING CONSTRUCTION

Showing (1) Pouring the 6 in. concrete slabs for the canal lining. (2) Buttress work on the main dam. (3) Forms for the turbine draft tubes. (4) Temporary roller gates for closing the last openings in the main dam.

The headrace canal, with the exception of the first hundred feet, is excavated through a glacial deposit which ranges from coarse gravel to quicksand, most of it through a moderately fine sand. For this reason all but the short rock section at the upper end is lined with concrete up to a level of six feet above the spillway elevation. Above this level the slope is riprapped to protect it against scour during the short duration of floods which might go above it. The forebay is lined with concrete to this higher level on account of the surge. The details of the canal are shown in Fig. 2. The slab is reinforced with expanded metal mesh to concentrate the expansion in the expansion joints. It is built up in 21-ft. sections, with construction joints at the center and sides of the floor and 40 ft. up the slope where the thickness is increased from 6 to 9 inches. Each joint is closed with a 6-in. copper expansion strip.

FIG. 7—THE CANAL AND HEADGATES
Top of main dam can be seen beyond headgates; concrete mixing plant under temporary trestle at center of the canal.

This design was used on account of the need for greater flexibility in the lining of the canal and it was hoped that there would be very little loss through the joints, but during construction a stratum of water-bearing sand was encountered along the inland side of the canal which made it necessary to leave openings through the lining to take care of the water. After the lining was completed an attempt was made to close up these openings by grouting, but it was not entirely successful and after the canal was filled it was found that there was a loss of about 5 sec.-ft. As the machinery in the power house was not ready for operations it was decided to empty the canal to make observations of the lining. The gates were opened and the canal emptied in about 4 hours. After the water was out of the canal a section of the lining about 1,000 ft. in length on the inland side was found to be damaged in places and other places pushed out into the canal. This was undoubtedly caused by a hydrostatic pressure built up between an impervious layer and the canal lining. Repairs were made by replacing the damaged portion of the lining, adding concrete in heavy steps along this 1,000-ft. damaged section, together with a single step along the toe of the slab at the river side, and concrete struts from side to side laid on the bottom. In addition to this numerous weepers were placed in the bottom of the canal. These consisted of 4-in. pipes carrying simple lift valves at the top. Furthermore, all the construction joints throughout the canal were carefully filled with gunite. Since these repairs were made the canal has been refilled and no abnormal leakage has appeared.

The forebay dam is built on sand. It is of reinforced concrete with a heavy bottom slab and 3-ft. and 3 ft. 6-in. buttresses at 10 ft. face to face. It is provided with a steel sheet pile cutoff 15 ft. deep. There is, however, little possibility of any uplift on this structure as the lining of the canal is connected to it by watertight joints similar to those used in other parts of the canal. Moreover, the ground drops away in front of the dam insuring proper drainage. The intake works are made an integral part of the central portion of the forebay dam as shown in section in Fig. 3. There is a log-way at the east end which runs down to the river below the power house. An interesting feature of the intake is the trash trough along the top of the trash racks shown in Section F-F. It runs the full length of the structure and empties into the log-way and is provided with a 12-in. valve at the upper end for flushing it out.

Fifteen reinforced-concrete penstocks, built in groups of three, have their upper ends in the 10-ft. spaces between the buttresses. They are closed with Broome caterpillar sluice gates operated by electric hoists situated in the gate house on top of the dam. As an emergency measure stop-log grooves have been cast in the concrete in front of the trash racks.

FIG. 8—UPSTREAM SIDE OF THE DAM AND SPILLWAY
Showing, left to right, cement shed and stone stockpile, mixing plant, part of the headgates, main dam and wasteway channel.

FIG. 9—BUTTRESS FORMS ASSEMBLED READY TO BE SENT OUT TO THE DAM

The penstocks are 10 ft. x 10 ft. 8 in. in section and 172 ft. long. They are heavily reinforced and have a minimum wall thickness of 18 in. Each group of three serves one turbine as shown in section in Fig. 2. As the whole penstock structure is built on sand, some of which is soft, it is divided up into separate sections by longitudinal and transverse joints. Longitudinal joints are made between the groups of three, and the five transverse joints are closed with lead strips, and in addition are calked with tar and oakum on the inside. The inner surface is waterproofed with an iron compound.

The Power House—Test shafts and borings made at the power house site indicated that quicksand underlay the whole area. The problem of confining this sand was solved by dividing the foundation area up into ten box sections by steel sheet piling driven to 25 ft. below subgrade. These sections act as sand columns transmitting the load to a safe depth. To take care of the unbalanced horizontal load and to prevent squeezing out of the material in front of the power house the tailrace apron was carried out across the light sand bed about fifty feet to a point where gravel was encountered in the river bed. Heavy buttresses were carried up from this apron to the side of the power house. Observations were made on the power house foundation during construction to check the settlement. It was progressive during the pouring of the great mass of concrete in the foundation and draft tube blocks but since these were completed there has been no settlement. Fig. 3 shows the power house in section. The ultimate installation will be five 10,000-hp. vertical turbines. The scroll cases and the Moody spreading draft tubes are of concrete.

The superstructure of the power house is of brick and steel with a gypsum roof. A transverse traveling crane of 50 tons capacity serves the whole generator floor and reaches the standard-gage railway track where it enters the west end of the building.

Construction—The construction work started in November, 1920, with the grading and laying of a 6½-mile railroad from Glens Falls to the camp site. Portable and semi-portable frame buildings were put up for the main camp, and a group of cottages which will later be used for the permanent employees was erected for the use of the construction staff. The camp was provided with a septic sewage system and with a duplicate water supply, a drinking water supply from a small reservoir in the hills back of the camp, and a general supply pumped from the river to an elevated tank. Electric current for lighting and power was brought to the site by a 6-mile transmission line from Glens Falls.

The construction camp was equipped with a machine and blacksmith shop, air compressors, sawmill, woodworking shop, and storehouses. These were all located along the standard-gage railway tracks. A 1,400-ft. cableway was built from a central point in the camp to a similar high point on the south shore, parallel to and above the center line of the main dam.

In the spring of 1921 two bridges with stone-filled crib piers and I-beam stringers were built across the river, a double-track structure above the dam site and a single track one below. Cofferdam No. 1, 350 ft. long by 250 ft. wide, at the north side of the river was driven outside the line of the bridge. The sides of the cofferdam were constructed of a single row of Lackawanna steel sheet piling, supported by three rows of wales which in turn were held by the crib pier and the intermediate struts.

The central concrete mixing plant and the rock-crushing plant were located on a natural terrace about 25 ft. above normal water level on the north river shore above

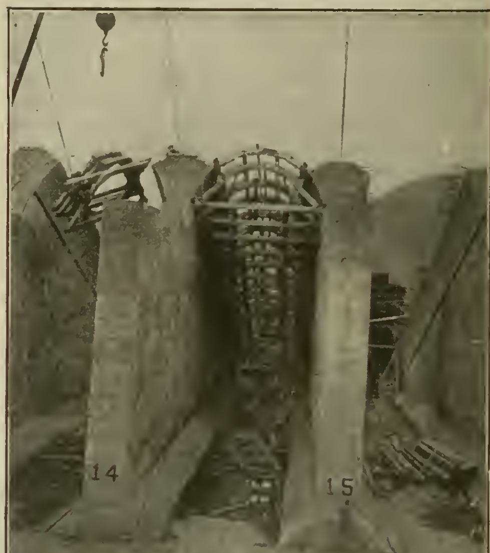


FIG. 10—DETAILS OF THE BUTTRESSES
Showing method of framing for the arch rings.

FIG. 11—THE FOREBAY DAM, PENSTOCKS AND POWER HOUSE
Showing the formwork for the penstocks.

the dam site. Rock for the crushing plant was brought from the excavation for the spillway channel on the south shore. The immediate needs of the mixing plant were supplied by one belt conveyor, and a second conveyor delivered the excess to a stock pile up at track level in the camp. Pit-run sand from the canal cut was supplied to the mixer from the high-level tracks. Cement was brought in bulk from the Glens Falls Cement Co. and was delivered in four hopper-bottom cars specially roofed for that purpose. This cement was dumped into large storage bins built under a spur of the high-level tracks and was fed to the mixing plant bins by a belt conveyor. The central mixing plant had two one-yard mixers equipped with Johnson proportioners for proportioning by weight. All the equipment, crushers, belt conveyors, screens, mixers, air compressors and large pumps were electrically driven. The concrete for the portion of the dam near the mixing plant was spouted from a tower at the mixer but for the greater part of the structure it was deposited from buckets moved by flat cars or from a spouting plant built in a gantry traveler and supplied by buckets carried out on the cableway.

Most of the concrete formwork was done at the woodworking shop in the camp on the high level and was sent out to the dam on the cableway. All reinforcing material was distributed in the same way from a storage yard located under the cableway along one of the tracks in the camp.

During construction of the north half of the dam openings were left between the buttresses at the upstream side of the dam as shown in Section A-A, Fig. 2. The idea of these openings was that as soon as the concreting of this half had been carried above high-water level the cofferdam could be cut and the river allowed to flow through these openings while the south half of the river was shut off by cofferdam No. 2 after the flood period of 1922. Four similar openings were left in the south half of the dam when it was built and these openings were equipped with temporary roller gates. After the main dam and the spillway had been completed, and during the low water of the fall and winter of 1922-23, the temporary openings in the north half were first closed with stop logs and then concreted up. Then when the dam was in shape to start filling the four roller gates were closed and calked from the downstream side. When everything appeared to be holding satisfactorily under the rising water in the pond these openings were concreted up by means of large steel pipes carried up above the level of the water in the pond.

The headrace canal, with the exception of a short section at the headgates, was all in sand and gravel. It was excavated by dragline and steam shovels approximately to grade and was then carefully finished off to subgrade by hand. This subgrade was used for the bottom of the forms in pouring the lining. The lining was poured in alternate 21-ft. sections, the bottom first then the lower 6-in. slab on the slopes, followed by the upper 9-in. slabs. For pouring the slabs 6-in. or 9-in. stringers were laid up the slope to make the side forms and 26-in. portable panels, held in place by concrete weights, were used for surface forms. The expanded mesh reinforcing was laid on the slopes before pouring started to provide a footing in the soft sand for the

FIG. 12—DOWNSTREAM FACE OF THE COMPLETED DAM
Showing the 20-ft. fill on the floor and apron of the channel section.

workmen. As the concrete was poured this mesh was pulled up into place with hooks.

Concrete for the canal lining was mixed in a plant suspended between the bents of a trestle which crossed the canal. From this 1-cu.yd. mixer the concrete was run directly into 1-cu.yd. buckets on flat cars operated on a double-track railroad laid in the bottom of the canal. Locomotive cranes distributed these buckets to the concreting gangs and also placed form panels.

Cement, sand, and stone for the canal mixing plant were dumped from the deck of the trestle to the bins underneath the track. Latterly, when the main dam was finished and the site of the central mixing plant was submerged, a tower was erected at the side of the canal plant and concrete was mixed there and delivered to cars on the deck of the trestle.

Concrete for the power house and the major part of the forebay dam was handled by train in 2-yd. side-dumping buckets from the central mixing plant to a distributing tower on a high point above the power house and forebay dam. Concrete for the penstocks was mixed in a 1-cu.yd. plant built on a high point at the end of the forebay dam. All concrete was proportioned by weight. The proportions were changed constantly, both on account of the four classes of concrete used and on account of the variations in the pit run of sand and crusher run. Concrete for the massive work was mixed substantially in the proportions of 1 : 3 : 6, for the lighter work 1 : 3 : 5, and for the light reinforced parts 1 : 2 : 4. The canal mix was made about 1 : 3 : 2 on account of the difficulty of working the concrete into the 6-in. forms.

Great care was used in the control of the mixing water to see that there was no excess. Samples were taken from the concrete at regular intervals and cast into 10-in. cylinders. These cylinders were cured and then tested at the Rensselaer Polytechnic Institute.

For winter concrete work the sand and stone bins were equipped with steam coils and the water was heated. By this means concrete was usually delivered at the forms around 50 deg., the early morning batches being as high as 90 degrees. Temperature tests were taken on all cold days and a check was kept on the temperature of the concrete in place for periods extending over weeks in some cases. All exposed work was protected with hay and paper.

Generally the temperatures were higher on the day immediately following placing and then fell off slowly. One large section of mass concrete in the wing dam poured on January 21 never registered an internal temperature below 34 throughout the winter.

The turbines were designed and built by Wm. Cramp & Sons, and the electrical equipment by the General Electric Co.

The general design was made by A. H. White, chief engineer of the International Paper Co. H. deB. Parsons was consulting engineer and designed the main dam. The structural details were worked out by E. E. Halmos, designing engineer, and S. A. Thoresen of the firm of Parsons, Klapp, Brinckerhoff & Douglas. The construction work was done by the Parklap Construction Corp., under the direction of W. J. Douglas, president, and E. E. Halmos. The field staff consisted of E. A. Little, manager, W. F. Barnes, general superintendent, and G. Miller, supervising field engineer. H. M. Hale was resident engineer for the International Paper Co.

The Truth About Civil Engineering

A Talk Broadcast from W. J. Z., New York City, by Frank C. Wight, Managing Editor, Engineering News-Record. [Printed by Request]

IN THESE days of the silver screen there is no need to tell anyone what a civil engineer is. Every movie fan knows that he is that handsome, though rugged, chap in the nicely pressed khaki breeches and knee boots who bosses a thousand or so roughnecks building a dam in the eucalyptus covered hills back of Los Angeles. His professional activities consist in a few moments' studious attention to a blueprint or two, a short glimpse through some kind of a surveyor's instrument and some hail-fellow-well-met directions to a couple of men working near a derrick. The rest of his time is spent in bashful devotion to the daughter of the New York banker who is financing the dam. Along about the fifth reel the slick-haired lounge lizard who has pursued said daughter all the way from New York, manages somehow to get a nasty-looking bomb over the side of the several hundred thousand yards of concrete that make up the dam, but before the fuse gets in its dirty work to discredit our hero, that gentleman—his pants still neatly pressed—dives overboard, grabs the bomb, swims out with it and hurls it toward a road over which, unknown to him, the villain in a speeding auto is kidnapping the heroine. The bomb explodes, the automobile dives into the crater, the villain dies in such fashion as the censor will permit and the heroine somehow tumbles into the arms of the civil engineer. Fade-out of civil engineer and banker's daughter against background of dam, derricks, and surveying instruments.

This isn't confined entirely to the movies. The civil engineer is in danger of becoming characterized by the artists, both pictorial and fictional, as the great romantic—the successor of the cowboy and the soldier, the exponent of the wide open spaces, the two-fisted man who gets things done but always in the romantic manner, who moves gaily through a picturesque, an unusual, an adventurous life. It is far from a joke to say that the greater number of the recruits to the profession are drawn there by just this appeal.

In marked contrast to this idealized picture of a civil engineer is the too prevalent viewpoint of the big business man, the politician and the banker, the men who handle the strings of the purse into which the civil engineer must dip for the wherewithal to carry on his work. These men are prone to consider the engineer as a sort of higher class journeyman—a mathematician, a surveyor, a draftsman—who deals only with material things; a good enough sort of expert to plan the transformation of steel and concrete and earth and rock into the tunnels, and buildings, and bridges and water-works the world must use, but after all a mechanic with no sense of men or business or beauty. He is necessary to the world, of course, but not one who can ever rise very high in its direction.

Of these two conceptions of the civil engineer, the latter is by far the more offensive. No special harm is done the profession by painting it with an over-romantic brush. Boys who are led to become civil engineers by the adventurous appeal can find sufficient adventure if their youthful ambition that way persists. And if the glamour of adventure wears away, as it does with most, there remains for them that solid work which makes up most of the profession's activities. But the other viewpoint is offensive to civil engineers because it is wrong and because it constantly works to reduce the effectiveness of a profession which, considered properly, could do so much more to improve the conduct of the world's business. It is as a plea for the consideration of the civil engineer as something more than a servant of business and government that this brief talk is intended.

Engineering, in the classic phrase of one of the oldest professional societies, is the directing of the powers of nature to the use of man. That is pretty broad defining and does not help much in an interpretation of the civil engineer. Another and less dignified definition is that an

engineer is one who can do for one dollar what any fool can do for two. But that merely explains motive and does not describe activities. It will help to an exact appreciation of what a civil engineer is perhaps to say that he is one who conceives and executes the structures necessary to man and the services necessary to his health and convenience. Bearing in mind, then, the important dual capacity of both conceiving and executing—he is responsible for bridges and buildings, for tunnels, for roads, railways, canals, for the control and regulation of rivers both as protection against floods and as preservation for power or water supply, be it for drinking water or irrigation, for draining wet lands and for watering those that are over dry, for laying out and maintaining the streets of our cities, for bringing water to those cities and for taking away their refuse.

These are his practical activities; he is, it will be seen, the great satisfier of the physical and material needs of man. For that, however, the civil engineer takes no undue credit for he realizes that civilization is a complicated organism, that each of the many functions has equal importance. The civil engineer is no more necessary than the doctor, the merchant or the farmer for without any of them the organism would either cease to function or at best function very imperfectly.

The civil engineer does, however, take credit for the manner in which he goes about satisfying the needs of humanity. He believes that the underlying principle of his creed and the way he practices that creed entitle him to a better appreciation of his wider capabilities, not because such appreciation would hasten his own advancement but because it would react to the good of everyone.

Honesty and economy are the fundamentals of this creed. The engineer is not vainglorious when he says that he is honest; he is not thanking God that he is not as other men. It is merely one way of expressing the scientific spirit that must govern engineering. From his earliest school days he is taught to pursue the facts and nothing but the facts. He must know the truth and he must utilize only the truth. Those material things he deals with are not susceptible to argument; they will act only according to immutable law. Added to this basic necessity for knowing the facts he must have the faculty of moving from fact to further fact by reasonable processes of thought so that the final result will be as near in accordance to the truth as the frailty of man's mental processes will permit.

It is submitted that the type of mind which is insatiable in its desire to learn the truth and then trained to apply that truth to beneficial ends is one which the world can well use in solving many of the problems not ordinarily associated with civil engineering.

The second part of the engineer's creed is equally important—economy. To do a thing as well as it needs to be done for the least cost consistent with that end. Not to do it cheaply, for that would not be doing it as well as it need be; not to spend money in needless embellishment for that would be doing it better than it need be, but to weigh the necessities and then exactly to satisfy them—this is the engineering ideal. Is not such an ideal needed in our government? Is it not needed in our industries? Is not the man who truly serves such an ideal better fitted to conduct a city than the much vaunted business man whose ideal is profit, whose whole training is based on a judicious assumption of risk and who is satisfied if one successful venture more than makes up the losses from half a dozen unsuccessful ones?

And so we civil engineers make a plea to the rest of you. We are not khaki clad romantics—though some of us do wear khaki once in a while and probably all of us have as much of a romantic and adventurous streak as the next one. We are not those chaps you see out on the road once in a while peeping through a funny looking telescope set up on three legs. Surveying is a necessary but rather elementary part of engineering, though every artist who paints a picture of an engineer sticks him up alongside a thing he fondly considers to be a surveying instrument. We are not rank materialists who are concerned only with the putting together of so much steel and concrete into a usable structure. We are a group of men reared in a stern school of adherence to facts who are touched now and then with the divine spark of imagination which gives you a Brooklyn Bridge or a Catskill Aqueduct. Because of the very nature of that with which we deal we must see clearly if we are to succeed. Because no material thing can be completed without human aid, we must understand our fellow man. Because only those things that pay can be built in this material world, we must appreciate the value of the doller and what it can be made to do. We submit that here is a combination of qualities—qualities, be it noted, of a profession and not necessarily always combined in each member of that profession—which the world has not adequately utilized.

Meanwhile, do not think of civil engineers as mathematicians who possibly make mathematics do things or, at the other end of the scale, as mechanics who have not organized in labor unious. Think of them as practical scientists, as men who come in daily contact with three things, (1) natural forces, (2) man and (3) money. To co-ordinate those three so that they jointly can do the best work is the real job of the engineer.

A Substantial Bridge Railing

WHAT appears like a concrete truss to carry substantial loads in the view herewith, is merely a hand-railing surmounting a concrete arch bridge in a Montreal park. This railing appears capable of holding a fairly heavy vehicle from going overside. Substantial railing construction on bridges and viaducts, as well

HEAVY RAIL OF A PARK BRIDGE

as on road fills, has been found desirable by many state highway departments and city bridge and street bureaus, but construction as heavy as that shown here is not common.

Seven Years' Federal Aid Road Work

During the period of federal aid in highway construction, from July 11, 1916, to June 30, 1923, there have been completed 23,297 miles of roads at a final cost of $407,704,641 according to statistics announced by the Bureau of Public Roads. There were under construction on June 30, 14,771 miles of federal-aid highway, with an estimated final cost of $274,080,168, construction on that date being 53 per cent completed. The average cost of all types of the 23,297 miles of highway was $17,500 per mile. On a general average, the figures varying with different types and localities, the cost of constructing has been divided: grading, 22 per cent; surfacing, 58 per cent; structures, 16 per cent; shoulders, 1 per cent, and miscellaneous, 3 per cent.

Design of Earthquake-Resistant Buildings in Japan

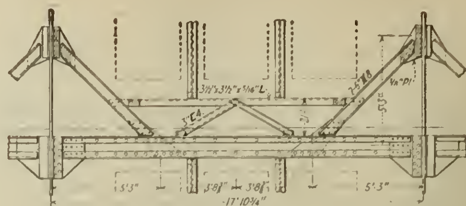
Details Provide Unusual Strength at Column Joints —Heavy Sway Bracing Used—Struts Between Foundation Piers

SUPPLEMENTING the notes on structural design of steel-frame buildings in Japan, published in last week's issue, page 434, there are presented herewith typical structural details of the Japan Oil Co. building in Tokyo. This is a seven-story steel-frame structure occupying a ground area of 150x156 ft. and was constructed by the George A. Fuller Co. of the Orient, a Japanese subsidiary of the New York organization of the same name, from designs prepared by Purdy & Henderson, consulting engineers, of New York City, in collaboration with Japanese designers. The details in the accompanying drawings have been selected to indicate the methods employed to make the structure secure against damage by earthquake shocks. These details cover a typical spandrel girder with the heavy knee-bracing of double 6-in. channels between column and girder, heavy column bases with clip angles to engage the reinforcement in the concrete struts which extend in both directions between all pairs of pile-supported concrete piers, the framing plan of a typical panel of the building, and, of particular interest, a typical column splice made up of layers of plates requiring 416 rivets. There are also shown details of the interior girder beam and column connections.

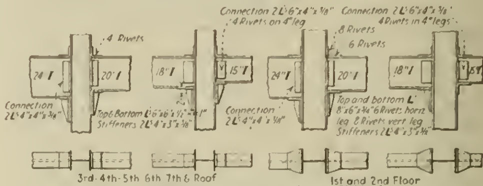
Taken in conjunction with last week's article, the drawings are largely self-explanatory. Of particular interest to American designers is the heavy column splice which places no value on the bearing of one column length upon the other. The assumed loading on column No. 58 at the second floor, the one shown in the accompanying drawing, is 640,000 lb. The following explanatory note appears on the designer's blueprint of the column splices: "Area of splice plates to equal area of column above and sufficient rivets provided to develop the plates at 16,000 lb. per square inch. Following rivet values to be used: Shop rivets, $\frac{7}{8}$-in. at 7,200 lb., and $\frac{3}{4}$-in. rivets at 5,300 lb.; field rivets, $\frac{7}{8}$-in. at 6,000 lb., and $\frac{3}{4}$-in. rivets at 4,500 lb. Where filler plates are required, the number of tack rivets to be equal to 20 per cent of shop rivets. Not less than two lines or more than four lines of tack rivets to be used except at roof splice."

It will be noted that both web and seat connections are provided between girders and columns.

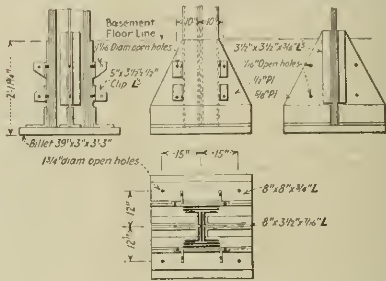
The preliminary indications that all of the three large steel structures in Tokyo—the Japan Oil, the Maranouchi, and the Nippon Yusen Kaisha office buildings—withstood the earthquake of Sept. 1 are confirmed by the following statement issued Sept. 13 by the U. S. Department of Commerce: "American steel and concrete buildings in Tokyo and Yokohama withstood the earthquake shock and are in good condition, according to a cable from Assistant Trade Commissioner G. C. Howard at Kobe. Officials of the Department of Commerce expressed gratification over the first practical demonstration of the effectiveness of the new so-called earthquake-proof factories and office buildings which have been constructed in the past three years. The fact that this construction has proved earthquake-proof is likely to influence adoption of this type in the future."



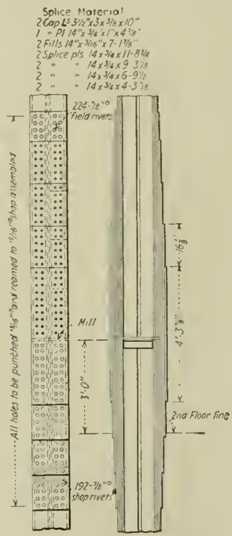
TYPICAL SPANDREL GIRDERS EXTERIOR WALLS



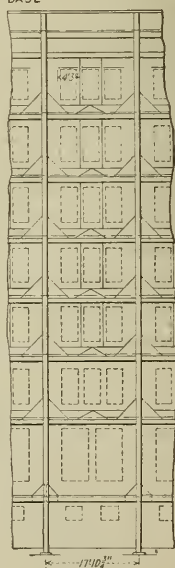
INTERIOR GIRDER BEAM COL. CONNECTIONS



DETAILS OF COLUMN BASE



TYPICAL COLUMN SPLICES AT 2ND FLOOR



NORTH ELEVATION
Showing Typical Framing in one Panel

TO WITHSTAND SEISMIC SHOCK

Structural details of Japan Oil Co. Building in Tokyo, indicating precautions taken to insure strength by heavy sway-bracing, and unusual column splice.

Garbage Piggery and Residue Drying Cheapest for Buffalo

H. P. Eddy Reports on Bids Advising Against Incineration and Recommending Either (1) Reduction or (2) Hog Feeding with Residue Driers of One-Half Piggery Capacity

BASED UPON a detailed analysis and comparison of bids for various single and combined processes of garbage disposal obtained last year by the city of Buffalo but not yet acted upon, Metcalf & Eddy, consulting engineers, Boston, Mass., have advised against incineration, either singly or to treat piggery wastes, and have recommended that a choice be made between garbage-reduction by the Cobwell-Merz process and a piggery supplemented by a garbage-and-manure drying plant.

Bids Were On Open Specifications—The bids considered were based on the bidder's own plans for plant and machinery only and could not be compared for purposes of the report until after elaborate estimates had been made to cover various omitted items necessary for working installations. After this had been done, and the schemes offered had been reduced to two, it was found that there was but little difference in capital cost between reduction alone and a piggery combined with a plant to dry the uneaten garbage and the piggery manure, but that the cost per ton for reducing 40,000 tons of green garbage a year would be some 40 per cent more than for feeding the same amount of garbage to hogs and disposing of the residue and the hog manure by drying. Reduction would yield grease and fertilizer base. The other plan would produce fat hogs and fertilizer base. It should be understood that of the three types of incinerators formally bid on only one had ever been operated in this country, and that on a small scale; none, the report states, had been used for garbage unmixed with combustible waste; and none had ever consumed garbage-feeding wastes. The final recommendation of the report was that the city authorities decide between (1) reduction alone and (2) hog feeding and residue drying and then have a plant of the type chosen properly designed and invite bids on the city's designs.

The bids in question were received July 25, 1922, and transmitted to the Buffalo Commission Council on Oct. 18, 1922, by William F. Schwartz, street commissioner of Buffalo, with a request that he be authorized to engage H. P. Eddy, of Metcalf & Eddy, to report on the bids. On Oct. 25, Mr. Eddy was authorized to make such a report, which was sent to Mr. Schwartz on March 10, 1923. The latter transmitted the report to the City Commission April 18, with the request that the Commission choose one of Mr. Eddy's alternative plans, Mr. Schwartz himself recommending the combined piggery and residue-drying plant as the least expensive of the two. The Buffalo Council has not yet acted on the recommendation.

Reduction Formerly Used at Buffalo—For many years the garbage of Buffalo was disposed of by reduction under various contracts. The latest of these was with the International Agricultural Corp., known locally as the Buffalo Fertilizer Co., at a plant located at Sloan, N. Y. On renewal of a contract with this company that expired July 31, 1916, the contract price was reduced from $1.25 to $1 per ton, and after the renewed contract expired three years later the same concern continued to dispose of the garbage until Oct. 1, 1919, but on a cost plus 10 per cent basis. During these two months the city delivered 3,714 tons of garbage to the company and paid it $13,515 or $3.64 a ton for its services, the amount being certified to by public accountants.

Change to Hog Feeding—Meanwhile a five-year contract was let for disposal by feeding to hogs, the price paid to the city to be 50c. a ton of garbage delivered to the contractor as a minimum, with maximum prices per ton 6, 7 and 8 times the price of live hogs, as the quantities of garbage increased. This contract was let to Dr. T. B. Huff, who organized the Huff Feeding Corp. This company, Mr. Schwartz states in his letter transmitting Mr. Eddy's report to the Buffalo Council, leased a site on the river road and spent $247,000 for hogs, buildings, water and sewer pipes. Mr. Schwartz adds that the company never had hogs enough to dispose of the garbage; that its sewage-works were inadequate; that large quantities of garbage remained uneaten, and that this material, together with hog offal, dumped on fields around the piggery, caused bad odors, swarms of flies, and a nuisance that led to local complaints and then to orders from the State Department of Health to abate the nuisance.

City Took Over Piggery—The outcome of the conditions just outlined was that the city took over the plant on Oct. 2, 1921, subsequently paying $45,000 for liens and claims against the Huff Feeding Corp. and $72,157 to the owner of 2,810 hogs at the piggery. From Oct. 1. 1919, to April 1, 1922, Mr. Schwartz states, about 100,000 tons of garbage were disposed of at the piggery, at a profit of about $15,000 to the city (methods of figuring profit not stated).

Bids Invited and Received—The lease of the piggery site, which expires Oct. 1, 1924, was such that the city did not feel warranted in spending money to improve the plant. Accordingly, Mr. Schwartz was authorized by the council to advertise for bids for (1) garbage disposal sites; (2) "machinery and equipment" to dispose of 200 tons of garbage daily by either incineration or reduction; (3) "machinery and equipment" as in (2) but of a capacity of 50 tons or more daily, to handle uneaten garbage, etc, and manure from a piggery, the latter to be provided by the city. Under (2) and (3) the bidders were to submit "detailed plans and specifications showing their methods of incineration or reduction, * * * * the cost of operation per ton, the commercial value of the residue, the names of the cities where similar plants are being operated, and a guaranty that no obnoxious gases or odors will be created through operation." The site specifications called for land within 15 miles of Buffalo, adjoining a railroad, the areas to be not less than ten acres for either an incineration or a reduction plant and from 200 to 600 acres for a piggery combined with a smaller reduction or incineration plant.

Four Proposals Found Informal—Four of the nine proposals were thrown out by Mr. Eddy as not complying with the city's specifications. Of the five remaining bidders, three proposed incineration, one drying to pro-

duce fertilizer material, and one reduction—for grease and fertilizer. Although Mr. Eddy worked out comparative costs for each of the five bidders and their ten bids yet in his conclusions he advises against incineration for Buffalo garbage, for reasons stated below. He also strongly recommends that the city decide whether it wants a reduction plant alone or one to dispose of the residue from a piggery and then have complete designs made for the kind of plant chosen and invite bids accordingly.

Five Bids Considered—The five bids studied by Mr. Eddy may be summarized as follows, taking the three bids for incinerators first, then the one for drying and finally that for reduction:

Vulcan Incinerator Co.—Top hand-fed incinerating units, circular in plan, about 12 ft. in diameter, with a two-story firebox projecting at the front so as to give a fire above and below the garbage; and a combustion chamber and dust collector projecting at the rear. Forced draft is provided for the extra grates and for the incinerating chamber, forced-draft air to be preheated. No power production from waste heat is proposed. There is no mechanical apparatus for handling either the garbage, clinker, ashes or dust. The total operating cost of properly operating a 200-ton-per-day plant is given in the bid as not above an average of $1 per ton of garbage incinerated. Vulcan incinerators are reported as in operation at Ardmore, Durand and Okmulgee, Okla., these places having had populations of 7,340, 14,187 and 17,430 in 1920.

Balmer Corp.—Top hand-fed units of three furnaces, with induced and forced draft of preheated air, the hot gases passing around baffle walls in a gas-settling and combustion chamber. Clinker and ash are lifted by elevators to elevated storage bins for removal by trucks. No power production from waste heat is proposed. Balmer plants are reported in operation with capacities from 5 to 1,000 tons in 24 hr.; one of 1,000-ton total capacity in Buenos Aires, a 300-ton plant at Montevideo and a dozen smaller ones in the Argentine.

George W. Goethals & Co., Inc.—A "universal incinerator, Didier system" is proposed in which the garbage is shredded, stored in bins, fed to charging cans and incinerated in retorts under preheated force draft. The gases from each battery of retorts pass through a portion of a combustion and settling chamber, the upper part of a water-tube boiler and a boiler superheater, the lower part of the water-tube boiler, and thence through the second compartment of the combustion chamber, in which there is a heater for the air blast. Two Didier plants have been operated: a 50-ton plant at Davos, Switzerland, a place of 15,000 population; and a 100-ton plant for Weisbaden, Germany. The smaller plant is in use but the larger one was shut down in 1919 on account of lack of funds.

C. H. A. Wannenwetsch & Co.—This bid is for converting garbage to a fertilizer base, by grinding, wringing or pressing, and drying after pre-sorting out foreign material by hand on a belt, with salvage of rags and other salable substances, and after pieces of iron and steel have been removed by passing the sorted garbage through magnetic rolls. The dryers are vertical steam-jacketed cylinders provided with stirring paddles on a vertical shaft. Plants of this kind "have been and are now operated" at industrial works to dry animal tankage, and "in one case piggery refuse was successfully dried under our observation." The report also states that such a plant is now being used to dry "garbage at the Buffalo Municipal Hospital."

C. O. Bartlett & Snow Co.—The "Cobwell-Merz process" for recovery of grease and tankage was proposed, making use of disintegrators, dehydrators, reducers (heat and solvent), with screens and magnetic separators for dried tankage and multiwhirl condensers, coolers and separators for grease. Besides installation cost a 6 per cent royalty fee on gross income from products during the remaining life of the patent (granted in 1918) would be paid by city. The process, at the time of the bid, was in use in New Bedford, Mass., Rochester, and Syracuse, N. Y., and had been used at Los Angeles, Calif. [and for a short time in New York City.—EDITOR].

Amount of Garbage—During the year ending with September, 1922, the deliveries of garbage to the piggery totalled 20,762 tons. It is estimated that this came from only 60 per cent of the population so that with complete collection there would have been 34,600 tons for disposal, or an average of 95 tons a day for every day in the year, or 115 tons per collection day (300 such days in a year). Based on the maximum collection day (112.8 tons) the daily maximum with full collection would be 188 tons. In percentages of average collection day the figures are: Maximum day, 169; maximum week, 150; maximum five consecutive weeks, 131.

The per capita production for the year 1921-22 [(Collection $\div$ 60) $\times$ 100] was 132 lb. Mr. Eddy assumes for 1923 an average production of 150 lb. per capita for a population of 533,000, which would give 40,000 tons for the year and average 133⅓ tons per collection day. Adding 50 per cent the maximum collection day would give 200 tons—which was the basis for the bids.

Meager Data; Bids Not Comparable—The meagerness of the information as to the "character and sufficiency of the mechanical devices" proposed by the bidders and the fact that the bids are "not strictly comparable" because of the differences in design of the plants proposed made it necessary for Mr. Eddy to estimate the cost of various plants complete, together with their operating expense and revenues, annual charges and net annual costs in order to make the bids comparable; also to make estimates for 100-ton plants in place of the 50-ton plant bids, since Mr. Eddy concluded that to dispose of piggery wastes 100-ton plants would be required.

Tabular Data—Table I herewith, which is a combination of several tables and parts of tables in Mr. Eddy's report, reduces to a comparative basis the bids for the 200-ton plants for disposing of all the garbage, and the bids for the 50-ton plants for piggery wastes only (compared as to first cost only, since Mr. Eddy considers a 50-ton plant for this work only half large enough). Table I also gives a summary of the comparative estimates for 100-ton plants to handle piggery wastes only.

Incinerator Bids Dropped—After considering these figures and related matters Mr. Eddy dropped from further consideration the three incinerator bids. His reasons for doing this are:

Conclusions: Incineration of garbage containing about 75 per cent moisture without the addition of fuel and without creating offensive odors with any of the incinerators bid upon appears to us to be impracticable.

TABLE I—COMPARISON OF BIDS FOR VARIOUS METHODS OF DISPOSAL OF THE GARBAGE OF BUFFALO

	Vulcan Incinerator Co.	Balmer Corp.	George W. Goethals Corp.	C. H. A. Wannenwetsch & Co.	C. O. Bartlett & Snow Co.
Construction Cost: 200-Ton Plant (Excluding Land)					
Proposal price	*$90,700*	*$300,000*	*$309,400*	*$218,000*	*$292,000*
Metcalf & Eddy estimate of items not covered by proposal[1]	197,200	64,400	269,000	273,700	283,400
Total	$287,900	$364,400	$578,400	$491,700	$575,400
Add for omissions 5 per cent	14,400	18,200	28,900	24,600	28,800
Total	$302,300	$382,600	$607,300	$516,300	$604,200
Add for engineering and contingencies 15 per cent	45,300	57,400	91,100	77,400	90,600
Total (revised estimate)	**$347,600**	**$440,000**	**$698,400**	**$593,700**	**$694,800**
Total, per ton of capacity	$1,738	$2,200	$3,492	$2,969	$3,474
Annual Operating Cost and Returns: 200-Ton Plant—133⅓ Tons per Day, 300 Days per Year—40,000 Tons per Year.					
Supervision and labor (8-hr. day)	$35,600	$34,400	$39,900	$71,100	$78,000
Fuel, coal at $5.50 per ton	17,600	17,600	17,600	26,400	55,000
Solvent at $0.16 per gal., 3 gal. per ton	....	....	....	....	19,200
Water supply at 150 per cent of city rates	400	400	2,800	17,200	400
Light at $0.10 per kw.-hr.	2,100	1,100	....	3,800	.....
Power at $0.01 per kw.-hr.	2,000	2,000	....	10,000	....
Miscellaneous supplies and expense at $0.15 per ton	6,000	6,000	6,000	6,000	7,500[2]
Repairs and maintenance	4,100	6,500	11,900	6,000	9,200
Royalty at 6 per cent of income, equal $0.28 per ton	....	....	....	....	11,200
Estimated gross annual cost of operation	$67,800	$68,000	$78,200	$140,500	$180,500
Return from sale of products—					
Tankage	....	....	....	41,000	63,000
Grease	....	....	....	....	120,000
Miscellaneous residuals at $0.10 per ton	....	....	....	4,000	4,000
Estimated total return	....	....	....	45,000	187,000
Estimated net annual cost of operation	$67,800	$68,000	$78,200	$95,500	$6,500
Cost of operation per ton (40,000 tons)	$1.69	$1.70	$1.96	$2.39	$0.16[3]
Annual Fixed Charges: 200-Ton Plant					
Interest at 4½ per cent	$15,600	$19,800	$31,400	$26,700	$31,300
Depreciation[4]	9,900	13,000	26,700	21,900	32,100
Total estimated annual fixed charges	$25,500	$32,800	$58,100	$48,600	$63,400
Fixed charges per ton (40,000 tons per year)	$0.64	$0.82	$1.45	$1.21	$1.58
Grand Summary: 200-Ton Plant, Total Net Charges					
Estimated total net annual operating cost and fixed charges	$93,300	$100,800	$136,300	$144,100	$56,900
Total net operating cost and fixed charges per ton (40,000 tons per year)	$2.33	$2.52	$3.41	$3.60	$1.42
50-Ton Plant, Construction Cost:					
Proposal price	*$34,300*	*$80,000*	*$115,000*	*$78,000*	*$197,700*
Metcalf & Eddy estimate of items not covered by proposal	104,700	58,000	146,200	141,900	170,300
Total	$139,000	$138,000	$261,200	$219,900	$368,000
Add for omissions 5 per cent	7,000	6,900	13,100	11,000	18,400
Total	$146,000	$144,900	$274,300	$230,900	$386,400
Add for engineering and contingencies 15 per cent	21,900	21,700	41,100	34,600	58,000
Total (revised estimate)	**$167,900**	**$166,600**	**$315,400**	**$265,500**	**$444,400**
100-Ton Plant: Construction, Operation, Fixed and Total Annual Charges, 66⅔ Tons per Day—300 Days per Year—20,000 Tons per Year[5]					
Estimated total cost of construction (excluding land)	$236,700	$259,600	$443,200	$376,700	$724,200
Cost of construction per ton of capacity	2,367	2,596	4,432	3,767	7,242
Estimated net annual operating cost	51,650	48,300	57,200	69,700	41,700
Operating cost per ton (20,000 tons per year)	2.58	2.41	2.86	3.49	2.09
Annual fixed charges	16,950	19,150	36,300	30,450	68,050
Estimated total net annual operating cost and fixed charges	68,600	67,450	93,500	100,150	109,750
Total net operating cost and fixed charges per ton refuse (20,000 tons per year)	3.43	3.37	4.68	5.01	5.49[5]
Total net operating cost and fixed charges per ton garbage (40,000 tons per year)	1.72	1.69	2.34	2.51	2.75[5]

[1] The items estimated to supplement the prices contained in the proposals include, where required, ramps, buildings or enlargements of buildings, garbage storage bins, employees' rooms and lockers, coal storage bins, office and weighhouse, ash storage bins, ventilating equipment, garbage and ash-handling equipment, railway siding, track and wagon scales, grading, pavements and planting, water supply, sewerage, drainage and sewage disposal facilities. No allowance has been made for unusual or difficult foundation work.

[2] Includes ½ lb. chlorine per ton of garbage at 7½c. per lb. chlorine.

[3] Profit.

[4] Depreciation allowances varied to suit character of plant but all figured on sinking fund basis, with contributions added and 4 per cent compound interest credited at end of each year.

[5] The 100-ton plants would treat piggery residue (uneaten garbage, etc., and manure). No piggery costs or revenues are included here, because Mr. Eddy does not recommend incineration for the piggery residue, but confines his combined piggery and piggery-waste disposal estimates to the Wannenwetsch and Cobwell bids for drying and reduction, respectively, as shown in Table II. See also footnotes to Table II for basis of estimating tankage and grease values.

TABLE II—ESTIMATE COST OF GARBAGE DISPOSAL BY PIGGERY WITH DRYING OR WITH REDUCTION FOR RESIDUE

Based on 200-ton piggery and 100-ton residue disposal plants—133⅓ tons of garbage per collection day—40,000 tons of garbage per year—20,000 tons of piggery residue per year

	Piggery With Wannenwetsch Drying Plant	Piggery With Cobwell Reduction Plant
Construction Cost		
Cost of building piggery (6,000 head)	$301,000[1]	$301,000[1]
Cost of building refuse disposal plant	376,700	724,200
Total construction cost	$677,700	$1,025,200
Operation Cost		
Annual excess of return over cost of operating piggery	$79,600[2]	$79,600[2]
Net annual cost of operating disposal plant	69,700	41,700
Balance—Difference between annual excess return over operating cost for piggery and operating cost of disposal plant (profit)	9,900	37,900
Annual Charges		
Annual balance of receipts and expenditures for piggery and disposal plant (profit)	9,900	37,900
Fixed charges on piggery	20,700	20,700
Fixed charges on disposal plant	$30,450	$68,050
Total fixed charges	51,150	88,750
Net annual charges	41,250	50,850
Net annual charges per ton of green garbage, 133⅓ tons per collection day, 40,000 tons per year	1.03	1.27[3]

[1] The main items are: Hog houses, $212,000; miscellaneous buildings, heating and equipment, $27,000; engineering omissions and contingencies (15 per cent on $262,000) $39,000.

[2] The annual charges total $91,800. Of this $71,000 is for operating expenses, thus divided: Supervision and labor, $33,700; freight, $19,000; light, power and water, $800; repairs and maintenance, (1 per cent on $301,000.) $3,010; carting, $1,600; supplies and miscellaneous, $13,000. The $20,700 fixed charges on the $301,000 of the capital cost include $13,500 for interest and $7,200 for depreciation, interest being figured at 4½ per cent and sinking fund at 2.4 per cent (25-year. Life), with 4 per cent on accumulated amounts. The net profit is based on a purchase of 19,500 hogs weighing 125 lb. each, a death rate loss of 5 per cent and a total sale of 18,500 hogs weighing 200 lb. each, the total weight bought being 2,437,000 lb., at 9c. a pound, costing $219,300 and the total weight sold being 3,700,000 lb. at 10c. yielding $370,000. This gives $150,700 for net gain in weight. Deducting from this $91,800 gives $58,900 as the net profit on the piggery or $1.47 per ton of garbage delivered. The average cost of hogs bought for the existing Buffalo piggery during the 13 months ending Oct. 31, 1922, was 10.8c. per pound (but not including freight) and the selling price averaged 11.9c. making a gross gain of 1.1c. per pound, with no allowance for freight or death losses. Hogs from the Buffalo piggery, Mr. Eddy states, command a price above the general market price because of the certainty that all of the piggery hogs have received double inoculation.

[3] The higher net annual cost per ton for the Cobwell than for the Wannenwetsch plant when each handles 100 tons of piggery refuse than when each treats 200 tons of green garbage, Mr. Eddy states, is due to the fact that in the 100-ton Cobwell plant the pre-drying in direct-heat driers is omitted, whereas in the 200-ton plant these driers are provided; this omission, Mr. Eddy states, makes necessary the installation of extra Cobwell reducers, which increase the cost figures as indicated. It is assumed that the unit yield and prices of grease and tankage will be the same from the green garbage and from the combined garbage and manure from the piggery. Two samples of piggery refuse, collected March 15, 1922, and Feb. 1, 1923 (the latter by a representative of Metcalf & Eddy), showed the following percentages after having been dried in a Wannenwetsch reducer in use at a local packing house for rendering animal tankage: Grease, 12.33 and 16.34; ammonia, 3.14 and 3.01; bone phosphate of lime, 2.28 and 8.39; potash (K_2O) 1.15 and 1; moisture, 7.07 and 7.69.

TABLE III—COMPARISON OF MOST ADVANTAGEOUS PROJECTS FOR (1) DIRECT DISPOSAL AND FOR (2) PIGGERY WITH AUXILIARY DISPOSAL

Each plant has a daily capacity of 200 tons of green garbage and is to dispose of 40,000 tons a year. The Cobwell reduction plant would treat all the garbage, and recover fertilizer base and grease. In the combination plant all the garbage would be offered to the pigs and the uneaten material and pig manure (assumed as 100 tons per collection day, and 20,000 tons per year) would be passed through the Wannenwetsch drying plant for the recovery of fertilizer base only.

	C. O. Bartlett & Snow Plant (Cobwell Reduction Process)	Piggery Combined With C. H. A. Wannenwetsch Drying Plant
Construction cost	$694,800	$677,700
Net annual operating cost per ton (profit)	0.16	0.25
Total net annual charges per ton	1.42	1.03

To add fuel to garbage economically would require constant regulation according to the proportion of moisture contained in the garbage.

The control of fuel in this manner would require very close attention to operation and it is probable that lapses in control would occur and that offensive odors would escape during such times.

The only way in which fuel could be provided within the limits of the specifications of the bidders would be to add rubbish or coal with the garbage as fed into the incinerators. Control would depend upon the judgment of the men mixing the garbage and fuel. It is probable that offensive odors would be produced at times, and that fuel would be wasted at other times.

The estimates of cost indicate that disposal by any of the incinerators bid upon will be more expensive than that by another method.

None of the incinerators bid upon has been operated in this country on anything but a very small scale, if at all, and such operation as has been cited by the bidders appears to have been upon refuse and not upon garbage alone.

In view of these conditions we are of the opinion that none of the bids for incinerators constitutes the most advantageous bid, considering not only the cost of installation and operation but also the sanitary disposal of the garbage and freedom from odor in operation.

Because of the nature of the material the disposal of piggery refuse by incineration will be more difficult and more likely to create offensive odors than the disposal of green garbage by this method. For this reason plants combining a piggery and an incineration plant have not been included herein.

We are of the opinion that the installation of any of the incinerators bid upon is not justified for the disposal of so large a quantity of garbage as that produced at Buffalo.

Comparison of Combined Piggery and Residue Disposal Plants—Table II summarizes Mr. Eddy's comparative estimates of net annual charges on a combined plant in which 200 tons of garbage would be: (1) fed to pigs and the uneaten material and pig manure reduced in 100-ton plants of the Wannenwetsch drying type to produce fertilizer base, and (2) the entire 200 tons of green garbage would be treated in a reduction plant of the Bartlett & Snow or Cobwell type, yielding both fertilizer base and grease. The first cost of the combined piggery and drying plant would be $677,700 and of the piggery and reduction plant, $1,025,200, but taking all charges into account the net tonnage cost would be $1.03 against $1.27. The Cobwell combination is at a disadvantage here since it is based on the 50-ton Cobwell bid in which extra reducers were required because the preliminary driers included in the 200-ton Cobwell bid were omitted.

Final Comparison—Mr. Eddy compares (Table III) the most advantageous of the projects for treating the entire 200 tons of garbage with the most advantageous combined piggery-and-residue treatment plan; or a 200-ton Cobwell reduction plant using pre-driers and producing grease and fertilizer base and a 200-ton piggery and a 100-ton drying plant to produce (a) fat hogs and (b) fertilizer base, from the uneaten garbage and hog manure. This comparison shows first costs close together, $694,800 for (1) against $677,700 for (2), but net charges of $1.42 and $1.03 respectively.

Mr. Eddy expresses the belief that a piggery can be successfully built and operated in a sanitary way and that either the Cobwell or Wannenwetsch process can be operated without odor. He considers the value of the dried garbage from the Wannenwetsch process as "problematic" because its large fat content would probably lessen its value as a fertilizer base, but allowance was made for this in the estimates. He points out that more operating skill is required for the Cobwell-Merz reduction process (as he calls the plant on which 200-ton bid was based) than for the Wannenwetsch drying process.

He points out that there are hazards, whichever of the two plans are chosen—of explosion in a reduction plant using solvent and of foot-and-mouth disease in the piggery. In case of the latter contingency, however, the supplementary drying plant would take care of half the garbage while, if the reduction plant were destroyed the entire volume would be subject to emergency disposal. Also, should a combination piggery and drying plant be built and the piggery subsequently abandoned, the drying plant would be available up to its capacity. Mr. Eddy also suggests that it "may be feasible, should circumstances justify it, to equip" the piggery-refuse drying plant for grease recovery.

Such objectionable odors as have occurred at garbage piggeries Mr. Eddy attributes to the piggery refuse, "which often has not been promptly and thoroughly cleaned up, and generally has not been disposed of in such a manner as to prevent offensive odors." Adequate provision for the prompt and sanitary disposal of piggery refuse "would be an important forward step" in garbage disposal by feeding to hogs. Either the Cobwell-Merz process for all the garbage or a combination piggery and Wannenwetsch residue drying plant "can be so constructed and operated," the report states, "as not to produce objectionable conditions in the neighborhood," *but* this "is dependent in both cases on skilled management."

Size and Cost of Plants Required in 1935—By 1935 it may be expected that the population of Buffalo will have increased to 640,000 (from about 500,000 in 1920). This would require a 240-ton plant, the approximate cost of which would be $775,000 for a Cobwell-Merz green garbage plant and $779,000 for a piggery combined with a Wannenwetsch auxiliary drying plant.

What Buffalo Should Do—Having shown that either of the alternative schemes selected from those bid on as most advantageous would require almost the same capital outlay, but would differ, as outlined, in gross and net operating costs and in total net annual charges, and in respect of risks, Mr. Eddy leaves the final choice to the city of Buffalo, but he adds this unequivocal advice: (1) The city should decide on one or the other scheme, then have complete designs made and request bids for its construction, and (2) the city should not overlook the fact, as has so often been done, that efficient operation is as essential as correct design and construction, for [italics ours—EDITOR], "*The primary object of the operation of such a plant should be the disposal of the garbage in a sanitary manner. The accomplishment of this object at the smallest expense, although of great importance, is an aim of secondary moment.*

[Information from Mr. Schwartz, sent Sept. 13, indicates that a site has not yet been obtained owing to strenuous objections to every site proposed; also that the city is under a court order to close the piggery on Sept. 15 but has secured a hearing for Sept. 26 on a petition for a modification of the order to give the city time to find some other means of disposal, and had also filed an appeal from the order.—EDITOR.]

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

A Guide to City Planning and Zoning

MANUAL OF INFORMATION ON CITY PLANNING AND ZONING: Including References on Regional, Rural and National Planning—By Theodora Kimball, Librarian, School of Landscape Architecture, Harvard University; Honorary Librarian, American City Planning Institute; Associate, British Town Planning Institute. Cambridge: Harvard University Press. London: Humphrey Milford; Oxford University Press. $3.50.

Rarely does a new art or science have so devoted and competent a guide to sources of information as Miss Kimball has been for some years past. Her present volume surpasses her earlier reference works in variety and extent. The result is worthily called a Manual of Information.

Miss Kimball has obtained contributions from Flavell Shurtleff, secretary of the National Conference on City Planning, and from John M. Gries, chief of the Division of Building and Housing, U. S. Department of Commerce, on the work being done by those two agencies. There is also a note from Stephen Child on L'Union Internationale des Villes and the American Center of Civic Documentation, two ambitious projects as yet in their infancy. Other information given relates to various government and private agencies devoted to city planning; periodicals treating the subject; colleges and universities having courses in city planning; educational films; typical city planning reports, by years; and a table of municipal appropriations for city planning work, covering the past few years. The larger part of the book is filled with a Bibliography. This contains many hundred references to books and periodicals, classified and sub-classified in detail. The arrangement is numerical but there is a classified contents and an alphabetically arranged subject index.

Enough has been said to make clear that the Manual is a valuable guide that no practitioner or student of city planning or zoning should be without.

For Every Engineer

ESTIMATING BUILDING COSTS—By Charles F. Dingman, M. Am. Soc. C. E., M. Am. Soc. M. E., M. N. J. Soc. A. New York and London: McGraw-Hill Book Co. Flexible cloth; 4x7 in.; pp. 240. $2.50.

In its small compass of 240 pages this manual contains more direct instruction on how to estimate costs than any other book known to the reviewer. There are more comprehensive volumes of data which are useful for estimating. The author gives a list of these books and urges all estimators to become familiar with them. While not lacking in essential data, his own volume is primarily a handbook of estimating processes. He undertakes to guide the reader through all the moves of estimating the cost of each operation of building work. Beginning with excavation, instruction is given, in separate chapters, on how to estimate brickwork, stone work, fireproofing, concrete, timber-framing, covering, finishing, roofing, plastering, and painting. There are general chapters on short-cut methods and on such estimating aids as remainder lists and equipment-rental tables. Plumbing, heating, electrical wiring and mechanical equipment are not considered, the author advising that sub-bids be secured from specialists in these operations. For the beginner in problems of estimating, no better book of instructions is known. Even the experienced estimator will find it an aid in securing orderly thinking and practices. One could wish that every engineer would read it to the purpose at least of absorbing the fact that true estimating is one of the most complex problems of construction engineering.

Acoustics and Soundproofing

REVIEWED BY E. A. ECKHARDT
Physicist, Bureau of Standards, Washington, D. C.

ACOUSTICS OF BUILDINGS: Including Acoustics of Auditoriums and Soundproofing of Rooms—By F. R. Watson, Professor of Experimental Physics, University of Illinois. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 155; 72 line cuts and halftones. $3.

Most engineers and architects engaged in designing buildings have experienced the embarrassments presented by the acoustic problems encountered. These problems in their major aspects involve either the insulation of one part of a building from another so that the use of each may be enjoyed without interference from the other or the arrangement of a room or auditorium so that satisfactory hearing conditions may prevail within it. Within a period of two years two books covering this ground have appeared in the English language, both in America. Professor Wallace C. Sabine's "Collected Papers on Acoustics" was the first to appear. It includes reprints of the various papers published by the author during the progress of his pioneer work in the subject. The value of this collection is beyond question. From the point of view of the user, however, it is unfortunate that the material was not reworked into a systematic unit. Prof. F. R. Watson's new book "Acoustics of Buildings" gives a systematic presentation of the subject designed to facilitate the direct application of the information conveyed. It should therefore have great practical usefulness.

Prof. Watson has made very substantial contributions to the subject matter of his book and it is therefore quite natural that a large part of the reading matter is a recapitulation of his earlier publications. This has been done, however, without impairing the systematic character of the presentation. The book is divided into three parts dealing with the fundamental physical ideas involved, their application to the acoustics of auditoriums and the soundproofing of buildings respectively. The large number of practical examples taken from the author's wide experience gives concreteness to the abstract principles presented and makes it easier for the reader to make similar applications to problems of his own.

On one important question involved in the acoustics of rooms Prof. Watson is undoubtedly in error. He concludes that the acceptable time of reverberation for auditoriums for different volumes varies with the cube root of the volume. In auditoriums the problem is almost invariably to get the reverberation time small

enough, and in very large auditoriums the cost usually determines how closely the ideal may be approached. Prof. Sabine found a definite reverberation time to be the ideal, independent of the size of the room, but somewhat different for speech and for music. Departures from these ideal values are compromises made to meet some other requirements, usually to stay within the limits set by the purse. As a matter of compromise, large auditoriums will have larger reverberation times, but if no expense is spared in further reducing the reverberation time, improvement will certainly result.

Prof. Watson's book is well illustrated by photographs, diagrams and graphs, and as the first comprehensive systematic presentation in the English language will be welcomed by those seeking information on the questions of "Building Acoustics."

Timely and of World-Wide Moment

GERMANY'S CAPACITY TO PAY: A Study of the Reparation Problem—By Harold G. Moulton and Constantine E. McGuire, with the Aid of the Council and Staff of the Institute of Economics. New York and London: McGraw-Hill Book Co. Cloth; 6x8 in.; pp. 384; 7 line cuts. $2.50.

Timeliness and an able marshalling of facts and figures are shown in this readable discussion of the greatest question now confronting the world, Germany's capacity to pay war reparations. The last touches were given to the book in June so that, except for the recent spectacular further decline of the mark, the implications of the fall of the Cuno cabinet and the latest stages of the Franco-British notes, the book is up to the minute.

The authors make no attempt to name a sum which Germany can pay. The entire discussion is on her capacity to pay as indicated by reviews of what is involved in paying foreign debts, the German international trade balance for decades past (nearly always adverse), what Germany has already paid, foreign trade requirements, the German budget and monetary problems, a significant chapter on How France Met the Indemnity of 1871 (by loans, on which large interest payments are still being made) and the international phases of the reparations problems. There are seven appendices of supporting data, well designed to keep the main text free from burdensome statistics.

The two concluding sentences of the book sum up its spirit and the substance of such conclusions as are reached:

> If one believes that the economic prosperity of the world will be promoted by the economic recovery and the restoration of the consuming power of Germany, he should favor her importation of large quantities of necessary food and raw materials and the exportation of correspondingly large quantities of manufactured goods. If, on the other hand, one believes that the disintegration of the German industrial system and the starvation of some millions of German people will promote the general welfare of the world, then he should welcome the continued curtailment of both German import and export trade.

Since the economic, social and political welfare of the world hinges so largely on the solution of this great German problem and any right and fairly prompt solution depends so much upon a sound public opinion, the book deserves wide reading. Certainly no one is qualified to pass judgment on Germany, France, England and the other countries involved without having in mind the major facts and principles which this book sets forth.

British House Sanitation

DOMESTIC SANITATION AND HOUSE DRAINAGE—By Henry C. Adams, M. Inst. C. E., F. R. San. I., M. Inst. Water Eng., Consulting Engineer, Lecturer on Sanitary Science, Northern Polytechnic. [Oxford Technical Publications.] London: Henry Frowde and Hodder & Stoughton. New York: Oxford University Press, American Branch. Cloth; 6x9 in.; pp. 227; 193 line cuts and halftones. $3.50.

British practice in house-design and construction as regards site, subsoil drainage, safeguards against dampness, the entire range of plumbing, earth privies and pail closets, refuse disposal, lighting, warming and ventilation are reviewed in this volume. School sanitation has a chapter but it is devoted wholly to water closets and urinals. There are short chapters on stables and cowsheds and a few pages on sanitary surveys.

The book is almost free from even late-Victorian notions on such matters as "sewer gas" and disease but contains these sentences, which might have been written when Victoria ascended the throne:

> The close relation between malaria and the soil is shown in various ways. If the sun's rays are prevented from reaching the soil by the interposition of paving, malaria ceases. If a marsh be flooded from the sea and a layer of salt water covers the soil, malaria disappears. It is promoted by the rapid drying up of marshes and river beds, and is especially rife when such soil is broken up and fresh surfaces are exposed to the sun. Subsoil water or dampness is an essential condition of malaria, and is especially harmful if the subsoil water is stagnant. For this reason villages are built on hills, but the wind may carry the malarial poison long distances.

The only reference to mosquitoes found in the book is a single sentence which the author, after declaring that the "neighborhood of marshes is bad for dwellings" because of various gases given off by marshes, adds: "They (marshes) also cause an excess of aqueous vapor and form breeding-grounds for mosquitoes." Why mosquitoes are objectionable the author does not state.

Either the author can never have heard that malaria is spread not by "bad air" from whatever source, but by mosquitoes that breed in marsh and other stagnant waters, or else he is willing to accept what all sanitary entomologists and—in this country at least—sanitary engineers also have accepted for some two decades. This blemish on the book is all the more a pity because the volume is based on lectures to "students" (of what sort is not stated) who presumably take as sanitary law and gospel all that a member of the Institution of Civil Engineers says.

Publications Received

THOSE WHO WISH to get some of the latest ideas on the civil service as applied to cities will do well to get the August *National Municipal Review*, which is devoted wholly to a report of the National Municipal League's Special Committee on Civil Service, and supporting and opposing written discussions. The title of the report is "Employment Management in Municipal Service." Among the members of the committee are Henry S. Dennison, president, Dennison Manufacturing Co., chairman, and William C. Beyer and Morris B. Lambie, of the Philadelphia and the Minnesota Bureaus of Municipal Research. Fourteen persons contribute discussions, including Col. H. M. Waite, formerly city engineer of Cincinnati and (later) city manager of Dayton, Ohio; C. R. Woodruff, president and C. S. Shaughnessy, chief examiner, Philadelphia Civil Service Commission; and W. D. Foulke, president, National Civil Service Reform League. (National Municipal League, 261 Broadway, New York City; 50c.)

The List of Engineering Articles on irrigation and related subjects published from time to time by the U. S. Reclamation Service fills 31 pp. of the latest report of the Service, and, together with a list of books of 2 pp., has been printed in pamphlet form (Washington, D. C.). The articles are grouped into general and those relating to some one of the many projects and are further classified by authors. There are about 360 references to *Engineering News-Record*, *Engineering News*, and *Engineering Record*, of which 110 are general and 250 deal with a single project. Of the 28 projects, only one shows no reference to this journal or its two forerunners and for that project there are only two references. Under the Boise Project (Idaho, Arrowrock dam, etc.) there are 34 references to one of the three journals named above; under the Rio Grande Project (New Mexico-Texas, Elephant Butte dam, etc.) there are 25 references.

The Diesel Oil Engine for Water-Works Service, a paper by Dr. Charles E. Lücke, together with related papers and discussions, have been reprinted from the *Journal* of the N.E.W.W. Assoc. for June and may be obtained from the Worthington Pump & Machinery Corp., 115 Broadway, New York City.

Northwest Lumber and Allied Industries are listed in *Abbey's Register* which covers Arizona, Idaho, Montana, Nevada, Oregon, Washington, Alaska, and British Columbia. Logging operations, saw, planing and shingle mills, box, sash and door and other manufactures are included, besides wholesalers and brokers. (Portland, Ore.: The Industrial Service Co. Cloth; 6 x 8 in.; pp. 312.)

Foreign Papers and Reports

Eight Annas is the price of "Notes on the Identification of Timbers in Southern India," by R. B. Robinson, engineer, South India Railway, Simla, India. Among the plates are a number of enlarged colored transverse sections of various timbers.

A Notable Discussion of "Rainfall and Runoff" by R. W. Holmes, of Auckland, New Zealand, has reached this country in the form of a reprint of a paper read by Mr. Holmes before the New Zealand Society of Civil Engineers. Long-time precipitation records at Auckland, N. Z., Norfolk, Va., Hemel Hempstead, England, Padua, Italy, and Rockhampton, Australia, are presented graphically by years in terms of percentages of the average for the period for each of the stations named. Other diagrams show deviations from the averages for groups of consecutive years in percentages of the average. Mass rainfall curves are also presented. Some interesting diagrams illustrate a brief study of tree-growth rings in relation to rainfall. The text discusses all these matters and some runoff data as well.

Like Many Other Cities, Glasgow, Scotland, is studying the activated-sludge process. Tests were made in 1915-19 using two 50-U. S. gal. barrels equipped with Jones-Attwood air diffusers and quite recently a working-scale mechanical-agitation unit of about 240,000 U. S. gal. daily capacity was put in use. A pamphlet report dealing briefly with these tests and reviewing experiences in a few English cities, with incidental reference to American results, has been made by F. W. Harris, city analyst and corporation chemist of Glasgow, and has been published by the Conveners and Members of the Committee on Sewage Disposal of the Corporation of Glasgow.

Space Restrictions due to the war having come to an end, Sir Alexander Houston's annual reports on the Chemical and Bacteriological Examinations of the London Waters are resuming their old-time fulness. The report for the year ended March 31, 1923, extends to about 100 pp., including many tables and a few plates. The interesting and satisfactory results with chlorination as a substitute for storage to effect bacterial reduction were continued during the year and resulted in saving some $80,000. Begun originally to save the coal used for pumping to the reservoirs for improvement of the water by storage, chlorination seems now to have established itself at London. By whatever means attained, Sir Alexander is a firm believer in making the water supply as hygienically safe as possible before it is applied to the slow sand filters. Small-scale studies of mechanical filtration but without coagulation were continued in 1922-23 and are summarized in the report. Indications are that mechanical filtration will finally be introduced for London water, but apparently for prefiltration and at least in the beginning to cope with organisms that, from time to time, block some of the slow sand filters. The report details some interesting but thus far unsuccessful studies designed to throw light on the relation of fish and sea-gull dejecta to B. Coli in the large uncovered London reservoirs. The use of bacteriophages to distinguish B. Coli from human and various animal sources is another one of Sir Alexander's many adventures in the field of water bacteriology. This study has not yet brought success. (London: P. S. King & Son, Ltd.; 15 shillings.)

New Books and Revised Editions

BRIEF DRAWING—By Ralph Curtis Ringwalt, LL.B., Member of the New York Bar. New York and London: Longmans Green & Co. Cloth; 5x8 in.; pp. 214. $1.50.

DER WASSERBAU—III Teil des Handbuchs der Ingenieurwissenschaften. Erster Band: *Die Gewasserkunde*—Von P. Gerhardt, R. Jasmund und H. Engels. Fünfte vermehrte Auflage. Leipzig: Wilhelm Engelmann. Cloth; 7x10 in.; pp. 806; 64 illustrations in the text, mostly line cuts.

ENGINEERING NON-FERROUS METALS AND ALLOYS—By Leslie Aitchison, Consulting Metallurgist to the Air Ministry, The Association of Drop Forgers and Stampers, etc., and William R. Barclay. With an introduction by Engr. Vice-Admiral Sir George G. Goodwin, K.C.B. (Late Engineer in Chief Admiralty), Past Pres., Inst. of Metals. [Oxfor Technical Publications.] London: Henry Frowde and Hodder & Stoughton. New York: Oxford University Press, American Branch. Cloth; 6x9 in.; pp. 300; 82 line cuts and halftones. $7.

Part I of this British book takes up general properties, constitution, casting, working, heat treatment, mechanical properties and testing. Part II deals with copper, aluminum and nickel, each with its alloys; miscellaneous non-ferrous alloys; and the choice and specification of non-ferrous alloys.

HANDBUCH DES MATERIALPRUFUNGSWESENS für Maschinen- und Bauingenieure—Von Dipl.-Ing. Otto Wawrziniok, ord. Professor an der Technischen Hochschule, Dresden. Zweite vermehrte und vollständig umgearbeitete Auflage. Berlin: Julius Springer. Cloth; 6x9 in.; pp. 700; 641 line cuts and halftones. $5 in Germany.

THE JOHNS HOPKINS UNIVERSITY LECTURES on Engineering Practice for 1922-23 include: The Relation of Highway Research to Modern Road Construction, by A. T. Goldbeck, chief, Division of Tests and Research, U. S. Bureau of Public Roads, Washington, D. C.; Possibilities for Steam Railroad Electrification, by Norman Wilson Storer, general engineer, Westinghouse Electric and Manufacturing Co., Pittsburgh, Pa.; and Power Development—Past and Future—by George A. Orrok, consulting engineer, New York City. Baltimore: Johns Hopkins Press; paper; 6x9 in.; pp. 90; halftones and line cuts. $1.

MANUAL, AMERICAN RAILWAY ENGINEERING ASSOCIATION: Definitions, Specifications and Principles of Practice for Railway Engineering—Edition of 1921. 6x9 in., pp. 1004. Cloth, $8; half morocco. $10.

The revised Manual brings the information contained in the edition of 1915 up to date. By a very complete set of specifications, definitions and descriptions, and by references to the proceedings of the association, it provides a handbook on the following subjects in the field of railway engineering: Roadway, ballast, ties, rail, track, buildings, wooden bridges and trestles, masonry, signs, fences, crossings, signals, interlocking records and accounts, organization, water service, yards and terminals, iron and steel structures, railway location, wood preservation, electricity, conservation of natural resources and uniform general contract forms.

LES METHODES MODERNES D'ORGANISATION INDUSTRIELLE—Par L. Benoist, Ingénieur Des Arts et Manufactures. Avec Exemples du Calcul des Temps D'Usinage en Construction Mécanique par Hermann. Paris. Gauthier-Villars et Cie. Paper; 6x8 in.; pp. 208; line cuts.

THE OFFICE OF THE CHIEF OF ENGINEERS OF THE ARMY: Its Non-Military History, Activities and Organization —By W. Stull Holt. Service Monographs of the United States Government No. 27, Institute for Government Research. Baltimore, Md.: The Johns Hopkins Press. Cloth; 6x9 in.; pp. 166. $1.

PHYSICS IN INDUSTRY—Lectures Delivered Before the Institute of Physics by Archibald Barr, M. Inst. C. E., Emeritus Professor of Civil Engineering and Mechanics, Glasgow University; Sir James Alfred Ewing, M. Inst. C. E.; and Clifford C. Paterson, M. Inst. C. E.; With a foreword by Sir J. J. Thomson, President Inst. P. Volume I. [Oxford Technical Publications.] London: Henry Frowde and Hodder & Stoughton. New York: Oxford University Press, American Branch. Boards, cloth back; 6x10 in.; pp. 59. 85c.

Prof. Barr deals with "Physics and Engineering Science with Special Reference to Mechanical Engineering" and Sir James Ewing and Mr. Paterson with "The Physicist in Engineering Practice" and "The Physicist in Electrical Engineering" respectively. Common to all the addresses is an appeal for research work, and particularly for research laboratories as an integral part of industrial works.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

The Cranberry Marsh Auger Pump

Sir—The new type of pump for low lift work as described by Eugene F. Deléry in *Engineering News-Record*, Aug. 9, 1923, p. 230, brings to mind extensive tests made by the writer in the spring of 1916, in collaboration with J. A. Schad and H. W. Tabor and under the direction of Prof. C. I. Corp of the University of Wisconsin.

The tests were made with an extremely simple type of screw lift pump designed by O. G. Malde, superintendent of the state Cranberry Marsh Experiment Station near Grand Rapids, Wis. These pumps were designed for lifts of 2 to 8 ft. The screw blade impeller operates in a cased opening built into the bottom of a large pit below the lower level of water (Fig. 3). The impeller is keyed to a shaft and the power is applied by means of a pulley attached to the upper end of the shaft above the upper level of water. As the pump operates, the level of the water in the pit increases until the water flows over a weir in the side of the pit.

FIG. 1—IMPELLER BLADES FOR AUGER PUMP

It is interesting to note that while the tests referred to were made for heads varying from 2 to 6 ft. and the New Orleans tests were made for heads of 3 to 14 ft., the efficiency of this crude 16-in. "Malde" pump is as great as that of the 4-in. rotary flow pump described by Mr. Deléry.

By referring to Fig. 2 it will be noted that the maximum efficiency seems quite constant, about 39 per cent, and that for this condition of maximum efficiency the discharge ranges from 3 to 5 sec.-ft. It would be interesting to have these tests extended to a head of 14 or 15 ft. to verify the indication that the same maximum efficiency would be obtained, and to compare the results with those obtained from the pump patented by Mr. Deléry.

The tests made of the simple "Malde" pump show also a broad variation of speeds necessary for maximum efficiency at varying heads, a steadily increasing delivery for increasing speed at constant lift, a large increase of delivery at very low lifts and a well sustained delivery over the whole range of lifts, requiring, however, a necessarily increased horsepower input for the increased lifts. The "Malde" pump does not show a constant power curve for the range of lifts but for the maximum efficiency of operation requires an increasing power input for increasing heads, maintaining, however, a more or less sustained volume of discharge. The maximum efficiency range for the higher speeds, 540 and 650 r.p.m., is greater than for the lower speeds and it is quite probable that were the "Malde" pump operated at the increased speeds of 1,800 to 3,000 r.p.m. the range of maximum efficiency would also obtain over a greater variation in head.

It is doubtful if the reverse nature of the curves for efficiency and discharge, shown on Mr. Deléry's Fig. 3, would persist over a wide range of tests; it would rather

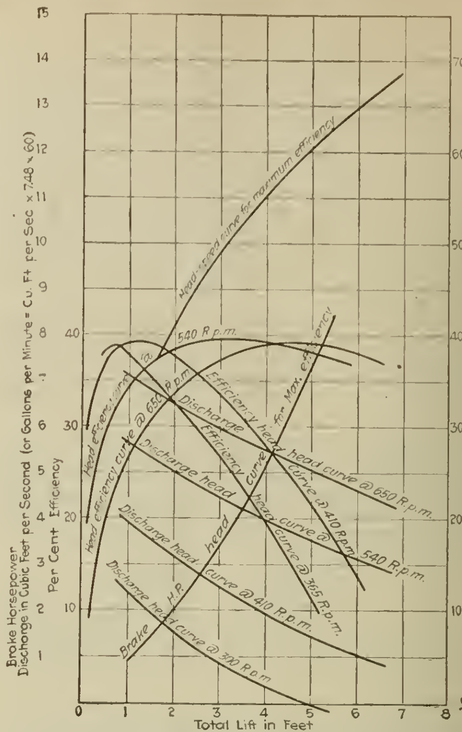


FIG. 2—PERFORMANCE CURVES FOR AUGER PUMP

tend to become more regular in outline. It is especially difficult to understand the almost vertical position of the discharge curve between heads of 6 to 7 ft. and the correspondingly almost horizontal position of the same curve between heads of 8 to 14 ft., the power input and efficiency presumably being approximately constant.

Further tests were made of the "Malde" pump after cutting off the lap of the blades, it being stated that it was easier to cast the impeller in this manner than with the blades overlapping. These tests uniformly showed a material decrease in the efficiency of the pump. Final tests

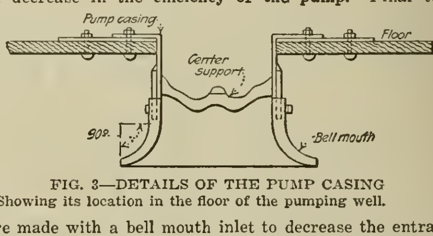


FIG. 3—DETAILS OF THE PUMP CASING
Showing its location in the floor of the pumping well.

were made with a bell mouth inlet to decrease the entrance loss. The resulting increase in efficiency due to this refinement was about 3 per cent.

The increased efficiency which might be expected in a pump with the refinements of the one described by Mr. Deléry over one of the crude type mentioned above is probably overcome by the friction losses within the chambers of the pump itself. Friction losses in the operation of the Cranberry Marsh pump are probably a minimum due to the comparatively large section of the pump pit as compared with the impeller orifice, and the relatively slow velocity of the water with regard to the pump pit walls

Pittsburgh, Pa., Aug. 20, 1923.

M. C. STEUBER, Civil Engineer.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Chemists Discuss Sewage and Water Supply

Activated Sludge and Filtration Main Topics at Section Meeting of American Chemical Society

Special Correspondence

Local interest as well as an unusual attractive program was responsible for two popular and enthusiastic sessions of the Division of Water, Sewage and Sanitation, at the 66th meeting of the American Chemical Society, Milwaukee, Wis., Sept. 10-14. John Arthur Wilson's paper on the "Scientific Development of the Activated Sludge Process at Milwaukee" was the center of a discussion that involved many of the sanitary chemists and engineers who have followed this project with intense interest. This formed a part of a symposium that added considerable to the general knowledge of this method of sewage disposal.

Activated Sludge Symposium — Dr. F. W. Mohlman, chief chemist of the Sanitary District of Chicago, discussed the filtration of activated sludge. Operation on a working scale of four types of filters (Simplex plate and frame, Worthington platen, Oliver and American continuous) at the Des Plaines and Calumet plants has shown that treatment of activated sludge with filter alum before filtration flocculates and coagulates the solids and greatly improves filtration. Alum has proved to be superior to sulphuric acid from a practical standpoint. The cost is about the same in each case and the very small addition of alum to the sludge is of negligible significance. Experience at the Corn Products plant at Argo, Ill., seemed to confirm the superiority of alum over other coagulants. Other conclusions brought out in this work are that dilution of sludge frequently accelerates filtration and that the moisture content and biological conditions of the sludge are controlling factors in filtration.

Prof. Edward Bartow, head of the chemistry department at the State University of Iowa, described the treatment of waste from a packing house at Mason City, Iowa. In 1921 an activated sludge plant had been constructed there. Originally it contained a sediment and grease tank, an aëration chamber and a Dorr clarifier. It did not accomplish complete treatment, although great improvement was noted. The excess sludge was mixed with tankage and sold as fertilizer. In remodeling the plant there have been added a Dorr clarifier and a grease skimmer for the removal of heavier solids and greases and a new aëration tank which will double the aëration capacity. Putrefaction in the clarifier is prevented by returning the clarified affluent to the aëration tank during periods of low flow.

Problems in Water Filtration — Dr. George N. Prentiss, chemical director of the C. M. & St. P. R.R., reported that a committee of chemists from the local section of the society had investigated the advisability of filtering the Milwaukee city water supply. Their recommendation—by majority opinion—was that the filtration project might well await the solution of the sewage disposal problem since at present the city water apparently offers no menace to the health of the community. Most of the sanitary chemists present seemed to agree with a statement by one of their number that "chlorination without filtration gives us a pretty slender thread on which to hang the health of half a million people."

Dr. W. D. Hatfield of the filtration plant at Highland Park (Detroit) Michigan offered a modified hematoxylin (colorimetric) test to replace the tedious gravimetric method of determining soluble aluminum in filtered waters. Apparently when restricted to a limited range of hydrogen-ion concentration, the method is satisfactory for all practical purposes.

Ulen and Co. Submits Only Bid on Moffat Tunnel

Ulen and Co., New York, was the only contractor who submitted a regular bid for construction of the Moffat Tunnel, Colo., for which the total amount of the Ulen bid was $6,075,000. At the time of going to press the tunnel commission had announced no decision, but word from its New York office was to the effect that the Ulen company had failed to be awarded the contract. Whether the commission will readvertise, or do the work itself is not, then known.

Five Killed in Collapse of Scotia Bridge Span

Falsework Under Skew Arch Gives Way As Concrete is Being Poured—State Engineer Reports

One of the spans on the Schenectady-Scotia reinforced-concrete bridge spanning the Mohawk River and the New York State Barge Canal and known as the Great Western Gateway collapsed the afternoon of Sept. 17, while the last concrete was being poured on the span. Five men are supposed to have been drowned or crushed under the timbers and concrete. These included four workmen, and the engineer for the construction company, Kenneth Davidson. The span which collapsed was the twenty-fourth span, and it went down without warning.

An investigation has been made of the accident by State Engineer Dwight B. LaDu, who reports as follows:

"This department's investigation of the causes leading to the collapse of a span of the Schenectady-Scotia Bridge, discloses the fact that the falsework on the twenty-fourth span of the structure collapsed at 5:15 p.m. Monday, Sept. 17, while concrete was being poured on the two downstream arch ribs of the span. The pouring of the concrete was practically complete at the time the span gave way. This span, which is the first from the Scotia end of the bridge, is on a sharp skew, the falsework being supported by over 96 piles, some additional piles having been placed at the suggestion of the assistant engineer in charge of construction. These piles support the timber bents which, in turn, support eight trusses, two under each rib. The piles supporting this falsework were driven to at

COLLAPSED SPAN OF SCHENECTADY-SCOTIA BRIDGE

least a 15-ton penetration which gave ample bearing power to support the load of the superimposed falsework and the concrete in the arches.

"It is the opinion of this department that there was some slight lateral movement in the piling which resulted in an accentuated movement of the blocking and wedges under the trusses. This movement resulted in a general turning movement of the trusses due to a considerable extent to the sharp skew on which they had been erected. This brought about a general collapse of the falsework and concrete with the resulting loss of life.

"This department, while supervising the construction of this bridge, has no responsibility for the stability of the falsework during the erection of the arch ribs and, under the contract, has no authority to determine the type of falsework to be used. It should be said, however, that the department had already directed the contractor at various times to strengthen the falsework under the spans. No settlement of the abutment or pier has been detected and the state will suffer no monetary loss due to the collapse of the span."

Plans Drawn Before War

Plans for the bridge were first drawn before the World War, but construction upon it was not started until three years ago. Twelve spans had been completed at the time of the accident. The structure has a total length of 4,436 ft. comprising 23 spans of lengths varying from 106 ft. to 120 ft., and one span across the Barge Canal channel of 212 ft. Plans called for width of roadway of 40 ft. between curbs with double tracks for electric cars in the center, and 6 ft. sidewalks. Four arch spans, each 106 ft. long, cross the river channel to the triangular pier on Van Slyck Island, where the bridge turns at an angle of 54 deg. The crossing of Van Slyck Island is in three arch spans 110 ft. each, one arch span 117 ft., all square-ended, and four arch spans 120 ft., each on a skew of 18 deg. Then comes the 212-ft. span across the barge canal which is on a skew, then six 120-ft. skew spans and an anchor pier on the far side of Hog Island, and five more skew spans of 120 ft. each. The structure between abutments is divided into five sections by two anchor piers and the massive piers of the channel span.

On the Scotia end of the bridge for a distance of 940 ft. the approach consists of an earth embankment.

The new structure is to replace an old steel toll-bridge which crosses the river about 1,200 ft. to the east. It will be paid for jointly by the State of New York, the City of Schenectady, the County of Schenectady and the Village of Scotia. The contract plans were prepared by Frank M. Williams, then state engineer, from a design by B. H. Davis, consulting engineer.

Money Asked for Philadelphia Port Improvement

Request has been made by the Department of Wharves, Docks, and Ferries of the City of Philadelphia to have an item of $3,270,000 provided for its use in the loan bill to be submitted in November to popular vote. This sum is asked to carry on the work of the department during the year 1924, and is divided as follows:

Pier 84 South:		
Completion of construction work	$350,000	
Completion of water supply, electrical work, plumbing, heating and sprinkler system	300,000	$650,000
Pier 82 South:		
Completion of construction work	$2,200,000	
Completion of water supply, electrical work, plumbing, heating and sprinkler system	300,000	2,500,000
For the construction of six (6) mud scows at $20,000 each..............		120,000
Total		$3,270,000

Pier 84 is at present almost complete, but funds are not available for the remaining work. On Pier 82, the substructure has been finished, and the item for construction work on this pier will provide for the entire superstructure.

The request has been made by report of the Director of the Department to the Mayor, and will be forwarded to City Council later. Public works of all kinds have been brought to a standstill in Philadelphia because the borrowing capacity of City Council has been completely exhausted. It is now intended that a large loan, which may reach a total of $40,000,000 or $50,000,000, will be submitted to the voters in November. This new loan will include funds for completion of the Delaware River Bridge, provision of subway and elevated railway lines, the improvement of the port facilities, construction of sewage disposal plants, etc.

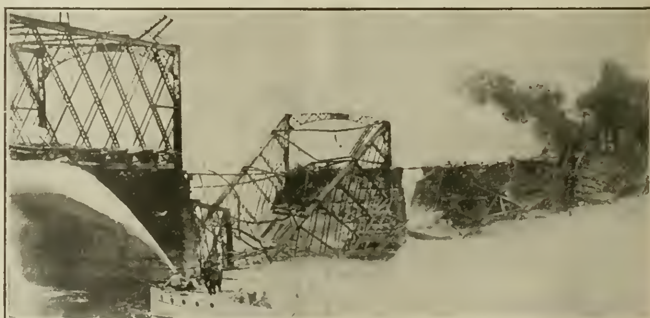
Temporary Relief Sought for Springfield Traffic

Following destruction of the North End bridge at Springfield, Mass., by fire Sept. 8, (*Engineering News-Record*, Sept. 13, p. 451) temporary measures for traffic relief between Springfield and West Springfield are being sought by city and county officials. Several plans have been considered but no definite project yet has been decided upon. Proposals to span the Connecticut River with an army pontoon bridge were discarded as being too expensive. No report has been made yet as to whether piers can be used without considerable reconstruction, so the feasibility of a temporary timber structure upon the old site remains uncertain.

The county commissioners of Hampden County have been trying to discover if they possess authority, through the enabling act of 1872 which authorized construction of the destroyed structure, to build a new bridge. It seems to be prevailing legal opinion that new legislation will be necessary.

Apportionment of cost of removing wreckage, as well as providing temporary traffic relief, has been a subject the county commissioners and city councils of the two towns affected have been perplexed by, though the question of wreckage removal cost has been waived, exigencies demanding that the five twisted steel spans be taken from the river before any possibility of ice and consequent jamming arises.

Partial telephone and electric light service was resumed the day following the fire by the placement of temporary cables in the river bed.



TWO VIEWS OF NORTH END BRIDGE, SPRINGFIELD, DESTROYED BY FIRE, SEPT. 8

Plan Elevator for Vancouver

To provide increased storage accommodation for the rapidly-growing shipments of wheat from the prairie provinces, an additional grain elevator with capacity for 2,000,000 bu. is to be erected at Vancouver, B. C. immediately. Work on the structure is expected to occupy four months, but it is expected to have a portion of it ready in time to handle the 1923 crop.

New Road Gives Entry to Chicago From Indiana

An agreement has been entered into by the Indiana State Highway Commission and Lake County to construct a paved highway from a point near Dyer, Ind., to 106th St., Chicago. The pavement from 106th St. for a distance of 1.56 miles will be approximately 69 ft. wide. The entire project is about 16 miles long. A large portion of it is already paved. The highway commission is to pay one-third the cost and Lake County two-thirds. Under terms of the co-operative agreement the highway commission will construct the road from the intersection of the Evansville-Chicago road with the Lincoln Highway to the north line of St. John township, Lake County. The county will build the road from this point to Roby, where State Roads Nos. 2, 8, 43 and 48 converge at the intersection of Calumet and Indianapolis avenues.

Public Ownership League Holds Convention

Protest was raised against Henry Ford's proposal to secure the Muscle Shoals property at the annual convention of the Public Ownership League of America held at Toronto Sept. 11-14. The convention passed resolutions protesting against any move on the part of the U. S. Government to accept the Ford proposal, on the ground that the power should remain the property of the people.

Outstanding among the various addresses was that delivered by Sir Adam Beck, chairman of the Ontario Hydro-Electric Commission, who gave a comprehensive account of the rise and progress of the provincial hydro-electrical system. He urged the immediate development of new services of power supply.

Earl D. Thompson, secretary of the League, discussed "Super-Power the Supreme Issue." Hon. George W. Joseph of Portland, Ore., dealt with "Public Ownership Possibilities in Oregon" and urged the saving of the water powers for the enrichment of the state. "Public Ownership of Telephones in Manitoba" was the subject of a paper by Mrs. J. E. Lowry.

The public ownership of railroads was advocated by Amos Pinchot, of New York, who considered it the most important problem before the public and asserted that the industrial concerns and railroads were spending probably millions yearly to convince the public that it cannot run its own railroads.

A resolution was adopted calling for a nationwide superpower system publicly owned and operated throughout the United States, steps to be taken at once to co-operate with members of Congress and others interested with a view to drafting a suitable measure. Charles K. Mohler, consulting engineer, Chicago, contributed a paper on "Essential Features of a Model Super-Power Law." George Wright, of the Toronto Transportation Commission, gave a history of the street railway system, claiming that it was a true type of successful public ownership. A. Emil Davies of London, England, chairman of the Nationalization Society, gave details of the progress of public ownership in Britain.

Traffic Is Chamber Topic

A general survey of the waterways of the country as the basis for preparing a comprehensive plan for their development by the government, the establishment of joint rail and waterway routes and dates, and the regulation of common carriers on waterways was discussed at the meeting of the committee on the development of waterways and the co-ordination of rail and waterway service of the United States Chamber of Commerce at its meeting on Sept. 11. The committee hopes that it will be able to outline methods of increasing the traffic on the Great Lakes and on the government barge line on the Mississippi as a means of relieving the general transportation situation.

Chicago Station Permit Issued

A building permit for the construction of the $6,000,000 Union Station building in Chicago has been granted to the Terminal Building Co. This is Chicago's second largest building project and will be the largest one-level terminal in the world. It will be surpassed in size only by the Pennsylvania and Grand Central terminals in New York City, which are both two-level terminals.

Seattle Engineers' Home Moved

IN ORDER to make way for the Community Hotel, contract for the construction of which was recently let, the building occupied by the Seattle Engineers Club was blocked up 12 ft. on cribbing and moved more than a block from its old location. The building is only six years old and has a replacement value estimated at more than $60,000. It was recently purchased by the Plymouth Church and was moved to their property. The Engineers Club will lease from the church trustees for a five-year period. As it cost but $20,000 to move the club building, it is considered a good investment, particularly because in its new site a basement story will be built on to make room for rentable store space. During the time the building was being moved regular meetings of the Engineers Club, lunches and all normal activities were uninterrupted. Heating was accomplished by electric connections and by special heaters. Water supply and sanitation were also maintained throughout the five weeks the building was being moved.

Plans Complete for Session of Construction Council

First Annual Meeting of Body to Be Held at Engineering Societies Building Sept. 21

The first annual meeting of the American Construction Council will be held at the Engineering Societies' Building tomorrow, Sept. 21, at 2 p.m., which session is to be followed by a dinner meeting at the Hotel Commodore at six o'clock and by an evening session in that hotel. Tomorrow morning there will be a meeting of the board of governors and the executive committee at the home of the president of the Council, Franklin D. Roosevelt. On the morning of Sept. 22 there will be meetings of the committees of the Council by special appointment.

Afternoon Meeting

The afternoon session will be opened by Mr. Roosevelt, who will be followed by H. A. Wheeler, vice-president of the Union Trust Co. of Chicago. Important topics to be discussed after Mr. Wheeler's address include: "Local Autonomy and National Organization in the Construction Industry," by Harry T. Stevens, president, New Jersey Building Congress, and Richard A. Wolff, secretary, New York Building Congress; "Apprenticeship, Vocational Guidance and Craftsmanship in the Construction Industry," Fred F. Moran, New York Building Congress; "Reduction of Unemployment in the Construction Industry," A. P. Greensfelder, Fruin-Colnon Co., St. Louis; "The American Construction Council's Program on Research," which is a report of the committee of the American Construction Council on public information and research, given by Dwight L. Hoopingarner, chairman. After the first three named addresses, committees of the Council having to do with these three subjects of discussion will report and discussion upon the report will be invited.

Evening Sessions

The dinner session will be opened by an address by the executive vice-president of the Council, D. Knick backer Boyd. The possibilities of an international exhibition of the construction industry during the sesqui-centennial exhibition in Philadelphia will be explained by the chairman of the executive committee of the Exhibition Association, Ernest T. Trigg. This will be followed by an address by E. T. Brunner, editor of *American Contractor*, on "A Look Into the Future of the American Construction Council."

At the evening session, which is scheduled to begin at eight o'clock at the Hotel Commodore, there will be a discussion by representatives of the twelve constituent groups of the Council on "What the American Construction Council Can Do to Help Our Branch of the Construction Industry." These will be followed by officers' reports, reports of the committees on resolutions, meetings of the twelve constituent groups for election of the board of governors, and the annual meeting of the board of governors.

Should the evening meeting not be finished by 10 o'clock it will be concluded Saturday morning.

Random Lines

BOY WANTED ABOUT 71 YEARS of age for blueprint work.—*Buffalo News.*

Well! There's one field left open when we get too old for real engineering.

* * *

More "Engineers"

An advertisement in the Bridgeport *Post*—

WANTED—Two men, reliable, to qualify for positions as business engineer; salary $3,000 and up; willingness during spare time to acquire understanding of this work more essential than previous experience.

There should be admitted to the profession, too, Mr. Ben Gardner, dwelling engineer of Sacramento, Cal., who advertises that he has keys for anything and that he repairs doors, windows, locks, porches, roofs, stairs, chimneys and furnaces; the electric sign engineers of the Thos. Cusack Co., whom a Buffalo paper lauds and an unnamed amusement engineer, who figures prominently in the advertising columns of the Philadelphia *Record*. *Good Housekeeping*, not to be outdone, has now a department of Household Engineering.

And out in Seattle, Floyd Foster Barnes, human engineer, is lecturing on such typically engineering subjects as "Psycho-Analysis and Love" and "Thoughts Are Things."

As a special feature of the Golden Jubilee Celebration at Lakeside, Ohio, there is to be a trilogy of pageants and the management is pleased to announce that "Mrs. Ruth Mougey Worrell, pageant engineer of wide and highly successful experience, has been secured as author and director of this feature of our celebration."

* * *

Blow Warm, Thou Air Blowers

Dimitrie Joanowici, Rumanian inventor who claims to be able to keep the harbors of Montreal and Quebec and Cabot Straits open for the winter navigation, is asking the sum of $2,000,000 as recompense for his secrets. He stated recently that he had placed his proposals before Hon. Ernest Lapointe, Minister of Marine and Fisheries, and that Mr. Lapointe had given him a good hearing. Mr. Joanowici stated Mr. Lapointe had informed him that the matter would be considered by the departmental engineers before any conclusion was reached. Mr. Joanowici's plan for keeping Cabot Straits open involves the use of a number of powerful electrically-driven air blowers which would be placed on the coasts of Newfoundland and Cape Breton. They would be used to divert the course of the ice so as to keep the straits open.

The above note was sent in as a serious communication by our Montreal correspondent. On reading it over we concluded it belongs in this column.

Hetch Hetchy Power Distribution Question in Limelight

M. M. O'Shaughnessy, city engineer of San Francisco, has recommended to the board of supervisors that the city immediately begin suit to condemn the local distribution system of private power companies for use in distributing Hetch Hetchy power. This would provide definite information on which the voters could choose the alternative of wholesaling power or acquiring a distribution system.

Attention concentrates on the subject at this time because the Moccasin Creek plant, the first Hetch Hetchy unit, is nearing completion with a capacity of forty-five per cent of the city's requirements.

Without reference to Mr. O'Shaughnessy's report, the board of supervisors passed by a vote of fifteen to two a resolution putting that body on record as "unequivocally opposed to the policy of entering into any contract, lease or agreement of any kind for the distribution of Hetch Hetchy power to or through any private corporation," and declaring that absolute municipal ownership and direct distribution to consumers of Hetch Hetchy power is the city's basic policy. The resolution also urged the appointment by the mayor of five citizens to negotiate with the private companies for the purchase of a distribution system and further instructed the city engineer to prepare plans and specifications for a distribution system capable of supplying all electric light and power requirements within the city. The power companies have already stated that their systems are not for sale.

Approval by popular vote is necessary before funds would be available for purchase or duplication of distributing systems. Mr. O'Shaughnessy's recommendation is for wholesaling power until final decision is made, thus avoiding the loss of $2,000,000 annually that would result from failure to utilize Moccasin Creek power.

Applications for Power Sites in Utah Conflict

The so-called Split Mountain site near Vernal, Utah, on the Green River, has come into prominence through conflicting applications to develop power at that point. One application has been filed with the state engineer of Utah by a Mr. Ratliff, Vernal citizen, for a combined power and irrigation project, and the other application has been filed with the Federal Power Commission by the Utah Power & Light Co. for a preliminary permit for a power development. Mr. Ratliff has also requested the Department of the Interior to grant him an irrigation right for 16,000 acres of land at or near the site, and as he is reported to be backed by Col. A. E. Humphreys, of Denver, Col., it is expected that he will be in a position to start developments at an early date, whereas the Utah Power & Light Co. has no immediate prospect of a market in the region of the power site and would consequently have to develop a market before it could undertake the development. The Federal Power Commission will not be called upon to make a decision in this case until the Ratliff interests make formal application to it for a preliminary permit.

Wallace Finds Removal of Davis Is "Backward Step"

In forcing out A. P. Davis as director of the Reclamation Service, Secretary Work of the Department of the Interior took a backward step and for reasons contrary to the policy of many industrial enterprises, L. W. Wallace, executive secretary of the Federated American Engineering Societies, declares in a statement which points out successes attained by engineers in business.

"Requesting the resignation of Mr. Davis," says Mr. Wallace, "Secretary Work gave as his reason that he believed the Reclamation Service should be administered by a business man and not by an engineer.

"The only inference one can draw from this is that he considers an engineer not competent to direct the business phases of a large enterprise that is essentially engineering in character, as is the Reclamation Service. The clear implication is that Secretary Work, a professional man, being a doctor, is of the opinion that members of the professional group of engineering are not successful administrators of business and particularly those lines of business that are essentially engineering.

"Evidently the Secretary does not know that many technical directors of large works within and without the Government Service have ably directed such projects both from a business and a technical point of view. It would appear that the Secretary does not know that one of the marked tendencies in recent years has been the placing of technically-trained engineers, chemists and scientific men in charge of large industrial and commercial enterprises.

"Obviously he does not know that many engineers, who, after they had secured their technical education and experience and while firmly establishing themselves as engineers, have coincidently come into prominence because of their business ability. One of the Secretary's colleagues on the Cabinet, the Secretary of Commerce, Herbert Hoover, is an illustration."

Advertising Signs to Be Removed From Connecticut Highways

On the ground that they are a menace to the safety of the traveling public, the Connecticut State Highway Department has ordered removal of all signs abutting the highways in an illegal way. Co-operating with the state police department and the motor vehicle department, steps have been taken to remove immediately many new advertising signs which have come to the attention of the state officials.

Orders have been issued to all district supervisors of the highway department to notify foremen in their jurisdictions to see that all such signs are taken down at once. At the same time, the department has notified its divisional officers that the attention of the state police will be called to all such violations.

Statutes prohibit the use of any sign, large or small, within the highway limits. In this class is included the great variety of posters which are frequently seen tacked to telephone poles and trees. The state police department estimates that no less than 5,000 signs of all descriptions were removed during the last year for various causes.

Council-Manager Plan Adopted by Portland, Maine

By a vote of 9,924 to 7,691 the electors of Portland, Me., approved a council-manager charter on Sept. 10. There were 6,931 votes for retaining the present charter and 640 for a revised charter prepared by a committee headed by C. S. Chaplin, mayor of Portland. Some 72 per cent of the registered voters took part in the election. The new charter will go into effect next January.

New Precedent in Rail Valuation Established by the I.C.C.

The Interstate Commerce Commission has finally disposed of the first two contested cases of tentative valuations and has fixed "final single sum values" of $45,000,000 on the San Pedro, Los Angeles & Salt Lake Railroad Co. and $23,245,257 on the Atlanta, Birmingham & Atlantic R.R. These figures are substantially the same as the tentative values announced some time ago and have been fixed at extended hearings in which the protests were completely overruled.

The findings in regard to the Atlanta, Birmingham, & Atlantic are regarded as having established a precedent for further valuation work in that, although the Atlanta line has consistently been losing money, the commission states that the valuation could not be based upon the "junk worth" of the property inasmuch as it is rendering a distinct service to the territory traversed.

As the Union Pacific, the controlling company for the San Pedro, Los Angeles & Salt Lake R.R., values it at $75,000,000, it has announced that it will protest the findings of the Interstate Commerce Commission. The Union Pacific claims that this value of $75,000,000 is the value of the railroad as a going concern, but the Interstate Commerce Commission maintains that it is not limited to such considerations and that the "final single-sum value" which it has ascertained for the property of this carrier is based upon a careful consideration of all the relevant facts that have come to its attention. It is, in the judgment of the commission a value which it is authorized by the Valuation Act to ascertain and report. . . "the fair value of the property which the carrier holds for and uses in the service of transportation and upon which it is entitled to earn a fair return."

Civil Service Examinations

UNITED STATES

For the civil service examinations named below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission.

Junior Engineer—Vacancies in the Bureau of Standards, Washington, D. C.; examinations to be in the subjects of ceramic, chemical, civil, electrical, mechanical and radio engineering, and the engineering of materials; positions at entrance salaries ranging from $1,200 to $1,590 a year plus increase of $20 a month.

Examinations will be held throughout the country on December 5, 1923.

CANADA

For the following civil service examination, apply to the Civil Service Commission, Ottawa, or to the postmaster in any of the large cities of Canada.

Geologist—For the Geological Survey, Department of Mines, Ottawa, Canada, for work in the field, surveys and mapping, explorations, reports for publication, and other related work; initial salary $3,600 per year.

Application must be made before September 29.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; Annual Conference, Chicago, Sept. 27-28, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga., Nov. 12-16.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Meeting, Washington, D. C., Nov. 13-15.

The San Francisco Engineers Club at a luncheon August 29 was addressed by Charles G. Hyde, professor of sanitary engineering, University of California, on his observations and experiences while in Europe, from which he had recently returned.

The Western Society of Engineers Oct. 1 will hear William Frances Gibbs, president Gibbs Bros. Co., New York, speak on "Reconditioning the Leviathan." On Oct. 15 transportation of perishable freight will be discussed by C. H. Nelson, manager refrigeration department, Atchison, Topeka & Santa Fe Ry., from the standpoint of railroad requirements and by J. W. Inghram, chief engineer, Railways Ice Co., on the engineering of refrigeration. Several engineers and officials of the Peoples Gas Light & Coke Co., Chicago, who studied European practice of gas manufacture and distribution this summer will present on Oct. 29 a symposium on their findings.

Personal Notes

VIRGIL C. LEE, of Anderson, Ind., has been named engineer for the Fort Wayne district of the Indiana State Highway Department to succeed O. B. Kercher, of Goshen, who resigned several weeks ago. Mr. Lee is a graduate of Purdue University. He will be in charge of state highway system in 13 counties.

A. G. SCHAMBERGER, JR., formerly draftsman with Bethlehem Steel Co., Bethlehem, Pa., has been made estimator and draftsman with the Community Steel Corp., and is located at Buffalo, N. Y.

R. W. MCCORMICK, a professor in Rose Polytechnic Institute at Terre Haute, and the first chairman of the Indiana State Board for Registration of Professional Engineers and Land Surveyors, has resigned from the board.

FRED F. FRIEND, formerly hydraulic engineer for the Electric Bond & Share Co., New York City, has moved to California and is now chief engineer of the Palo Verde Drainage and Levee District.

J. W. BLAIR, Texas City, Tex., is now associated with John Monks & Sons, contractors, New York City, as general foreman on construction of sugar refineries. Mr. Blair was formerly general superintendent on construction of the Galveston Causeway.

R. T. MCKAY, until recently concrete engineer with Mamer Co., Benton Harbor, Mich., has been made concrete engineer on the staff of Brussel & Viterbo, consulting engineers, Chicago, Ill.

WILLIAM D. SMITH, formerly chief draftsman for the Port of Tacoma, Tacoma, Wash., is now designer for Hedrick & Kremers, consulting engineers, Portland, Ore.

H. P. HEVENOR, consulting engineer and in this capacity connected with Dwight P. Robinson & Co., Inc., for the past year, has opened offices at 110 E. 42nd St., New York City. For 18 years Mr. Hevenor has been a specialist in track design and construction, for a short time with the Brooklyn Rapid Transit Co. and for five years in the office of the chief engineer of the New York, New Haven & Hartford R.R. In 1916 he entered private practice under the firm name of Engel & Hevenor, and installed track on the New York Seventh Avenue subway, Third Avenue Ry., and Eighth and Ninth Ave. R.R., also did special track construction for the Trenton & Mercer County Traction Co., Capitol Traction Co., Washington, D. C., Newport News & Hampton Railway Gas & Electric Co., Delaware, Lackawanna R.R., New York, New Haven & Hartford R.R. and the Connecticut Co.

GEORGE JEROME, consulting engineer, has been appointed city engineer of Detroit, Mich., by John W. Reid, who became commissioner of public works Sept. 1. Mr. Jerome at the time of his appointment was engineer for the village of Ferndale and conducted a private practice in engineering in Detroit, where he was formerly assistant city engineer.

T. E. MOSS WHEAT, civil engineer, announces the opening of offices at 306 Murphy Bldg., Detroit, Mich., for the practice of civil and structural engineering, surveys, reports, designs, supervision and appraisals, and includes the announcement of the dissolution of the firm of WRIGHT, NICE & WHEAT, Detroit, Mich. Mr. Wheat is a 1914 civil engineer graduate of the University of Michigan, served in the Bureau of Public Works, Manila, and on the erection of a radio station at

Cauacao, P. I., and in the United States as superintendent for the Division of Military Aeronautics of production of aircraft hangars at various factories and later in charge of reclamation of hangar buildings. After the war Mr. Wheat was connected with Smith, Hinchman & Grylls on St. Clair River surveys, city layout including sewer design, water-works and streets, and other construction work.

C. E. PUTNAM, Tacoma, has been appointed city engineer of Tacoma, Wash., to succeed J. C. Manley, resigned. Mr. Putnam has had 20 years of experience in engineering, and since 1921 has been construction engineer in the Tacoma city service.

R. F. RAGLAND, formerly assistant engineer, Yellowstone National Park, is now resident engineer for the Bureau of Public Roads, U. S. Department of Agriculture, in charge of highway construction at Seward, Alaska.

McKELVEY CONSTRUCTION Co., St. Louis, Mo., has opened a branch office in the Hammond Bldg., Detroit, Mich., with H. E. Anderson in charge. Mr. Anderson has been associated with the company since its organization two years ago.

E. W. BEATTY, Montreal, president of the Canadian Pacific Ry., accompanied by several of the directors of the railway started on Sept. 7 on a tour of inspection of the lines between Montreal and the Pacific Coast.

OTTO M. RAU, a power engineer for many years connected with the Edison General Electric Co. of New York, has been appointed consulting engineer of the Giant Power Survey Board of the State of Pennsylvania. Mr. Rau has established an office in the Fuller Building, 10 South 18th Street, Philadelphia. During the war, Mr. Rau was consulting engineer in the power section of the Emergency Fleet Corporation.

Obituary

SHEPLEY W. EVANS, civil engineer, for many years a member of the firm of Sparks & Evans, Philadelphia, Pa., died Sept. 3 at his home in Merion, Pa. Mr. Evans was a graduate of Dartmouth College in the year 1871.

MANUS MCHUGH, contractor, Philadelphia, Pa., died in that city Sept. 9 at the age of 69 years. Mr. McHugh was born in Londonderry, Ireland, but came to this country in infancy. He had for nearly forty years held municipal contracts for Philadelphia and had constructed many bridges in and near the city.

LANGDON GIBSON, who until two years ago was production manager of the General Electric Co. and had been associated with that company for 31 years, died Sept. 5 at Criehaven, Maine, of cerebral hemorrhage. Mr. Gibson was 58 years old. He was one of the members of the Stanton expedition through the Grand Canyon of the Colorado in 1889 and also accompanied Admiral Peary on his second northern expedition.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

More Motor Vehicles Mean Continued Road Program

Steady Market for Equipment Indicated by Registration of 13,002,427 and Revenue of $200,000,000

For manufacturers of road-building equipment and materials figures on the registration of motor vehicles in the United States for the first six months of 1923, showing a total of 13,002,427 passenger automobiles and trucks, as against 12,238,375 for the entire year of 1922, are significant in indicating the need for a continuing program of both road construction and maintenance. The statistics are contained in a report just issued by the U. S. Bureau of Public Roads, which leaves the Good Roads Board of the American Automobile Association to the conclusion that neither the United States nor any of the individual states are approaching the saturation point in number of motor vehicles in use.

The increase in number of motor vehicles in the United States has continued at approximately the same rate as preceding years, states the Good Roads Board. In the states leading in numbers of motor vehicles where the road programs are also in advance of the other states, and where the first indications of approach to the point of saturation might be expected, the percentage of increase has kept pace and in some instances has outdistanced the records of the Southern states where the road programs are in course of development.

TRUCKS SHOW GAIN

An interesting deduction gathered from the report is the marked increase in numbers of motor trucks for the six months' period as compared with the entire year of 1922, indicating the rapid growth of the use of the motor vehicle for commercial purposes. The truck registration is 1,371,058, an increase of 92,254 since January 1.

In all but nine states, material increases were shown in number of motor vehicles registered during the six months' period of 1923 over the entire year's registrations of 1922. With six months yet to go the record of 1923 in all states will exceed that of 1922.

The State of Ohio climbed up to second place in total number of motor vehicles registered, changing places with California. New York again leads with a total registration during the six months period of 1,025,718 motor vehicles. Ohio is second with 965,000 and California third with 933,808. Pennsylvania is fourth with 922,062; Illinois fifth with 833,920; Michigan sixth with 624,590 and Texas seventh with 571,981. The total number of motor vehicles registered in all of the states during the six months period was 13,002,427 as against 12,238,375 for the entire year of 1922.

The total revenue from registration was $167,240,937.76 for the first six months as compared to $152,047,823.74. In addition to the revenue from registrations the states collected from the motorists $8,669,174.03 in taxes on gasoline during the six months period of this year, as compared to a total collection of $11,923,442.61 for 1922. As the gasoline tax is collected as the fuel is used, the record for the year 1923 may be expected to double that of 1922. The gasoline tax in some of the stat s did not go into effect until late in the year.

The final record for 1923 will indicate that motorists will have paid direct taxes in registration fees to the states and gasoline taxes approximately $200,000,000, according to the Good Roads Board of the A.A.A. This will not include the personal property tax or special registration or gasoline taxes imposed by cities, counties and townships.

Road Equipment Exhibitors Must Be Association Members

At a joint meeting in Chicago, Sept. 7, of the board of directors of the Highway Industries Exhibitors' Association and Charles M. Upham, recently appointed manager of next year's Good Roads Show and convention of the American Road Builders' Association, a decision was reached requiring all exhibitors at the next show, to be held at the Coliseum, Chicago, Jan. 14-19, to be members both of the Highway Industries Exhibitors' Association and the American Road Builders' Association. A clause covering this requirement will be inserted in the contracts for space at next year's Good Roads Show. According to the terms of the resolution passed, it also becomes necessary for present members of the exhibitors' association who are not members of the road builders to join the latter organization.

The meeting of directors, representing manufacturers of equipment and materials which will constitute next year's exhibit, was characterized by complete harmony and pledges of cooperation between the exhibitors and the road builders. Mr. Upham announced that the floor plan of the Coliseum has been rearranged to provide better facilities and more space for exhibits. In addition, a larger entrance from the Coliseum Annex into the adjoining Greer building will be provided.

Cast-Iron Pipe Production

Based on returns from 12 establishments, statistics on the production, orders, sales and shipments of cast-iron pipe have been issued for the first time by the Department of Commerce. The figures cover the month of June and are as follows:

Production, 81,208 tons; shipments, 88,318 tons; orders to be shipped from stock, 17,905 tons; orders to be made on orders, 199,271 tons; orders not specified as to sizes, 4,366 tons.

American Lumber Manufacturers to Send Commission to Japan

Fifty thousand dollars was appropriated Sept. 1 by the Douglas Fir Exploitation & Export Co., as a cash contribution for Japanese relief, according to a telegram from Seattle to the National Lumber Manufacturers Association, Washington, by Edgar P. Allen, its director of public relations, who has been in San Francisco, Portland, Tacoma and Seattle for several days in conference with West Coast lumbermen in regard to their co-operation in meeting the Japanese crisis. In addition to the cash contribution the association expects t spend $50,000 more in providing technical, executive and administration assistance in rebuilding the devastated regions. Furthermore, the individual lumbermen and sawmills of the West Coast are making contributions to the Red Cross fund and every precaution will be taken to hold down lumber prices for the Japanese and prevent profiteering. The Douglas Fir Exploitation & Export Company is an export association of more than one hundred lumber manufacturers of the Pacific Coast. It is largely through this company that the individual manufacturers transact their ordinary export business with Japan.

In the matter of practical assistance the export company plans to send a commission of lumber experts and building advisors to Japan at once, with the consent and approval of the United States Government. This commission hopes to overcome the chief immediate difficulty in meeting the Japanese emergency demand for lumber, in that it has not been their custom to accept American grades and sizes but have imported according to their own specifications which necessitate special orders.

It will be one of the purposes of the lumbermen's commission to instruct Japanese builders in the use of commercially standard American products in order that full supplies of materials may be furnished without delay. It is believed that the commission of lumber experts will be able to sail to Japan within the next thirty days and in all probability the work abroad will require at least three months of the commission's time.

Shows Way to Make Better Lime

Experiments conducted at the Bureau of Standards have shown a way to improve the manufacture of hydrated lime so that the grade known as "finishing" hydrate is regularly produced instead of the grade known as "masons'" hydrate which, because of its lesser plasticity, commands a lower price. These tests have shown that plasticity depends not alone upon the colloidal content of the hydrate, but upon the effect on this colloid of the manufacturing process. The colloid, like glue, must not be allowed to dry out during the manufacturing process, and it must also be prevented from flocculating itself when the mixing water is added preparatory to use.

It has been found that the drying out can be prevented by letting the freshly made hydrate cool in an atmosphere of steam, while flocculating can be prevented by adding small amounts of a readily soluble calcium salt. A hydrator designed to apply these principles has just been completed for further experiment.

Foreign-Made Brick Appears in American Market

For the first time during the business career of anyone now manufacturing brick, according to the monthly statement issued Sept. 1 by the Common Brick Manufacturers' Association, Cleveland, some competition is felt from foreign-made brick. This is apparent so far, the association states, only in the New York market, where considerable quantities of brick from Germany and Holland are reported to be coming in. It is stated that these brick can be purchased on board ship at German and Holland ports for $4 a thousand, and that American manufacturers cannot compete with this low production cost even after transportation and handling on this side of the ocean has been absorbed. This competition, the manufacturers believe, is not likely to reach far inland, but would affect Atlantic ports unless the American manufacturers in those locations find some protection. American made brick still is claimed to be preferred by the builders in New York and is in ready demand even at a higher price than the foreign made brick.

Cost Accounting Suggestions for Trade Associations

A pamphlet dealing with the acceptance and installation of uniform methods of cost accounting by the members of a trade association has just been issued by the Fabricated Production Department of the Chamber of Commerce of the United States. The pamphlet it designed to "be of assistance to the officers and members of those trade associations which have undertaken to secure the numerous and important advantages of such uniform methods."

The first part of the text is devoted to the ways and means by which the trade association's service to its members may be made the most effective. It deals with such matters as the organization of an association cost bureau and cost councils, and provisions for keeping the members informed of developments generally. The second part is designed to be of direct and substantial value to the president, the general manager, the auditor and other executive heads of the various member companies. It suggests some of the preliminary steps that may well be taken in order to make sure that the association's uniform cost accounting methods are put into use most effectively.

New Manufacturing Plant Opened by Sullivan Co.

Manufacturing began last month at the new western works in Michigan City, Ind., of the Sullivan Machinery Co., manufacturers of compressors, drills and other mining and quarrying machinery. The new buildings were completed some time ago, and during the past month the machinery and equipment have been moved from the company's old plant at Chicago to the new quarters. The new plant is designed for the manufacture of air compressors, diamond core drills, drill steel sharpening machines and cutter bit sharpeners. The new buildings are one-story, and equipped with all modern appliances for manufacturing and handling the product rapidly and at low cost. The plant is served by the Pere Marquette R.R. With these facilities, which will give an initial manufacturing capacity double that of the old works at Chicago, the company announces that it will be able to meet the increased demands from its field and to serve its customers to much better advantage than heretofore.

The general office force and officials of the company, members of the board of directors, the company's bankers, railway officials and others spent a day at Michigan City inspecting the new plant. Addresses were made by Frederick K. Copeland, president of the company since its consolidation in 1892; the president of the Chamber of Commerce of Michigan City and others.

Business Notes

Pawling & Harnischfeger Co., Milwaukee, builders of traveling cranes, hoists, lumber handling cranes and excavating machinery, announces the appointment of N. B. Norris as manager of its New Orleans office. The company has also opened a new office in Detroit, with James Van Buskirk in charge.

Southern Pine Association, New Orleans, announces the closing on Sept. 1 of its regional office at Jacksonville, Fla. This action, Secretary-Manager H. C. Berckes states, is in line with the policy of the association not to maintain any regional offices in Southern pine producing territory. The association, however, through the New Orleans headquarters, will continue to render such special services as may be required both to Georgia-Florida subscribers and to those in all other sections of producing territory, as the needs arise.

H. T. Garvie, chief engineer and general manager of the British Steel Piling Co., London, will arrive in America Sept. 20 for a three weeks' visit. His address will be McKiernan-Terry Drill Co., 15 Park Row, New York City, for whom his company acts as selling agents for all countries outside North America. The British Steel Piling Co. first introduced steel piling in Great Britain 16 years ago and is interested in the representation in Europe and British Colonies of contractors' plant generally, but principally the small tilting-drum concrete mixers, steam shovels, guy derricks, tar macadam plants and similar equipment.

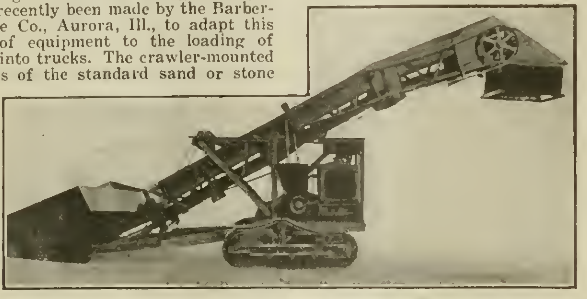
D. F. Holtman, construction engineer of the National Lumber Manufacturers' Association, returned to Washington Aug. 27 after a summer in the West visiting logging and lumbering operations. He was with a party including W. A. Gately of the Department of Commerce, who was making a survey of waste prevention problems and possibilities for report to Secretary of Commerce Hoover; E. P. Ivory of the Forest Products Laboratory, whose special mission was a study of lumber grading problems; and J. E. Jones, Chief Inspector of the Southern Pine Association. C. J. Hogue of the West Coast Forest Products Bureau, arranged the itinerary and accompanied the party.

STONE & WEBSTER, INC., Boston, has opened an office in the Leader Building, Cleveland, Ohio, in charge of J. R. Hammond, district manager of construction and engineering.

Equipment and Materials

Mechanical Loader Designed for Handling Snow

Changes in its elevating conveyor have recently been made by the Barber-Greene Co., Aurora, Ill., to adapt this type of equipment to the loading of snow into trucks. The crawler-mounted chassis of the standard sand or stone



loader is retained, but the new feature is the loading boom which, instead of carrying an endless chain of buckets, is equipped with a continuous wide rubber belt. The design of the receiving end of the conveyor also has been altered to provide for wide scoops to gather in and feed snow to the moving belt. The discharge end of the conveyor is provided with baffle plates to deflect the snow to one side or the other.

The overall length of the snow loader is 28 ft., maximum height 12 ft. 9 in., plowing width, 6 ft. 6 in., and weight 12,200 lb. The rated capacity of the equipment is 5 cu.yd. per minute. The inclined loading boom is carried on a chassis with crawler treads driven by a four-cylinder Buda gasoline engine. The machine has four speeds, three forward for loading of 30, 60, and 120 ft. per minute, and one reverse, of 35 ft. per minute.

There are two plows or scoops, one on each side of the conveyor belt, which are fitted with hardened steel scrapers and may be adjusted in height with relation to the pavement surface so as to pass over such obstructions as manholes. The conveyor is a four-ply rubber belt, 32 in. wide, with cross-angle flights every 20 in. and is flanked on either side by 12-in. skirtboards to increase its carrying capacity.

On city streets the load can best be utilized in picking up snow which has been pushed by plows toward the gutters. To date more than twenty of these machines have been placed in service by municipalities or street railway companies. The machine can be utilized the year round by exchanging the snow-loading boom for the bucket conveyor boom designed for handling sand, gravel and coal.

Coat Water Pipe With Asphalt from Pressure Distributors

Applying asphalt as a protective coating to water pipe with equipment designed to spread asphaltic oils on roads was the method recently employed by the Los Angeles water department. The work in hand was the coating of 1,500 ft. of 14-in. conduit near the corner of La Brea and Third St., Los Angeles, and was in charge of Thomas Brooks, assistant superintendent of the city water deoartment. Hitherto all such coating had been done by hand with brushes and buckets. Mr. Brooks decided to utilize the large motor truck pressure distributors of the A. F. Gilmore Co., oil producers and refiners of Los Angeles, to apply the asphalt by spraying.

Part of the equipment of these trucks is a metal hose leading from the tanks. It was a simple matter to lengthen the hose and attach. As in the case of oils for road building, the asphalt was heated to the required temperatures at the refinery, loaded into the truck tanks there, hauled to the job and maintained at that heat. The job was completed by three men within seven hours.

PRESSURE DISTRIBUTOR WHICH DELIVERED ASPHALT TO HOSE LINES AND SPRAYS FOR COATING PIPE

Publications from the Construction Industry

Gasoline Locomotives — FATE-ROOT-HEATH CO., Plymouth, Ohio, has published a 31-p. bulletin illustrating the uses of its gasoline locomotives on a variety of heavy construction work. Photographs and explanatory text relating to jobs on which Plymouth locomotives were employed for hauling materials include dams, bridges, dry docks, stadiums, canals, power plants, industrial buildings, filtration plants, subways, aqueducts, and tunnels.

Snow Plows — GOOD ROADS MACHINERY CO., INC., Kennett Square, Pa., features its Champion snow plow in a 31-p. illustrated pamphlet just issued. The plow is designed for attachment to the front end of a motor truck or tractor and consists of a steel scraper blade 10 ft. long and 20 in. wide. The blade may be set at any angle to the line of travel and a lifting device permits the scraper to be raised by the operator. The company manufactures also the Climax snow plow, which is a special adaptation of its road grader for snow removal work. This machine consists of a steel scraper bar attached to a semi-circle and swung under a frame that is carried by a four-wheel truck.

Water Filters—GRAVER CORP., East Chicago, Ind., explains in a 12-p. illustrated bulletin the features of its horizontal pressure type water filters. They consist of a cylindrical steel shell with a manifold and strainer system underneath filtering material of crushed quartz and graded gravel. These filters operate according to the mechanical or rapid sand method and are built in six sizes, all 8 ft. in diameter and ranging from 10 to 24 ft. in length. The process involves the use of a coagulant whose application is regulated automatically by a differential pressure tube. The filters may be operated as single units or, where larger capacities are demanded, in batteries of two or more.

Brass Pipe—BRIDGEPORT BRASS CO., Bridgeport, Conn., presents in an attractively prepared 47-p. illustrated booklet information to assist architects, engineers, builders, plumbers and owners in obtaining the maximum value for a given expenditure for brass pipe as a means of eliminating expense and damage due to corrosion. The text contains a great deal of valuable technical data on corrosion of steel, wrought iron, cast iron and brass pipe. A number of pages are devoted to the manufacturing processes which the company employs in the production of its Plumrite brass pipe including the composition and mixing of material, pouring, piercing, drawing, annealing and testing. Useful suggestions are offered on the selection of sizes of brass pipe for plumbing installations in large buildings. Practical hints are given, also, on cutting threads in brass pipe, cutting pipe, and making joints and bends. The text concludes with a discussion of items of cost in a piping system for hot and cold water service. The company points out that the data in its booklet have taken two years to collect and it is believed that the practices outlined and recommended are representative of the best in use today.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Record Cement Production During August

Production of portland cement in the United States in August totaled 12,967,000 bbl., shipments were 14,971,000 bbl. and stocks at the end of the month were 6,077,000 bbl., according to statistics of the Department of the Interior, prepared by Ernest F. Burchard of the Geological Survey and based mainly on reports of producers. Last month's production exceeded that of the same month in 1922 by 1,303,000 bbl.

For the first eight months of this year production has been 87,907,000 bbl. as against 70,139,000 for the same period last year, or a gain of 17,768,000 bbl.

Shipments for the first eight months of 1923 were 90,909,000 bbl. compared with 76,240,000 bbl. for the same period in 1922.

August production and shipments are greater than in any month thus far recorded and stocks are higher than in August last year.

Public Bond Sales Continue Dull During August

The dullness in the bond market, so noticeable in July of this year as compared with previous years, continued during the month of August. The aggregate of the bond disposals for August, according to the *Commercial and Financial Chronicle*, is only $49,750,564, as against $69,375,996 in August, 1922. Not many issues of one million dollars or over figured in the awards for the month the present year. The state of California put out $4,000,000 4½-per cent highway bonds; Rapides Parish, La., issued $2,000,000 5-per cent road bonds and Crawford County, Pa., issued $1,000,000 4¼-per cent road bonds.

The number of places in the United States selling permanent bonds and the number of separate issues made during August, 1923, were 340 and 474, respectively. This contrasts with 387 and 561 for July, 1923, and with 537 and 701 for August, 1922.

Of the 44 representative bond issues included in the accompanying table four were sold at par, three below and the remainder above par. The yields ranged from 4.20 to 5.99 and the rate of interest from 4¼ to 6 per cent.

Immigration Statistics on Labor in Construction Industry

Immigration statistics recently made public by the Department of Labor and presented to its members by the Associated General Contractors of America give facts concerning the number of aliens entering the country who may be considered as potential additions to the ranks of construction labor.

The figures show that a total of 522,919 immigrants were admitted to the United States during the last fiscal year as compared with 71,450 aliens who emigrated from the United States during the same period. Of the immigrants 307,522 were men.

A list of occupations of the immigrants includes the following: Carpenters and joiners, 12,305; iron and steel workers, 4,076; painters and glaziers, 2,550; plumbers, 1,197; metal workers, 764; masons, 3,276; stone cutters, 521; tinners, 512; mechanics, 4,644; blacksmiths, 2,296; and laborers, 83,552.

More carpenters and joiners came

REPRESENTATIVE BOND SALES DURING AUGUST & SEPTEMBER

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Delaware	Highway	600,000	4½	102.82	4.35	Jan. 1, 1923	Jan. 1, 1963	Barr Bros. & Co., New York
County								
Allen, Indiana	Roads	128,000	5	100.70	4.86	Aug. 1, 1923	1924–1933	First National Bank, Fort Wayne
Carteret, N. C.	Road and bridge	50,000	5½	102.38	5.34	July 1, 1923	1933–1962	Stacy & Braun, Toledo
Chowan, N. C.	Road and bridge	150,000	5¼	100.02	5.24	July 1, 1923	1926–1953	Kauffman-Smith-Einert & Co., Inc., St. Louis
Fillmore, Minn.	Road	100,000	4¾	101.50	4.61	Aug. 1, 1923	1933–1942	Northwestern Trust Co., St. Paul
Gastonia Graded School District, N. C.	School building	100,000	5¼	101.71	4.93	Aug. 1, 1923	1925–1949	Lewis S. Rosenstiel Co., Cincinnati
York, Pa.	Road	1,000,000	4¼	100.78	4.20	Aug. 5, 1923	1934–1953	Brown Bros. & Co., Harris, Small & Co., Biddle & Henry, Philadelphia
Alpena Union School Dist., Mich.	School	200,000	5	101.67	4.85	Aug. 15, 1923	1928–1952	Security Trust Co., and Whittlesey, McClean & Co., Detroit
Ann Arbor School Dist., Mich.	Public schools	100,000	4½	97.59	4.69	Oct. 1, 1922	1941–1943	Harris, Small & Co., Detroit
Blue Earth, Minn.	Roads	100,000	4¾	101.29	4.63	Aug. 1, 1923	1933–1942	Kalman, Wood & Co., Merchants Trust & Savings Bank & Syndicate, St. Paul
Crawford, Pa.	Roads	1,000,000	4¼	100.54	4.20	Aug. 1, 1923	1928–1948	Titusville Trust Co., Titusville
Jackson, Minn.	Roads	150,000	4¾	100.02	4.74	Aug. 1, 1923	1933–1942	Paine, Webber & Co., and Lane, Pipper & Joffray, Inc., Minneapolis
Lake County Special Tax School District, Fla.	Schools	60,000	5½	101.21	5.41	July 1, 1923	1933–1953	First State Bank of Eustis
Medina School Dist., Ohio	Schools	80,000	5	100.00	5.00	June 1, 1923	1924–1944	V. W. Furber, Akron
Tompkins, N. Y.	Highway improvement	200,000	4½	100.09	4.49	Aug. 1, 1923	1924–1943	Sherwood & Merrifield, New York
De Kalb, Ind.	Drainage	63,664	6	100.03	5.99	June 1, 1923	1924–1933	Fletcher-American Co., Indianapolis
Lake, Ohio	Water supply system	175,000	5	100.01	4.99	April 1, 1923	1925–1942	Second Ward Securities Co., Chicago
Laurens, S. C.	Road and bridge	250,000	5	98.50	5.14	July 2, 1923	1925–1953	Bank of Charleston, Charleston
Whittier School Dist., Calif.	Schools	90,000	4¾	100.12	4.74	Aug. 1, 1923	1926–1942	First National Bank of Whittier
Geneva Village School Dist., Ohio.	School building	275,000	5½	102.91	5.18	July 1, 1923	1924–1946	Otis & Co., Toledo
Rensselaer, N. Y.	Highway improvement	100,000	4¼	100.34	4.22	Sept. 1, 1923	1924–1948	Geo. B. Gibbons, New York
Municipality								
Litchfield, Mass	Electric light and water	90,000	5¼	101.33	5.05	Aug. 1, 1923	1924–1938	Minneapolis Loan & Trust Co., & Minneapolis Trust Co., Minneapolis
Cuyahoga Falls, Ohio	Street improvement	206,993	6	102.14	5.46	Aug. 1, 1923	1924–1932	Richards, Parish & Lamson, Cleveland
Fairport, N. Y.	Water	325,000	4½	100.10	4.49	July 1, 1923	1928–1952	Barr Bros. & Co., New York
Hoboken, N. J.	School	721,000	5	100.04	4.99	Aug. 1, 1923	1925–1963	Geo. B. Gibbons & Co., New York
Leetonia, Ohio	Sewer and sewage disposal	350,000	5½	100.38	5.42	June 1, 1923	1924–1933	Lewis S. Rosenstiel Co., Cincinnati
Michigan City, Ind.	Water works	40,000	5	100.07	4.99	July 1, 1923	1924–1938	Thompson, Kent & Grace, Inc., Chicago
Salisbury, N. C.	School	100,000	5¼	100.45	5.22	July 1, 1923	1926–1953	Mississippi Valley Trust Co., St. Louis, and Detroit Trust Co., Detroit
Solvay, N. Y.	Public improvements	200,000	5	101.70	4.82	Aug. 1, 1923	1928–1952	H. L. Allen & Co., New York
Goshen, Ind.	Water, light and power	50,000	5	100.00	5.00	Aug. 9, 1923	1925–1934	Mier State Bank, Ligonier
Greenwood, Miss.	General improvements	168,000	5½	102.08	5.27	Sept. 1, 1923	1924–1943	Wm. R. Compton Co., New Orleans
Leonia School Dist., N. J.	Schools	200,000	4½	100.00	4.50	April 1, 1923	1925–1963	B. J. Van Ingen & Co., New York
New Castle, Pa.	General improvements	125,000	4½	102.23	4.30	Aug. 1, 1923	1938–1943	Harris, Forbes & Co., New York
Northborough, Mass.	Schools	56,600	4½	102.44	4.20	Aug. 1, 1923	1924–1942	Merrill, Oldham & Co., Boston
Ouachita Parish, La.	Courthouse and jail	400,000	5	100.51	4.96	Aug. 1, 1923	1924–1964	Hibernia Securities Co., New Orleans
Rapides Parish, La.	Road and refunding	2,000,000	5	100.00	5.00	Aug. 1, 1923	1924–1942	J. A. Bentley & L. E. French & Co., Alexandria
Redondo Beach, Calif.	Park and improvements	125,000	5	100.31	4.97	Jan. 1, 1923	1924–1963	M. H. Lewis & Co., Los Angeles
Danville, Va.	Water improvement	100,000	5	100.61	4.93	June 1, 1923	1924–1948	Robert Garrett & Sons, Baltimore
Kenosha, Wis.	Schools	200,000	4¾	100.40	4.71	Sept. 1, 1923	1929–1943	A. B. Leach & Co., Inc., New York & Syndicate
Evansville, Ind.	Water	270,000	5	102.83	4.68	Sept. 1, 1923	1930–1939	Federal Securities Co., Chicago
Hazleton, Pa.	Public improvement	165,000	4½	103.03	4.28	Sept. 1, 1923	1937–1952	American Bank & Trust Co., Hazleton
Raeford, N. C.	Street improvement	70,000	6	100.62	5.92	April 1, 1923	1925–1944	C. W. McNear & Co., Chicago
Tampa, Fla.	Water works	1,350,000	5	98.67	5.07	July 2, 1923	1924–1972	J. G. White & Co., Inc. & Syndicate, New York
Township								
Vermillion School Township, Ind.	School building	88,000	5	100.31	4.95	Aug. 1, 1923	1924–1937	City Trust Co., Indianapolis

into the country than men following any other single line of skilled work, the next closest total being that of 5,559 tailors.

Lumber Movement Declines

According to reports to the National Lumber Manufacturers Association received from 387 of the larger commercial lumber mills of the country, the national lumber movement declined considerably in the week ending Sept. 8, although substantially larger than for the corresponding week of 1922. The 131 reporting mills of the West Coast Lumbermen's Association and the 129 reporting mills of the Southern Pine Association, however, showed an increase in unfilled orders from 548,820,147 to 563,574,584 ft. For all the mills shipments were 81 and orders 82 per cent of production. For Southern Pine mills these percentages were 83 and 89 and for West Coast mills 87 and 96.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 159 to 171, are the following:

Apartment, Brooklyn, N. Y., Kraslow Building Co., Inc., $1,500,000.

Bank and office, Cleveland, O., Brotherhood of Locomotive Engineers, $5,000,000.

Transmission Line, Timmins, Ont., Hollinger Consolidated Gold Mines, $1,000,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 159 to 171, are the following:

Office, Dallas, Tex., to Watson Co., $5,000,000.

Office, Los Angeles, Calif., to Foundation Co., San Francisco, about $1,500,000.

Road, Florida, 7.121 mi., to C. F. Lytle, Jacksonville, $252,357.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Sept. 6; the next, on Oct. 4.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4 00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.00
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.25	—5.30	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.80	3.20	3.45	3.85	3.65	4.10	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	45%	+43%	47%	53–5%	36%	33.2@42.2%	35%	+47.42
Cast-iron pipe, 6 in. and over, ton	63.60	60.00	63.00	60.20	60.50	69.00	62.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.70@2.80	3.00	2.25	2.20	2.50	2.84	2.63	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	1.89	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.83	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	61.00	40.00	52.25	58.50	+46.75	44.25	38.00	29.00	70.00
Lime, finishing, hydrated, ton	18.20	22.50	—20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	—1.75	1.50	1.50	2.70	2.10	2.80	10.00
Common brick, delivered, 1,000	23.65	11.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	.115	.0724	.0816	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1263	.102	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.95	.98	—1.04	1.14	.99	1.09	—1.09	.86	1.22
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.50@.55	.35@.50	.50	.50@.62½	+.35@.40

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.56). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.42; 6-in., $119.

Changes Since Last Week

This week's market is characterized by a slightly firmer tendency in lumber. Minneapolis reports an advance of $2 per M. ft. in Douglas fir, while the other eight cities reporting weekly to *Engineering News-Record*, show decided firmness in lumber prices.

Black steel pipe also firmed slightly in Montreal and Dallas while lime quotations dropped somewhat in the latter city.

Raw linseed oil is quoted in Dallas at $1.04 per gal. (5 bbl. lots) as against $1.10, and at $1.09 in San Francisco, compared with $1.16 per gal., one week ago.

Common labor is being paid 35@40c. in Montreal as compared with the former rate of 30c. per hr.

The iron and steel situation, briefly, is as follows: Pig-iron market tending downward since settlement of coal strike. Furnaces piling iron, preparatory to going out of blast until demand improves. Structurals very firm at $2.50 base. Car material demand strong and plate shipments improved. Structural demand also increased, principally for schools, commercial and residential buildings and bridges. Bars stronger; buying active, particularly in cold-finished material. Bulk of present business in sheets and tin plates.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

Volume 91 — NEW YORK, SEPTEMBER 27, 1923 — Number 13

Local vs. National Society

THE decline of one-fourth in the membership of the New England Water Works Association in the past seven years, mentioned in the address of the retiring president last week, must be a matter of concern to the officers and others who have the welfare of the organization at heart. It is true that the 769 members as of Sept. 1 is a goodly number for an association which recruits its ranks chiefly from a small section of the country; but the members could once truly say that the "New England Water Works Association is local in name only." It is still largely true. That it is not so markedly true now as formerly is due in part to the strenuous efforts of recent years to make the American Water Works Association a large and thoroughly representative national organization, with sectional branches, both geographical and technical. Perhaps men who are members of both organizations have put so much of their time and strength into the American Association for the past few years that they have unwittingly robbed the New England Association. The situation deserves careful study by all the friends and supporters of both organizations, for neither is going to gain materially and permanently through the decline of the other.

A Construction Safety Code

DISCUSSION of the proposed safety code for construction work, which will be taken up by the Construction Section of the National Safety Council at the meeting next week in Buffalo, N. Y., should be active. Following factory practice, construction organizations have in a few years made remarkable progress in accident prevention. In the beginning the effort was largely individual and it is still confined too largely to a comparatively small number of progressive constructors. Group effort was made possible by the organization six years ago of a construction section of the National Safety Council and, although the work of the section has been handicapped by inadequate support by builders and general contractors, it has, with a few loyal members, done much good. This year's meeting should witness a change. Contractors should become members. The expense is small, the encouragement to a good object will be great, and the benefits derived through the service of the national council will repay all the efforts and money expended. It is particularly timely to join in the section work now that the American Engineering Standards Committee is formulating the comprehensive safety code just ready to be presented for discussion and revision. In this code the engineering contractor has for the first time a manual which will guide him and his superintendents and foremen in planning the safety measures best suited to the particular operations in which he is engaged. Indeed it is wisely the purpose of the code not to give the builder or the sewer contractor a "set of rules" to nail to his field-office door. Full accident prevention efficiency is had only when the superintendents and foremen are induced to do constructive thinking in devising safety measures. Knowing the sources of danger, which it is the duty of the employer to give him, the man who has working crews and specific operations to direct develops remarkable efficacy and constructive pride in devising safety methods.

Keep Cars Full Loaded and Moving

ALMOST every week the railroads are establishing new records for cars loaded, for the average load per car, and mileage per car per month. How much of this improvement in service is due to increased and improved facilities it is impossible to say but it is quite certain that a large part of it is due to efforts of the American Railway Association, spurred on by the expressed public dissatisfaction with the railway service of the past few years. The association's realization of the need of drastic improvements in the service culminated in the inauguration last spring of a movement to improve the car and locomotive performance throughout the summer months in order to have the railroads in the best possible condition for the rush of the fall and early winter. Responsibility for the success of their plan rested largely with the railroads but no small part of it also rested with the shippers and consignees in loading or unloading and releasing cars promptly. There is every indication that both parties have done their part well and that the country would have gone into the rush season with something approaching the required number of cars, but for the three weeks' cessation in anthracite mining. This will increase the peak of the demand for cars in the ensuing months and the railroads will be hard pressed to meet it. The situation is one which requires hearty co-operation with the railroads by everyone who has anything to do with the shipment or loading of freight. It can be met if cars are loaded to capacity, loaded promptly and released as soon as possible after reaching their destination.

Engineering Trail Making

ROAD building in Alaska is pioneer engineering in almost its bleakest aspects. As described by the head of the Alaska Road Commission in this issue, two-thirds of the nearly 7,000 miles of Alaskan roads are trails for dog-teams and pack-trains. The distinction between this trail making and the Wilderness Trail of Daniel Boone or a dozen other historic trails of the pioneer days of America is that the development and maintenance have been under engineering direction. The Indian and the buffalo had more to do with the location of the trail which Boone and his axmen cleared across the mountains than did the engineer. Its maintenance was the concern of no one and least of all did it have the attention of engineers. It is perhaps in the

respect of maintenance that Alaska's 1,500 miles of trails stand out most distinctly. In mentioning trail maintenance nothing of course of the character of road upkeep in the States, even the dirt road states, is in mind. It means little more than that defined trail is made a little more clearly defined and easily traveled each year and is being thus progressively developed into wagon road. With a not much greater yearly expenditure for its whole mileage than many Eastern states have put into a score of miles of paved road construction, the engineers of the Alaska commission are developing a real road system which each year puts a little less hindrance on travel and each year is a little more open to the use of modern vehicles. This is highway engineering of the highest quality from which engineers working under better conditions should not withhold praise.

Inspection From the Outside

IN ONE of our large cities the dealers in reinforcing steel have taken a novel method of improving the practice in reinforced-concrete construction, with the idea that every poorly built structure is a detriment to their business and every well built one an advertisement. They have put into the field a number of traveling inspectors who go from job to job and check up the steel used against the amount called for on the drawings. Some of the contractors have resented this as an unwarranted intrusion into their business but the steel people have been backed up by the owners and engineers and have proved to their own satisfaction that the scheme pays as a preventative against skimpy construction. The idea might well be adopted by the cement companies. It is too true that the rules for good concrete making are not observed by many who should realize their necessity. This includes engineers as well as contractors. An outside agent might well observe infractions which when reported and emphasized would be remedied, though in the routine of construction and inspection they would be passed over. Every poorly built concrete structure is money out of the pocket of the cement industry. That industry is spending great sums to spread the knowledge of how to make good concrete. It might well spend a little more in the wider application of the experiment of "butting in" on specific jobs with a view to specific improvement in practice.

Building Methods Primitive

THERE has been less development of the small labor-saving machine in engineering construction than is to the credit of either the constructor or the equipment manufacturer. Equipment for mass operations, as the steam shovel and concrete mixer, has been advanced far in mechanical perfection and in employment. So have special machines like the trench excavator and the paving mixer. It is in machines for individually small operations that development has lagged. Building construction, which is pronouncedly a series of non-continuous processes of great variety, furnishes a particularly good example. Except for the high development of pneumatic tools in steel erection, we find very few light-task, labor-saving machines used. Carpentry, plastering, painting are, most commonly, hand operations on large buildings and are always manually performed in residence and other small building work. Why should acres of plaster in a modern large office or commercial building be put on with hand trowels and other acres of painting be a pail-and-brush operation? Why should yards of concrete floor be laboriously smoothed with hand floats? It is not beyond inventive skill to device usable tools. Indeed we already, it would appear, have the elements of successful tools in the cement gun, the sand blast, the paint sprayer and the wooden floor finisher.

All the backwardness does not, however, lie with the equipment manufacturer. Neither the contractor nor the artisan has progressed much beyond primitive thought in conducting many building operations. It does not seem possible for them to project their imagination beyond the hod and trowel in plastering or the bristle brush as a means of applying paint. Perhaps this is provocative speech, but that is exactly what the building contractor and his workmen deserve. In speaking publicly recently of his industry one of the most prominent building contractors of the country said: "In the building industry alone, among leading industries, primitive methods still prevail." Again he said: "The high cost of building is traceable to the lack of progress in the building industry toward developing improved methods." Indeed a little more ingenuity exercised by builders in devising new machines and methods and a little less in inventing subterfuges for constructive thinking would greatly help present building conditions.

Specializing by Proclivities

DURING this season thousands of young men are entering our engineering schools, there to start or to renew a task which each expects will lead him to eminence in the engineering profession. Fortunately for them, perhaps, they are not much concerned with the efficacy of the courses which are laid out for them to pursue. They want to become engineers, and having selected from a narrow choice the particular kind of engineer they want to be, their job is merely to complete the provided program to the best of their ability. The profession—and the educators—know that the problem is not so simple; that engineering has diversifications not at all expressed in the diversifications of the college courses, and that not a few of the troubles of the engineering profession are due to the misfits who are in it. How best to fit the individual proclivities to the prospective job is one of the most engaging problems ahead in engineering education.

Two opposing methods of doing this should be noted. One is in practical operation in many universities; the other is only a proposal. The actuality is a growing tendency toward a basic course which comprises the fundamentals of engineering and through which all varieties of engineers must pass. Having concluded this, the individual by that time trained in thought and competent to judge his own proclivities and capabilities, may select the specialty which he is to follow either in post-graduate school or in the harder school of experience. The proposal is the one made at the Ithaca convention of the Society for the Promotion of Engineering Education by Professor Bennett, of the University of Wisconsin. This suggests a functional division of engineering courses to take the place of the present industrial divisions. Instead of training a boy to be a civil, an electrical, or a mechanical engineer,

direct his studies toward the functional divisions of engineering — research, design, supervision, management, sales. While all of these would have necessarily a certain few fundamentals in common, the type of instruction would vary with the type of activity to be followed.

Each of these methods recognizes the difference in individuals and endeavors to prevent the errors which result from fitting square pegs into round holes. The distinction is that the one basic course depends on a system of natural selection, while the functional courses depend upon some artificial method of predicting the individual's bent. As the science of psychology stands today, the former seems more reliable. At some future time the psychologist may be able to solve this problem for us. It may be possible by some system of test to determine what bent the individual boy should pursue—whether he will make a better salesman than a bridge designer, or a better manager than a testing engineer. That day is far off and when it comes, if ever, there will always be the right of free individual choice to counteract some of its benefit. Professor Bennett recognizes, we think, these difficulties, not only in the exact assignment of subjects to meet his requirements, but more especially in the determination of proclivities. But the growth and development of engineering make such a proposed system of instruction most attractive and worth studying. Certainly, if there is any way of ascertaining what the boy should do, either of the two schemes should turn out more definite minded engineers than the current scheme of accepting a boy for study in some industrial branch of engineering with the details of which or the requirements for which he is only vaguely acquainted.

A further opportunity for specialization of training exists in the lower ranks of engineering. There is a great deal of such engineering that does not require four years in a technical school. Many men who cannot afford that much time or the money it entails would be just as well fitted for the practice of this kind of engineering by shorter and more specialized courses. They would be satisfied to spend their lives in the practice of what to other men who have greater ambition or capabilities would be drudgery. The man and the job would be fitted together to the satisfaction of both, and the man who with elementary training rose above the elementary job would be just that much ahead. Much of the current discontent with engineers pay is justified but there are many so-called engineers who are doing work that does not call for higher engineering ability and who are not entitled to any greater reward than they receive. Either they should never have gone into engineering in the first place—many a good bricklayer is running a transit—or they should have gone into it with a limited training which would not have promised them more than their capabilities could fulfill.

There are those engineers who see in the few short term schools that exist a menace to the profession. Properly used they are far from that. If they do not promise to turn out a professional engineer, one competent by his training to rise to any engineering responsibility, they serve a very useful purpose and should be encouraged because they may help to do what should be the ultimate aim of all engineering schools—to provide instruction in accordance with and in proportion to the student's proclivities.

Moral Suasion to Cheapen Coal

THERE is no simple solution of the problem of producing coal at fair prices, for fair wages and at a fair profit. That is the conclusion of the final report of the now defunct Federal Coal Commission. After eleven months of strenuous endeavor and after spending over half a million dollars the best the commission can do in the way of remedy is to suggest certain procedure on the part of the government, the industry itself and the public which, it is hoped, will in time cure the complicated disease that hampers all industry and disturbs every citizen. The essence of the conclusion is that it will take time to effect a cure. In the process the government must relax its inhibition on industrial combination and must insist on the public recording of statistics of production and cost, the industry must reform its methods of doing business at least to the degree of making its worst members conform with the practices of the best, and the public must learn to use anthracite substitutes and as a local issue control the cost and mechanics of distribution.

That the report will be disappointing to the public at large cannot be denied. It has been hoped that somehow the commission would find a direct way of preventing the rising cost of fuel and the recurring controversies that spell shortage. It is evident from the voluminous chapters of the report already issued that the complications of the problem are so great that the six men making up the commission can come to no agreement either as to specific blame for the past or specific improvement in the future. Anyone reading those reports will appreciate the difficulties in reaching a decision but the fact remains that the public wanted a decision and will be disappointed that none has been made.

To use the vernacular, the report hasn't the punch. It preserves a fine impartiality of view which was most necessary for the ascertainment of fact but which is most trying when expressed in the excessive verbiage of the conclusions. A few stronger expressions of opinion—even though they had to be divided—would have gained for the report the publicity which now it probably will never receive, and in that respect it will fail in one of the principal things it purposes to do, that is to teach the public how it can prevent future disturbances in the coal industry.

On the other hand the report will probably have a salutary effect on the industry itself. Provided Congress agrees with the commission, the industry will hereafter keep open books and will be taxed out of its excess profits, it will have available a mass of information regarding itself of unprecedented volume and accuracy and, best of all perhaps, it will be forced by fear of future government action to clean house, knowing full well that the dirtiness of that house is now a matter of public information. These are, to be sure, merely moral impositions, so that we will be able in the next few years to see to what extent moral suasion can control a private business which, as the commission points out, economically affects the public interest though the legality of such an assumption may well be questioned.

The net result of the work of the commission will be that for some years the coal industry will continue to have the public at its mercy. That, we repeat, is a disappointing end to a promising beginning, however much that end was inevitable.

Constructing Mitchell Dam on the Coosa River

Electric Traction on Narrow-Gage Tracks—Eight-Inch Stones Run Through Concrete Mixers—Unusual Supports for Deck Forms—Complicated Forms for Hydraucones

By L. V. Branch
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MITCHELL DAM is the second large development of the Alabama Power Co. on the Coosa River, in Alabama. The first development, the Lock 12 plant, placed in service in 1914, operates under a normal head of 70 ft. and has an installed plant capacity of 110,000 h.p. The new plant, here described, is located 13 miles lower down the Coosa River and also develops a 70-ft. head, backing the river up to the elevation of the tailwater of the Lock 12 plant. Other proposed developments will ultimately make use, for power purposes, of practically the total fall and regulated flow of the Coosa River and, by construction of locks at the various dams, will connect the upper navigable section of the Coosa River with the Alabama River, which is now navigable from Montgomery to Mobile Bay.

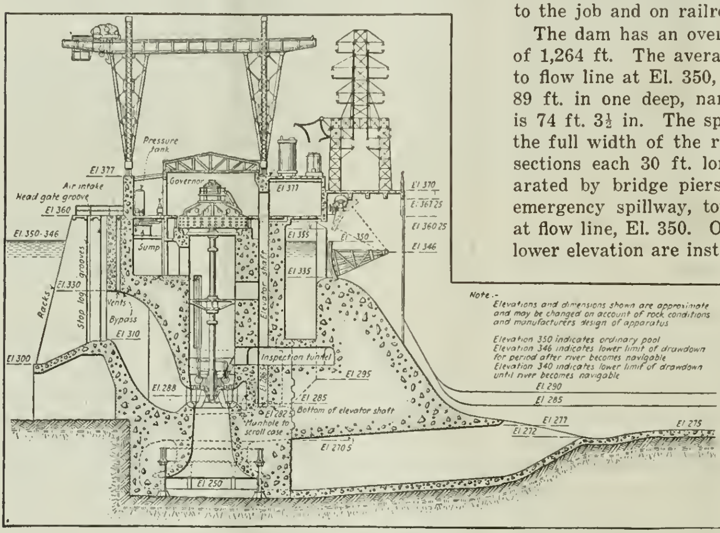


FIG. 1—SECTION THROUGH DAM AND ONE UNIT OF TOWER PLANT

In this development each unit of the power plant is located in a separate concrete tower placed upstream from the dam. This design, shown in Fig. 1, results in very short penstocks but comparatively long draft tubes. These draft tubes, passing under the dam, discharge at the downstream toe. Surplus water, during flood periods, passing over the dam removes the high tailwater from over the draft tube discharge openings, thus increasing the effective head on the plant. This "backwater suppressor" was described by J. A. Sirnit, designing and electrical engineer for the Alabama Power Co., in an article in *Engineering News-Record,* June 8, 1922, p. 966.

The plant is designed for four units of the suppressor type and for one unit of the conventional type to be located at the west end of the dam, a total ultimate installation of 120,000 h.p. At present foundations have been constructed for four units. Three of 24,000 h.p. each, a total of 72,000 h.p., have been installed. The turbines are single-runner, vertical-shaft, concrete casing turbines designed for normal operation at 100 r.p.m. under 70-ft. head, controlled by oil-pressure type governors. The vertical shafts, in 3 sections and 25 in. in diameter, have an overall length of 83 ft. The generators are of 100-r.p.m., 6,600-volt, 3-phase, 60-cycle type and have a maximum rating of 20,000 kva.

The application for a license for this plant under the Water Power Act was filed with the Federal Power Commission on Nov. 3, 1920; the license was granted June 27, 1921, and work was started immediately thereafter on the construction camp, power transmission line to the job and on railroad connection.

The dam has an overall length, including abutments, of 1,264 ft. The average height of the dam, river bed to flow line at El. 350, is 73 ft., and maximum height 89 ft. in one deep, narrow channel. The base width is 74 ft. 3½ in. The spillway, of ogee section, occupies the full width of the river channel and consists of 26 sections each 30 ft. long, with crest at El. 335, separated by bridge piers 6 ft. wide, and 5 sections of emergency spillway, totaling 150 ft. long, with crest at flow line, El. 350. On the 780 ft. of spillway at the lower elevation are installed 26 tainter type gates 15 ft. high and 30 ft. long. These gates are operated through clutches by individual motors for each pair of gates. The gate operating motors are installed in recesses in alternate bridge piers. These 6-ft. bridge piers are 34 ft. in height, the deck of the bridge being at El. 370, or 20 ft. above flow line.

The maximum flood recorded for this stretch of the Coosa River is 175,000 sec.-ft. This flood can be passed at Mitchell Dam by operation of the spillway gates, without raising the pond level. The dam is designed for maximum high water 4 ft. higher, that is, with 19 ft. of water over the main spillway and 4 ft. over the 150 ft. of emergency spillway. At this stage 300,000 sec.-ft. will pass the dam; a flow of 30½ sec.-ft. per square mile for the 9,827 sq.mi. of catchment area.

The dam contains no sluices. Fig. 1 shows normal section of spillway and section through power house.

Railroad Connections—The site of the dam is about 35 miles due north of Montgomery and within 7 miles of the main line of the Louisville and Nashville R.R running between Montgomery and Birmingham. Railroad connections with the L. & N. R.R. were made at Coopers station where yards with suitable switching tracks and storage tracks for 40 cars were constructed. Track scales were installed at this terminal and two warehouses, with a combined capacity of 7,000 bbl. of cement, were erected.

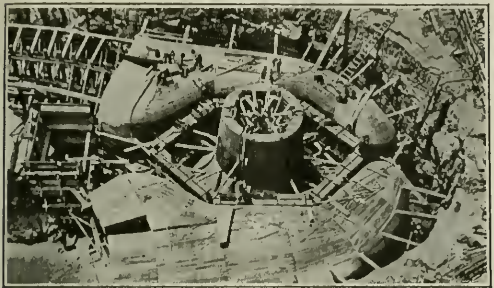


FIG. 2—ASSEMBLING FORMS FOR DRAFT TUBE OF UNIT

The railroad to the dam had a main line length of 8 miles, with an additional mile of spur tracks at the dam. These standard-gage tracks at the dam extended past the warehouses and cement and sand storages to a point under the cableways at the west end of the dam at high level, and the line was later extended out on the bridge over the dam, and to the quarry. It did not reach the river level at the dam site, for all construction tracks on the low level were narrow gage.

Camp—On account of the distance from the job to the nearest towns, it was necessary to provide camp accommodations for practically the full force required by the work. During the period when the maximum force was required, the camp had a population of 2,000.

The power company owned about a square mile of land at the west abutment of the dam. This area was a series of sharp ridges, separated by draws leading to the river. These ridges and valleys provided sightly, well drained locations for the segregation of the various sections of the camp, although the rough topography and spreading out of the camp greatly increased the cost of road construction, water supply and maintenance of camp.

The ridge nearest the dam was occupied by the main white camp and service buildings. A higher ridge above this camp was occupied by twenty-four comfortable cottages for white families and a well equipped hospital with normal bed capacity for fifteen patients. The hospital often cared for twenty patients at a time.

The negro camp, covering an area of 32 acres, was separated from the other camps and surrounded by a 10-ft. wire fence to prevent trespassers entering the camp. The gates in this fence were never all locked nor guarded, but they concentrated entrance to the camp at points under easy observation. To care for gangs of new negro laborers shipped in to the job, there were provided a mess hall, bath house and six 24-men bunk houses. For negro families, 20 two-family houses and one hundred and eighty 10 x 14-ft. shacks were erected. All these shacks were equipped with double bed, with spring and mattress, and cast-iron laundry heater. There was always a waiting list of men who wanted a shack for a family, or a group of men who wanted a similar shack as a bunk house. These small shacks proved one of the best investments in the camp facilities. A filtered water hydrant was provided for each group of eight or twelve of these houses. The negro camp was also provided with a billiard hall and a dance hall, for in order to hold large forces of negro labor it is necessary to provide amusement and quarters for the families.

The company sold building materials at cost to white employees who wished to erect small frame houses or tent houses for individual use, provided connection for electric lights and water and handled the sanitary work for the camp without charge. That portion of the camp which will be used by permanent operators of the plant was provided with sanitary sewers. In the balance of the camp the dry closet can system was used, the cans being changed daily or on alternate days, as necessary. Excellent results were secured.

The camp water supply was pumped from the river to a settling tank where alum and soda ash were added when necessary, filtered through gravity sand filters, chlorinated and then pumped to storage tanks. Water samples were taken at frequent intervals and sent to a commercial laboratory for analysis. This water supply plant gave excellent results.

Plant layout—Preliminary studies of plant requirements were based on placing 200,000 cu.yd. of concrete in fifteen months. While this made an average rate slightly in excess of 500 cu.yd. per working day, the progress schedule provided for placing double this

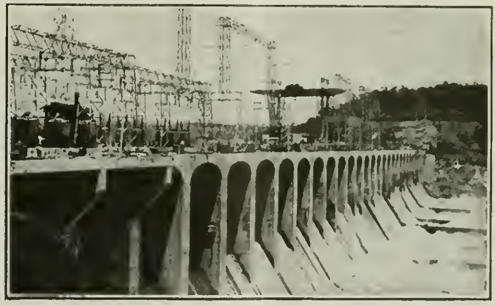


FIG. 3—GENERAL VIEW OF DAM AND BRIDGE

quantity for considerable periods, or a maximum of 30,000 cu.yd. in one month. The rock crushing, mixing and placing plants were designed for a maximum rated capacity of 100 cu.yd. of concrete per hour. The actual maximum rates of placing concrete were 1,743 cu.yd. for a two-shift day, 9,050 cu.yd. for a seven-day week and 35,476 cu.yd. during the month of November, 1922.

For concrete placing, the equipment selected was stiff-leg derricks with 60-ft. booms and two 10-ton traveling cableways. A combination railroad and derrick trestle was erected at the downstream toe of the dam. Three wooden stiff-leg derricks, with 60-ft. booms were mounted as travelers on this trestle. These very satisfactorily covered the main body of the dam. One similar derrick mounted on an extra high traveler proved efficient in reaching the top section of the dam and the bridge piers. Stationary stiff-leg derricks of the same size were erected upstream of each power house unit for work on these units.

Two 10-ton capacity traveling Lidgerwood cableways of 1,530-ft. span were provided for handling concrete forms and feeding those portions of the job not covered by the derricks. The cableways handled practically all of the work on the bridge piers and decks as well as a large portion of the upper part of the power house. The cableways were used on handling rock excavation and concrete in the body of the dam whenever they were not absolutely required on special

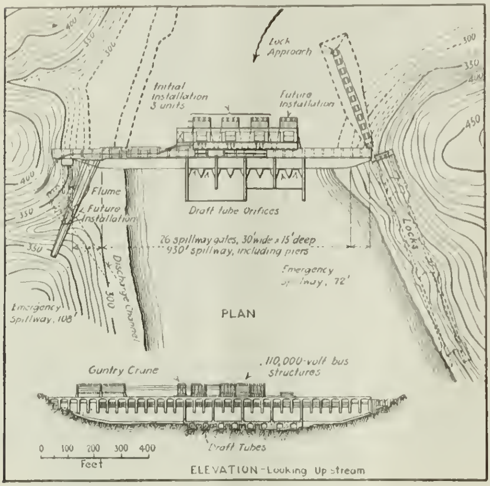


FIG. 4—PLAN AND ELEVATION OF DAM
Showing location of future canal locks.

work. When on straight concrete work a cableway carried an average of twelve 2-cu.yd. batches per hour, whereas the derricks had a considerably greater capacity. One derrick placed 220 2-cu.yd. batches of concrete in eleven hours, in addition to 32 cu.yd. of derrick plum stone. This gives the derrick an average of 43 cu.yd. per hour, as compared with 24 cu.yd. per hour for a cableway.

Yard and Plant Railroad—All tracks on the low level (river bottom) were narrow gage, 36-in.; the ½-mi. track from quarry to crushing plant and main warehouse was of both narrow and standard gage. The decision to use 36-in. gage tracks on the job was based on the use of electric locomotives with a third rail system, cheaper construction costs and lighter units for handling concrete, which greatly reduced the cost of the trestle on the lower face of the dam.

The principal motive power on the 36-in.-gage line was six 8-ton Baldwin-Westinghouse type locomotives, equipped with a steel shoe for sliding connection with a third rail placed 21 in. outside of the running rails. In addition to the contact shoe, each locomotive was equipped with a reel on which was wound about 200 ft. of conductor cable so that the locomotive could operate some distance beyond the end of the power rail. Workmen were protected from the third rail by a guard side board and cover boards.

In general, the electric traction was highly satisfactory on permanently installed tracks, but was a nuisance on tracks subject to frequent moving or where for various reasons the third rail could not be installed on either side of the track, thus making the locomotive dependent on the cable for power connection.

Cofferdam and Steam Control—The unwatering of the dam and power house foundations was handled in three sections. Cofferdam 1 enclosed the foundations for the west half of the dam, including units 1 and 2 of the power plant. This cofferdam, at the outer upstream corner, extended to the edge of a deep channel of the river, which crossed the dam foundation at an angle of 64 deg. with the axis of the dam. This section of the cofferdam enclosed an area of approximately 5 acres, having a length of 600 ft. and a width, up and downstream, of 400 ft. The average height of the cofferdam was 18 ft. The upstream and downstream arms of the cofferdam consisted of timber cribs rock-filled, sheeted on the outer side, and provided with toe fill of earth and clay. The outer arm, exposed to the swift current of the river, consisted of a double line of rock-filled timber cribs with a clay chamber between the two lines of cribs.

Cofferdam 2 was constructed during the flood season in the spring of 1922, to enclose the east end of the dam foundations; it extended from the east bank 136 ft. to the east edge of the deep channel above mentioned. A clear opening 200 ft. wide, including the deep channel of the river, was left between Cofferdams 1 and 2. This channel was computed to have a capacity of 65,000 sec.-ft. before flooding Cofferdam 2.

The closure cofferdam or Cofferdam 3, crossing the deepest channel of the river and enclosing the foundations for units 3 and 4 of the power plant, was started as soon as the spring floods of 1922 had passed. As the construction of the third cofferdam proceeded, the first two cofferdams were removed and the river was gradually diverted through eight culvert openings left in the west end of the dam and over a 102-ft. spillway gap left in the east end of the dam. These water passages had a capacity of 35,000 sec.-ft. before the third cofferdam was overtopped.

A section of the upstream arm of this closure cofferdam had a maximum height of 42 ft. and as it was all constructed in swift water it presented quite a construction problem. The 36-ft. square cribs of 12 x 12-in. timbers were started on top of the completed cofferdam, then lowered to water surface by crane, and held in position by cables. They were sunk by building up the timber cribs, and were filled with rock after landing on the river bottom. On account of the great depth and swift water, steel sheet piling was used for sheeting this cofferdam instead of the planking and earth used on the other cofferdams.

The pumping equipment used for the cofferdam work consisted of belt-driven and direct-connected motor-driven centrifugal pumps.

As the eight culverts through the westerly end of the dam were lower than the spillway gap left in the east end of the dam, these culverts carried the full flow of the river during low stages of the river. The spillway gap was therefore filled first without any difficulty. The culvert entrances, divided by a central pier into two parts, were provided with a heavy timber gate for each opening, hinged at the top of the opening and held open by cables. The closure of the culverts was made when only four to five feet of water flowed through them by cutting or loosening the clamps on the cables and permitting the gates to drop into place. The culverts were concreted, after the leakage through the gates was reduced to a point where it could be carried in a few small pipes. These drain pipes were grouted later.

Quarry Operations—The coarse aggregate for the concrete was secured by local quarrying and crushing operations. The quarry was located on the right bank of the river one-half mile below the dam. The rock was a hornblende schist found in an almost vertical cliff 130 to 150 ft. high. The quarry was too short (only 280 ft.) for satisfactory operation, but could not be lengthened on account of property ownership at one end

and very heavy stripping at the other. The quarry rock was generally hard and tough, making excellent aggregate, but due to the presence of a few soft seams and some weathered rock at the surface it required washing much of the time.

Primary drilling was accomplished with two No. 4 Loomis Clipper and two No. 3½ Keystone well drills. These drills were operated by 11-hp. and 12-hp. electric motors respectively. Records on over 3,000 ft. of drilling show an average of 9.33 ft. per drill per shift of 10 hours; drilling bits were 5⅝ in. in diam. The following record of blasting may be of interest:

Pounds of explosive used	69,000
18 per cent was 75 per cent gelatin dynamite for the bottoms of holes.	
61 per cent was 60 per cent and 21 per cent was 40 per cent ammonia dynamite for the balance.	
Cu.yd. of rock, solid measure, per foot of hole shot	11.9
Cu.yd of rock, solid measure, per lb. of dynamite	1.74
Pounds of powder per cu.yd. of rock	0.575

Blasted rock for the crushers was loaded by steam shovel, equipped with a 2½-cu.yd. dipper, in 5-cu.yd. dump cars, 36-in.-gage, operated in trains of 4 to 5 cars by 8-ton electric locomotives. Derrick plum rock was loaded by a 15-ton locomotive crane; this crane also helped on moving the quarry tracks.

Crushing Plant—The primary breaker was a 48 x 60-in. jaw crusher, set for a 7-in. opening, driven by a 150-hp. motor. This type of crusher was selected on account of the larger size of rock that could be fed the crusher as compared with a gyratory crusher of equal capacity or cost. The rock was conveyed from the jaw crusher by a 42-in. belt conveyor to a 72-in. x 16-ft. screen over the secondary crushers. The object of this screen was to separate the fines for the sand rolls, 3-in. to 6-in. size and oversize for the secondary crushers, and 6-in. to 8½-in. size to use as mixer plum rock. The secondary crushers were two 12-in. gyratories, one of the gyratories later being exchanged for a 16-in. crusher.

Mixing Plant and Concrete Materials—Two 2-cu.yd. mixers mixed all the concrete for the job. Erected over the mixer measuring hoppers were bins for cement, sand and two sizes of crushed rock; these bins had sufficient capacity to furnish materials for 350 cu.yd. of concrete. All materials were delivered to the mixer bins by belt conveyors.

Cement storage was provided for 3,100 bbl. in bins and 16,800 bbl. in warehouses. An attempt was made to get the major portion of the cement shipped loose and get sacked cement only for the reserve storage in warehouses. All bulk cement shipments were received in good condition. Although a scraper unloader for the bulk cement was provided, the labor crew unloading cement preferred to use shovels to pass the cement to the car door chute leading to the storage bins. Unloading the bulk cement was no more costly, nor more difficult to keep a full crew employed, than with the sacked cement. While there was an initial saving of 5 cents a barrel in the first cost of the bulk cement, the greater saving was in handling and loss of sacks. Only 41,000 bbl. of bulk cement were received, as the cement company had difficulty in loading the bulk cement at the same time it was loading sacked cement.

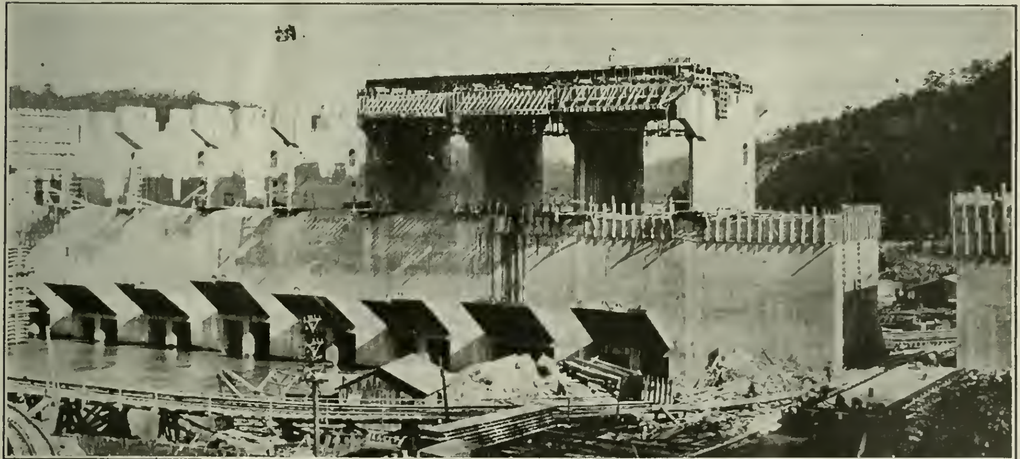


FIG. 5—CLOSURE GATES FOR STREAM CONTROL, AND BRIDGE PIERS
Showing method of supporting forms for bridge deck.

Passing the cement from the bulk bin to the 16-in belt conveyor caused some difficulty due to the tendency of the cement to flow in waves. After considerable experimentation, it was found that a 6-in. pipe inserted in the bin bottom and discharging close to the belt gave best results. The pipe was closed by a radial gate over the lower end of the pipe. Where loose cement is used in large quantities, it is believed that a weighing machine should be used instead of a measuring hopper, as was done here. On account of the dust, it is difficult to control manually the filling of a box to the same elevation for each batch.

Slag cement was used in the amount of 29,200 bbl. This was used only in the mass concrete to the extent of 0.208 bbl. per cubic yard of the mass concrete. The slag cement was very slow in setting so was not used at all in the reinforced concrete. Long-time tests of mixtures of the slag and standard portland cement showed strengths equal to or greater than those of the straight portland cement tested at same time. The slag cement

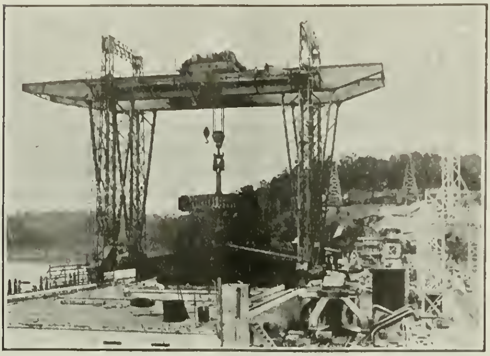


FIG. 6—GANTRY CRANE AND 125-TON ROTOR

was very finely ground, so it made an easy flowing, workable concrete. On a volume or barrel basis, it was considerably cheaper than portland cement, but, due to low specific gravity, on a weight basis it was very little cheaper than the portland cement.

Sand was purchased from commercial sand pits and received on the job in hopper-bottom cars. It was dumped into the storage bin, from which it was transported to the mixer sand bin by a 16-in. belt conveyor. This washed bank sand was deficient in the fine sizes, so it was not found objectionable to use the fines from the quarry and crushers as sand.

Derrick plum rock, up to 4 cu.yd. in size, were selected from the draft tube excavations and from the quarry for dropping in the concrete. Only 8,971 cu.yd. of rock were placed in this way. The principal difficulty was to secure the rock from the quarry which was worked primarily for crusher rock. An additional amount of over 8,000 cu.yd. of small plum stones up to 8½ in. in size, was passed through the mixers with the concrete. The amount of reinforcing steel used in the construction of the plant was 1,205 tons. Of the total concrete, 39 per cent was classed as cut-up and required more or less reinforcing steel.

Concrete Forms—The construction of the concrete forms, next to the stream control, was probably the most complicated and difficult problem to be solved.

For the straight sections of the dam, panel forms were used. These panels, designed to be moved by derricks or cableways, were 5 ft. high by 17 ft. 10 in. long. The vertical posts were 6 in. x 8 in. x 8 ft. 6 in., spaced 36 in. apart and lagged with sized 2-in. lumber for 5 ft. height. The post projecting above the form for a distance of 3 ft. 4½ in. supported the next tier of forms. Two ⅝-in. anchor bolts were used in each post for each 5-ft. lift.

The expansion joints in the dam were spaced 72 ft. apart, except opposite the power house units where the joints were 108 ft. apart. These lengths between expansion joints correspond to two and three spans of the bridge, respectively, for the bridge piers on top of the dam are 36 ft. center to center and all expansion joints come at one side of a bridge pier.

The bridge pier forms were built in large panels 36 ft. long and with three lifts of form for the 34-ft. height of the pier. As the piers were only 6 ft. thick, through bolts were used to hold these forms.

An unusual design of form support was used for the 32 spans of the bridge deck. Four spans of this deck at the west end of dam were 56 ft. wide in order to make room for the two circuit feeder sections of the substation structure. The next ten spans were 44 ft. wide and supported the bus tie and lightning arrester sections of the substation as well as the railroad track to the plant. The balance of the bridge deck was 32 ft. wide. The bridge deck is of flat-slab girder type reinforced concrete. Most of this deck was constructed after the pond had been filled and water was passing over the crest of the dam. The forms were supported from 30-in. and 36-in. heavy plate girders resting on blocking on top of the bridge piers. Four steel girders were required for the narrower sections of the deck and seven for the wide sections. Timbers 8 in. x 8 in. were suspended by 1¼-in. rods and U-bolts under these girders and the bridge floor forms were built up on these suspended timbers.

The forms for the power house units were very complicated as the turbines had concrete casings and the first two draft tubes included hydraucone regainers.

FIG. 7—HYDRAUCONE REGAINER IN DRAFT TUBE

Fig. 2 shows a view of the hydraucone and draft tube forms for unit 2. This form of draft tube required more complicated formwork and more rock excavation than were required for the draft tubes constructed for units 3 and 4 where the hydraucone bell was omitted. All these forms for waterway openings were built in the shop in segments and were fitted together in place in lifts much like a set of blocks.

The heavily reinforced beams over the waterway openings required continuous concrete pours of considerable height. The height from the top of the draft tube floor to the generator foundation was 105 ft. This height was divided into four construction stages. The continuous pour from draft tube floor to bottom of turbine casing was 33 ft. high and required 4,200 cu.yd. of concrete. The next stage had a height of 41.5 ft. in which 3,850 cu.yd. of concrete were placed in one continuous pour of 4½ days' duration.

Permanent Plant Erection—Very little could be done on the plant erection until the bridge over the dam had been completed from the west bank out to the power house section. Then the permanent gantry crane was the first equipment needed but its erection rendered one of the cableways practically useless on account of the interference.

This double gantry cantilever crane is designed to handle the heavy parts of the turbines and generators. It covers a side track of the railroad on deck of dam, an erecting space between the machine shop and unit 1

FIG. 8—LOCATION OF CONSTRUCTION TRACKS AND CONCRETE MIXING PLANT

of the power plant and the four power plant units. The main hook has a capacity of 125 tons between crane legs and a capacity of 70 tons, on both cantilevers, at a distance 13 ft. outside of legs. The auxiliary hoist has a capacity of 20 tons. The upstream cantilever of the gantry covers the trash racks, stop logs and penstock gates while the downstream cantilever covers the 7,500-kva. transformers located outdoors on the roof of the operating room.

The erection of the gantry crane was completed on the last day of January of this year and it was immediately placed in service on the erection of the first unit of the power plant. The first unit was put in service, on the line, on April 7, followed by the second 24,000-hp. unit on May 25. The third unit was placed in service during August.

The elapsed time from the beginning of the work to the placing of the first concrete was 187 days; to the final closure of the dam and filling of pond, 545 days; and to the completion of the installation of the first power plant unit, 621 days. The entire project will be completed and in operation within 25 months from the date that the license was granted to the Alabama Power Co. by the Federal Power Commission

The turbines were built by the Allis-Chalmers Co., and the generators by the General Electric Co. The construction work was done by the Dixie Construction Co., a subsidiary of the Alabama Power Co.

O. G. Thurlow, chief engineer of the Alabama Power Co., was in charge of the work, and was also the originator of the backwater suppressor used.

Modern Engineering to Save Mediaeval Tower

Reinforced concrete is to be used to prevent the collapse of the great tower of the Strasbourg Cathedral designed by Jean Hultz in 1439. The original footings of the tower are of stone masonry on wooden piles. At the time of construction these piles were entirely sub merged. About 1750 a new drainage system so lowered the level of the ground water that the tops of the piles were no longer submerged and they have subsequently decayed and permitted the tower to settle. Moreover the tower as finally completed was considerably higher and heavier than the one planned by Hultz at the time the footings were laid. In order to reinforce this old foundation and to replace the decayed piles, the columns of the tower have been encased in concrete to provide a hold for jacks and the whole tower has been jacked back into proper place and the old footings are being replaced by larger footings of reinforced concrete.

Status of Interstate Water Compacts

TREATY making between western states over irrigation water rights has been progressing rapidly since the Colorado River Compact was negotiated at Santa Fe, N. M., last November. Of the seven states involved in the Colorado case all but Arizona have ratified the action by legislative act. Compacts have been consummated or are under advisement in six other cases as follows:

The La Plata River compact between Colorado and New Mexico was negotiated at Santa Fe immediately following the Colorado River compact. Both states have ratified the treaty by legislative enactment. Congressional ratification is the final step. No enforcement of this compact will be attempted until Congress takes action. The La Plata River is a small tributary of the San Juan rising in the La Plata Mountains just southwest of Durango, Colo. The amount of water involved is small, about 60,000 acre-feet annually, but it is a concrete example of an interstate stream requiring legislative action by two states in order that future development may be placed on a sound basis. The commissioner for New Mexico was Stephen B. Davis, Jr., an attorney of Las Vegas, N. M.; Delph E. Carpenter represented Colorado.

Early in March an interstate water treaty was made between the states of Nebraska and Colorado on the South Platte River. R. H. Willis, engineer of Bridgeport, Neb., represented Nebraska and Delph E. Carpenter, Colorado. Nebraska has already ratified, but the Colorado legislature had adjourned at the time the compact was entered into and legislative enactment may be deferred until the regular session of the 1924-25 legislature.

Negotiations have been under way for over two years concerning an interstate settlement of the water of the Arkansas River. Litigation is in active progress on the Arkansas River concerning its interstate problem at this time. It has been pursued off and on for a period of over twenty years. George S. Knapp, Kansas state irrigation commissioner, and Delph E. Carpenter, for Colorado, constituted a commission instituted by the legislatures of both states to negotiate a compact.

Negotiations are now under way for an adjustment of the interstate water problems of the Rio Grande between New Mexico, Colorado and the federal government. Attorney J. O. Seth, of Santa Fe, is the New Mexico commissioner, and Delph E. Carpenter the Colorado commissioner. No commissioner has, as yet, been appointed for the United States. R. I. Meeker is associated as engineer for Colorado, with the attorney, on both the Arkansas and Rio Grande interstate water problems. He also served as engineer for Colorado on the Colorado and La Plata Rivers compacts.

An interstate water problem is imminent on the North Platte River among Nebraska, Wyoming, Colorado and the federal government. Wyoming, by legislative enactment in June, 1923, provided for negotiations, but so far a commissioner has not been appointed. Neither of the other states has passed legislation concerning this stream.

The states of New Mexico and Texas have provided by legislative enactment for a compact on the Pecos River between New Mexico and Texas. The federal government is also a party to the negotiations on account of the reclamation project in that stream basin.

Highway Development by the Alaska Road Commission

Wagon, Sled and Tram Roads—Trails, Ferries, Cableways—Truss and Suspension Bridges—Light Roads and Good Trails Needed—No Hard Surfacing—Day Labor—Organization and Transportation

BY JAMES GORDON STEESE
Major, U. S. A. (retired); President, Alaska Road Commission, Juneau, Alaska

SINCE ITS organization in 1905, the Alaska Road Commission has expended about $8,000,000 for the construction, repair and maintenance of roads, tramways, ferries, bridges and trails. The work thus far accomplished includes the construction of 1,114 miles of wagon road, 623 miles of sled road, 4,404 miles of permanent trail and 712 miles of temporary flagged trail, a total of 6,854 miles. For the current working season, about $900,000 is available, including both federal and territorial funds.

The improvements contemplated for 1923 include a great variety of forms of pioneer construction, ranging from a cableway and cage over a glacial torrent, or a line of stakes set across the treeless tundra or a frozen arm of the sea, to a well located, graded and graveled road, or a steel bridge of five 150-ft. spans on piers consisting of twin cylinders of interlocking steel sheetpiles filled with concrete. A typical road and winter trail are shown in Fig. 1, the tripod on the latter being a marker to indicate the route. A road map is shown in Fig. 2.

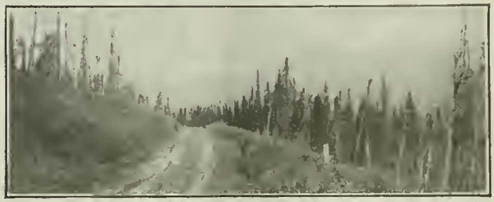


FIG. 1—TYPICAL ALASKA HIGHWAYS

Above: view on Ophir-Tokotna Road. Below: winter trail; the tripod is a marker set up by the road commission to indicate the route.

Types of Construction—Under the classification of the commission, "wagon roads" are any roads cleared, grubbed, ditched, graded and drained sufficiently to accommodate wagon traffic. Light motor vehicles (up to 2-ton trucks) are now using these roads in increasing numbers and about 800 miles have been given a gravel surface 14 ft. wide at an increased first cost, but with an eventual saving in annual maintenance charges. "Sled roads" are cleared and graded like wagon roads, but not grubbed. They are drained only sufficiently to prevent their destruction by the summer rains. Their wearing surface is of snow. Double bob-sleds, drawn by two, four or more horses, haul heavy loads over these roads as well as over the wagon roads in winter time. Caterpillar tractors were successfully used during the past three winters and such traffic is expected to increase. Tractor freighting service is shown in Fig. 3.

"Trails" include any construction less than the above, suitable for dog sled or single-horse double-ender in winter or pack train in summer. Except when river surfaces are used (a practice which is very dangerous on account of numerous hot springs and overflows even in the dead of winter), some work is always necessary on account of the thick brush covering even the treeless regions, to permit the use of dog teams. "Flagged trails" represent cutoffs across frozen lakes, swamps and arms of the sea. The flags or tripods (see Fig. 1) are necessary on account of the absence of landmarks or to prevent travelers from getting lost in bad weather. Most of them must be replaced annually.

The commission maintains and operates about a dozen ferries, an 87-mile tram road with cars drawn by dogs, and several shorter trams. It has designed and erected twenty standard overhead cable trolleys varying in span up to 650 ft. Standard designs have been developed for all types of bridges. Structures built include many light cable suspension bridges designed for pack train and snow loads only, a steel highway span of 300 ft. for 20-ton trucks and combination spans up to 150 ft.

Hard-surfaced roads are not built, since neither the funds available nor the prospective traffic warrant such expensive construction. In the vicinity of the principal towns and mining districts, where the heaviest traffic exists, a heavier and wider surfacing is provided, about equivalent to a good macadam road in the eastern States. The great demand is for more and more mileage of light construction and the improvement of trails to road standard. The commission's program calls for an expenditure of $10,000,000 as rapidly as the funds can be secured.

All important bridges are designed in and purchased by the head office. Wood and steel combination bridges are most common. Fir timber from the States is secured wherever practicable. Native timber is very inferior and unsuitable for bridge work, but must be used in many localities on account of excessive transportation charges. Hundreds of culverts of native wood are built every year, but more corrugated iron culverts are being imported and eventually few native timber boxes will be permitted. Standard plans are furnished superintendents and foremen in outlying districts and they then rustle their materials as best they can. Typical bridges are shown in Fig. 4, while Fig. 5 shows the driving of steel sheetpiling to form cylinder piers which are filled with concrete.

Construction Methods and Outfits—Since Alaska is a mountainous country much heavy rock work is encountered. The commission owns several portable compressor outfits, each capable of operating several air tools. The Keystone Canyon relocation of the Richardson Highway involved three miles of benching on the vertical rock walls of the canyon some 300 ft. above

FIG. 2—PRINCIPAL ROADS AND TRAILS OF ALASKA

the bed of the river, with two highway suspension bridges of 150- and 175-ft. span across side canyons.

Clearing and grubbing is let by contract wherever practicable. Dense timber is found over a large part of the Territory. Grading is done with grading machines drawn by 5-ton crawler tractors. For the graveling, steam shovels load dump trucks or 3-yd. dump trailers drawn by 5-ton crawler tractors. In most cases, the crews are working far from a base of supplies, and must be housed and fed. The commission owns a number of horses and has warehouses, caches, garages and barns located at suitable points. Its road equipment has a value of about $500,000.

Due to the remoteness and inaccessibility of most of its projects, the commission performs most of its work by day labor. The pioneer nature of much of this work also precludes the preparation of specifications in advance at any relatively reasonable cost for surveying, engineering and supervision.

The work varies from primitive pioneer cruising and blazing of pack trails to surveying and locating well graded gravel roads and involves the constant improvement of old roads or trails. The condition of the roads continues to improve by thawing and drying out from year to year. For this reason, the carrying on of construction through protracted periods has not always been a disadvantage. The cruising, location and clearing of the right-of-way and the gradual grading results in a road structure at less total cost than would have been possible had the construction been completed the first season. In fact, the construction of a road in one season is impossible in the large areas of marshy and permanently frozen ground which always require two or three seasons of exposure to the sun's rays to become dried out and compacted. A great deal of pioneer reconnaissance work is performed each year in developing new districts.

Perhaps the worst obstacles to road construction are the numerous glacial streams which cannot be avoided and cannot be permanently controlled at any reasonable cost. Their vagaries are inconceivable. Just out of Valdez, the Richardson Highway crosses the delta of Valdez Glacier for 3½ miles, in which distance there are twenty-six trestles or short-span bridges aggregating nearly 2,000 ft. in length. During different seasons of different years water flows under any, all or none of these bridges, and nearly every year new openings are broken out between bridges. A pile driver is maintained constantly on the job.

On smaller streams, bridge abutments may be placed on permanent banks upon which heavy trees are growing, only to disappear a year or two later. Long truss spans have been left high and dry, the river moving half a mile or more to a new location, and a year or two later it may move back. In some cases wing dams, dikes and revetments have been successful for a few years, but sooner or later they all go out.

Supply and Transportation—The question of supply is the most difficult feature of engineering construction work in Alaska. Most of the interior can be reached only by river boat during the short summer season or by dog team in winter. A rate of 25c. per pound is not uncommon, and the community that can land its supplies from the nearest base for 10c. per pound is considered lucky.

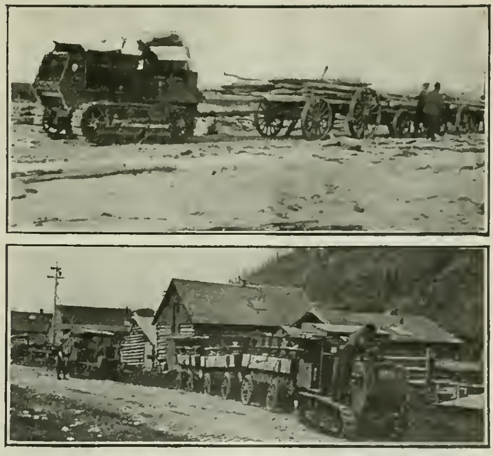


FIG. 3—TRACTOR HAULING IN ALASKA

Above: hauling poles for corduroy road in Seward Peninsula. Below: tractor-trailer freight train on Richardson Road, leaving Chitina for Fairbanks.

In the fall of 1920, the commission ordered two 90-ft. combination truss spans for a river crossing on the Richardson Highway, twenty-eight miles from Fairbanks. This material left Seattle during the following summer and was lightered ashore at St. Michael in time to catch the last boat up the Yukon River. After making nearly a thousand miles, this boat was frozen in for the winter about 200 miles short of destination. The lowest bid for freighting over the snow was $135 per thousand feet b.m., a not unreasonable charge for the service, but too expensive for our resources. The material reached Fairbanks on the first boat in June, 1922, and was freighted out by truck the twenty-eight miles at a cost of 50c. per ton-mile. Meanwhile, the old bridge was patched up at a cost of some $1,200 to last out the 1921 season.

About this time the Alaska Railroad was completed and as a result the transportation situation in the Tanana valley has been radically changed. Last spring,

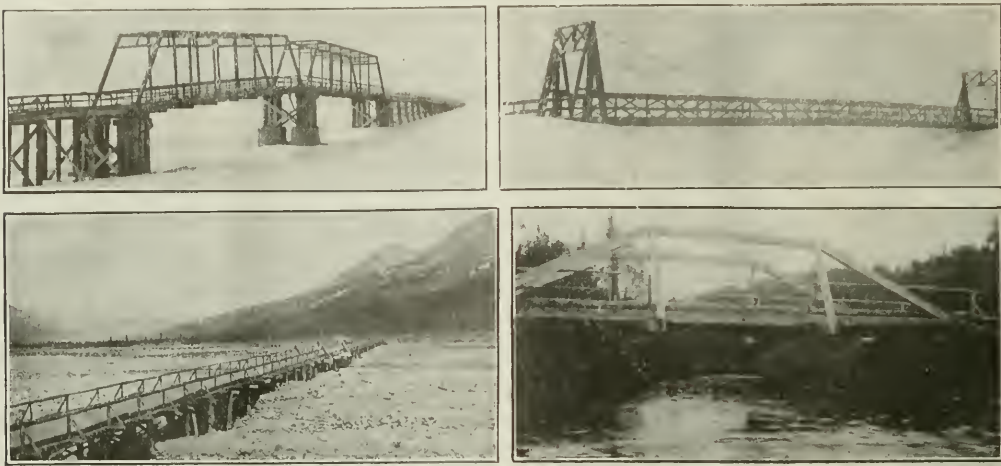


FIG. 4—TYPICAL HIGHWAY BRIDGES IN ALASKA
Above: suspension bridge over Nome River, and truss bridge over Snake River at Nome. Below: trestle near Miller's on Richardson Road, and timber truss bridge over Moose Creek.

in less than 90 days the commission took down a 100-ft. and 150-ft. combination span, using the ice as falsework, freighted them three miles with horse sleds, then shipped them 265 miles over the Alaska R.R. standard gage and 90 miles over the narrow gage, then freighted them twelve miles by tractor-drawn sleds and re-erected them over a river on the other side of the Alaskan Range with ice as falsework.

Richardson Highway—The most important project of

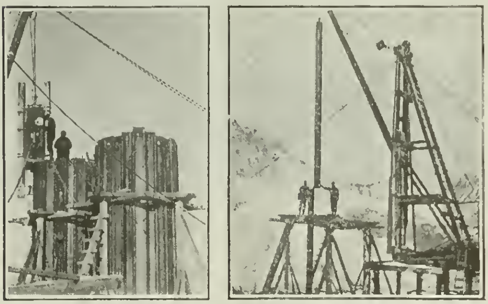


FIG. 5—BUILDING PIERS FOR NIZINA RIVER BRIDGE
Steel sheetpiling driven to form cylinders which are filled with concrete.

the commission is the Richardson Highway, extending from Valdez, an open-all-the-year south coast port, via Fairbanks to Circle, on the Upper Yukon River, a distance of 531 miles. It crosses the Chugach or Coast Range through Thompson Pass at an elevation of 2,750 ft., the main Rocky Mountains or Alaskan Range through Isabelle Pass at 3,300 ft., and the portage between the Tanana and upper Yukon River valleys. The 371-mile section between Valdez and Fairbanks has been passable for light automobiles since 1913; about fifty miles have been completed on each end of the 160-mile extension to Circle, leaving a gap in the middle of about sixty miles still under construction, but used as a bob-sled road in winter time. Along this highway are met about all the problems of road construction found anywhere in the Territory. The south coast has heavy rainfall and snowfall and is heavily wooded. The interior valleys are comparatively dry, have light snowfall and a very low temperature. The ground is permanently frozen immediately under the moss. The passes lie well above timber line and near the permanent snow line. Throughout is a jumbled mass of steep snow-clad mountains, glaciers, canyons, rivers, swamps and bare wind-swept wastes.

Organization—The Alaska Road Commission is composed, in addition to the writer, of John C. Gotwals, chief engineer, and P. A. Agnew, secretary and disbursing officer. Its headquarters are at Juneau, the capital of the Territory. District offices, each under a superintendent, are maintained at Eagle, Chitina, Valdez, Anchorage, Fairbanks, Nenana, Tokotna and Nome. A purchasing office is maintained at Seattle and a sub-office at Washington, D. C., during the Congressional hearings. The extent of the Territory may be realized from the fact that it would take a single individual, if he traveled continuously by the best means of transportation procurable, two years to inspect all the work for which the commission is responsible.

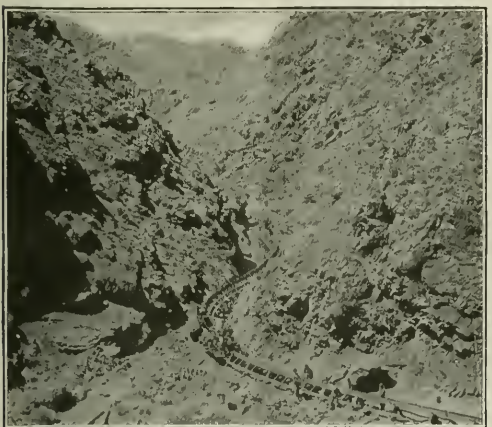
New England Railway Consolidation

Consolidation of the railways of New England into a group or regional system is recommended in the report of a committee appointed by the governors of the six New England states. The other alternative in the general project of railway consolidation was the partition of these lines to form New England extensions of outside groups or trunk lines, as noted in *Engineering News-Record* of July 26, p. 127. The proposed plan includes the Boston & Maine R.R. 2,515 miles; the New York, New Haven & Hartford, 1,950; Maine Central, 1,201; Bangor & Aroostock, 626; Rutland R.R., 415; Central New England, 295, and the New York, Ontario & Western R.R., 568 miles, making a total of 7,570 miles. It excludes the Boston & Albany (as part of the New York Central System), the Central Vermont and Portland lines of the Canadian National Railways, and all lines of the Canadian Pacific Railway.

Monorail Railroad Constructed to Tap Desert Mine

Fordson Tractor Hauls Heavy Loads on Grades of 10 Per Cent and 40-Deg. Curves, on Line to Cost Only $5,000 to $7,000 per Mile

A MAGNESIUM sulphate deposit owned by the American Magnesium Co. and located near the Death Valley Desert in southern California is to be tapped by a 28-mile monorail railroad extending over the Slate Range to the Panamint Range. Of this line about 16 miles has been completed and is carrying construction trains which are delivering material for continuing the railroad. Although detailed costs are not available, the type of construction selected, which was chosen because of the fact that it would require very little grading and would permit of sharp curves, is estimated to cost about $7,000 per mile in the rough



TYPICAL CONSTRUCTION IN THE MOUNTAIN COUNTRY
In the absence of rainfall streams are unknown and canyon bottoms make good roadbeds.

mountainous country and about $5,000 per mile in the desert with no rock work or sharp curves involved.

The construction consists of standard 6x8-in. ties, 8 ft. long, placed on 8-ft. centers. Each bent consists of a single plumb-post placed in the center of the tie and braced on either side. The plumb posts carry a 6x8-in. stringer which in turn supports the single 50-lb. rail. There are also two side rails of timber, carried by the braces, which act as guide rails, their vertical faces making contact with the rollers on either side.

The engine and cars are designed like a pack saddle, and are suspended on two wheels from the single rail. Equilibrium is maintained by the rollers on either side which contact with the timber guide rails. The motive power at present being used is Fordson tractors chain driven from both the front and back wheels which are 24 in. in diameter. On tests made with this equipment an engine so constructed carried a 5-ton load on grades up to 10 per cent. Loads of 3 tons were able to make a 14-per cent grade. This seemed to be about the maximum load that could be successfully handled on such steep grades with the Fordson power unit.

The maximum grade on the railroad as built is 10 per cent with 40-deg. curves. In operating under these

MONORAIL TRAIN HAULING CONSTRUCTION MATERIAL

conditions the only trouble so far experienced was in twisting drive shafts. This difficulty was eliminated by substituting a chain drive. Under present conditions one locomotive ordinarily hauls two cars carrying a total of 5 tons of timber distributed on all three units. The cars are 14 ft. long with wheelbase 10½ ft. long. Equipment now used has rigid wheelbase construction, but patents have been taken out on swivel cars which will greatly reduce resistance on the curves.

The foregoing was prepared from information supplied by T. H. Wright of the T. H. Wright Mercantile Co., Los Angeles, who is building the monorail line.

Elimination of Cat-Tails from Reservoirs

A COLORADO correspondent recently requested information as to the eradication of cat-tails. Lyman E. Bishop, consulting engineer, Denver, who has earned the title of cat-tail expert because of his contentions as to their existence only under swamp conditions, in an investigation in a law-suit over seepage and ground water levels, suggests lowering the ground water level below the creeping root stalks. If the ground is dry for any considerable time the plant dies.

C. R. Knowles, superintendent of water service, Illinois Central R.R. Co., makes the following comment:

> We have had some experience in removing water hyacinths and water lilies from our reservoirs in the South. We have also had some experience in removing cat-tails in our northern reservoirs. Our practice has been to pull them out by hand, destroying the roots as far as possible, but I do not know of any method whereby they can be completely removed. The use of creosote oil will help considerably and if used diligently it will in time eradicate cat-tails or other aquatic growth. The objection to creosote oil, unless used carefully, is its effect on the water. The proper method is to apply the oil at the water's edge. As the oil is heavier than the water, it will sink and come into contact with the roots of the plant, which it will kill.
>
> It is suggested that the creosote be tried experimentally at first. If possible to do so a temporary breakwater should be placed between the growth of plants and the main portion of the reservoir. This practice was followed at one of our reservoirs in Mississippi with good success in the extermination of water lilies. It is best to use the creosote when the stage of water is at the lowest as often the plant life may then be killed without affecting the water.

In a recent issue *Nature Magazine* notes many uses of cat-tails. The Germans during the war made an excellent bread from the pollen. A cotton substitute is made from the brown spikes and an artificial silk from cat-tail floss. The roots are fairly rich in starch and sugar and the Iroquois Indians formerly dried and pulverized the roots yielding a sweet-tasting flour (30 per cent starch and sugar) from which bread and puddings were made. In swampy lands from 2 to 4 tons of flour per acre may be secured. Our Colorado correspondent may find it more profitable to cultivate than to eradicate his cat-tails.

Underpinning New York Public Library Without Shores

Used Method Known as "Stealing"—Rammed Mortar Transfers Load to New Footings—Unusual Rock Conditions

By C. S. Rindsfoos
Jarrett-Chambers Co., Inc., New York City

The underpinning of the north wall of the New York Public Library is of interest not only because the structure is a monumental one but also because of the method used and the character of the material encountered. The necessity for this work was occasioned by the extension of the Queensboro Subway from its present terminus near Park Ave. to a new terminus at Eighth Ave. This extension will have its south wall along the building line of the north face of the library, and since the bottom of the cut for the subway had to be made at a considerable depth below the footings of the building, it was necessary to underpin these footings before the cut was made.

The old spread footings of the building were of concrete and rested on hardpan. The records from the first subway constructed in 42nd St. indicated that rock was from 3 to 10 ft. below the underside of these footings. This rock, however, was found to be of a decomposed nature for a depth of as much as 13 ft., and much softer than the hardpan. It was therefore essential to carry the underpinning through this soft rock.

In view of the monumental character of the structure involved, and because the underpinning would not only have to sustain the weight of the building but also act as a retaining wall to support the earth behind it, and finally because this underpinning would be subject to unusual shock from the blasting in the rock cut alongside and below it, more than usual precautions were taken in the design and actual construction.

After a steam shovel had made the first cut down to a level of about 2 ft. above the underside of the old footings, the work of underpinning began. Holes 4 ft. wide and about 30 ft. c. to c. were sunk along the side of the building and carried down through the hardpan and soft rock to solid rock. These holes were drifted back under the old footings to a distance of 6 ft. and then concreted up to within 6 in. of the underside of the old footings. After this concrete had set sufficiently the 6-in. space was rammed full of a 1:2 mortar mixed just wet enough to be molded into balls. These balls were thrown into place by hand and rammed home with a sledge hammer and a thick wooden block. V-shaped

FIG. 1—COMPLETED UNDERPINNING FOR NORTH WALL OF NEW YORK LIBRARY

The old spread footing can be seen on the right just below the trusses supporting the sidewalk.

recesses were cast in the side of these piers to make a bond with the subsequent work. In similar manner a second and a third set of concrete piers was built. When these piers were completed the intervening spaces were excavated to solid rock and closed with a curtain wall 3 ft. thick.

It should be noted that this work was carried on without the use of any shoring whatsoever. The process used is sometimes known as "stealing" and while not unusual for small buildings, has, so far as the writer knows, never before been employed so extensively or for such an important structure.

The use of rammed dry mortar in preference to the ordinary custom of using granite blocks and steel wedges was found to be most effective. Not the slightest settlement of the building occurred. Before approving of this method the engineers tested samples of mortar mixed as specified for the 6-in. layer of rammed mortar and found that it sustained a load of over 4,000 lb. per square inch.

The decomposed rock encountered on this job raises some interesting questions. It is no new thing to find a layer of soft rock overlying the solid rock on Manhattan Island, but rarely of anything like the thickness here described, which was as much as 13 ft. deep in places. One wonders whether this process of decomposition occurred before or after the overburden was laid down in past geological times, and, if after, at what rate does it go on. It might be inferred that, had the rock disintegrated before it was covered with

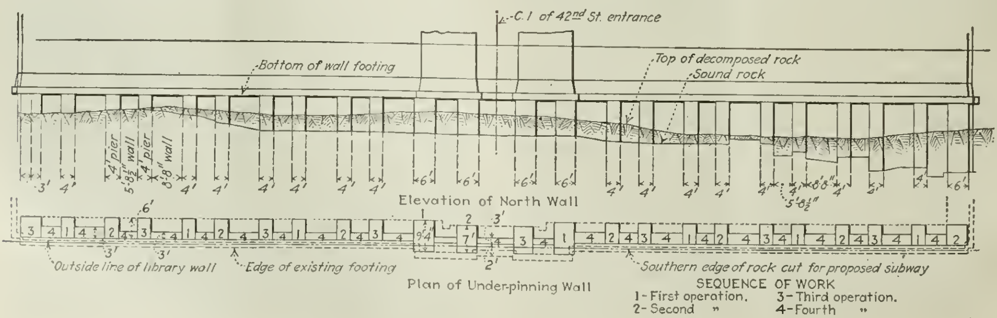


FIG. 2—PLAN AND ELEVATION OF THE NORTH WALL

overburden, the rainwater would have washed it away as fast as it weathered. This consideration, together with the fact that, when exposed to view, it has all the appearance of sound rock, leads the writer to believe that the rock has softened in place and that this change is still going on. What, then, will be the effect on some of the heavy, deep foundations in other parts of the city? If this softening is going on now, what will be the effect of the process in the case of those buildings which have lately been founded on steel pipes loaded up to 90 tons per pipe, to say nothing of foundations constructed by more positive methods.

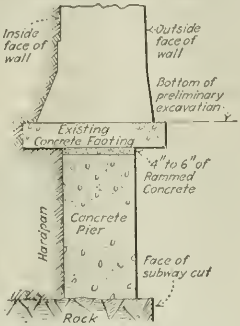


FIG. 3—DETAILS OF A TYPICAL PIER

The underpinning of the library building was performed by Jarrett-Chambers Co., Inc., New York City, under the general supervision of John H. Meyers, engineer, 2nd Division, Transit Commission, and Carrere & Hastings, Shreve, Lamb & Blake, architects for the library.

Concrete Block Ties on Railways in India

CONCRETE ties of the Stent design, of which about 200,000 are in use on over a hundred miles of main track in India, are of the block type, each tie consisting of a pair of reinforced-concrete blocks connected by a steel tie-bar. Fig. 1 shows these ties on the broad gage (5 ft. 6 in.) line of the Southern Punjab Ry., near Delhi, and their construction is shown in Fig. 2. The dimensions vary according to the gage and character of track and for maximum axle loads ranging from 14 to 26 tons. Where double-head rails are used, cast-iron chairs are attached to the blocks.

In the design shown by Fig. 2, for a gage of 5 ft. 6 in., 110-lb. rails and 26 tons axle loads, the blocks are 25x16½ in. on the base and 6½ in. thick, reinforced by upper and lower sets of horizontal bars connected by stirrups. Secured to this reinforcement is an anchor whose end projects from the block and to which the steel tie-bar of I-section is attached by a split pin. Four plugs of treated wood inserted in the block serve to hold either drive spikes or screw spikes. The upper surface has an inclination of 1 in 20 to give the rails the desired inward slope. Each block weighs 166 lb. and the tie-bar 16 lb., the total weight of tie with all fittings being about 350 lb. A concrete mix of 1:2:3½ is made with 2 parts hard silica quartzite and 3½ parts of ¼- to ¾-in. aggregate. Only sufficient water is used to make the concrete flow when the form is shaken on a vibrating table. After being left in the forms for twelve hours the ties are cured thirty days under water and then thirty days in air, but are usually at least three months old before being laid. Their life is estimated at fifty years.

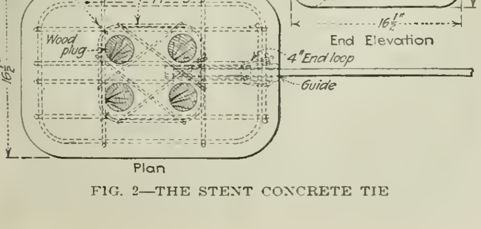


FIG. 2—THE STENT CONCRETE TIE

A few of the ties which have been in service for about nine years are said to be in as good condition as when laid, certain defects in earlier experimental ties having been eliminated. Their first cost in India is higher than that of wood ties, as steel and cement have


FIG. 1—CONCRETE BLOCK TIES ON SOUTHERN PUNJAB RY.

to be imported, but when compared on the basis of life and cost the concrete ties are said to show a marked economy. These ties are in use on several railways in India, their most extensive use being on the Northwestern Ry., which has laid them on seventy-five miles of track and is laying fifty miles additional this year. Broken stone ballast is used, 6 to 8 in. deep under the blocks.

These concrete ties are the invention of D. H. Stent, consulting engineer, Delhi, India (or care of Grindlay & Co., London, England), who was formerly executive engineer of the Bombay, Baroda & Central India Ry. They are manufactured by Bird & Co., Calcutta, India.

Signs Removed from Washington Highways

Advertising signs have been gradually eliminated from Washington state highways, according to a report from the highway division of the Department of Public Works in that state, and in a final "clean-up" in the Spokane district 5,000 advertising signs were removed from 1,100 miles of state roads. Although advertisers have offered some objection, the traveling public is very much pleased, according to the report, which states that "the highways look much cleaner and in many cases are safer, as signs on curves have been eliminated as much as possible."

Utilization of Methane Gas from Imhoff Tanks

One Year's Experience at an Essen-Rellinghausen Plant Indicates Gas Production of 0.3 Cu.Ft. per Capita Daily Which May Be Used for Various Purposes

BY DR. ING. KARL IMHOFF
Chief Engineer of the Ruhrverband, Essen, Germany
Translated from the German by HAROLD M. LEWIS *of the Physical Survey, Plan of New York and Its Environs*

SINCE the time when sludge chambers were first used in sewage disposal it has been known that the gases developed in them were useful ones. These gases come from the biological destruction of the sludge (not from the liquid sewage, as has recently been emphasized in published articles). Their usefulness consists chiefly in the high content of methane (fire damp, marsh-gas), CH_4.

Collection of the Gas—The gases have not been much utilized up to the present time because it has been considered necessary to build large roofs above the water level to collect them. This not only required heavy expense but also greatly complicated the operation of the plant. The few examples of the utilization of the gases which have been mentioned in the technical press deal with small sludge chambers which already had, for other reasons, a solid concrete roof. It is not recommended that large plants should be built of this type, where the gas roof is above the water level and there is therefore a large gas chamber, for if there is the least leak in the roof a great loss of gas will result. Still worse, there is the danger of an explosion from the entrance of air, and many accidents of this kind have already been recorded.

It is much better to place the gas-intercepting roof below the water level. In the two-story Imhoff tanks, with separate settling and sludge digestion chambers, this type of construction is very suitable, for they already have, as partitions between the two chambers, thin sloping reinforced-concrete walls which collect and lead obliquely to the vents at the water level—the gas bubbles arising from the entire surface of the sludge. (See following articles by me: "Eight Years of Imhoff Tank Design and Operation," *Engineering News*, Jan. 6 and 13, 1916, pp. 14 and 52; "Separate Sludge Digestion and Improved Mixing in Imhoff Tank, *Engineering Record*, July 22, 1916, p. 101, reprinted in London *Surveyor*, 1916, p. 187.) Imhoff tanks thereby permit a simple type of gas-collecting installation by making small changes in the vent shafts. As a result of this opportunity there has recently been constructed in the Ruhr coal district the first large municipal sewage-works with provision for collecting all of the gas produced.

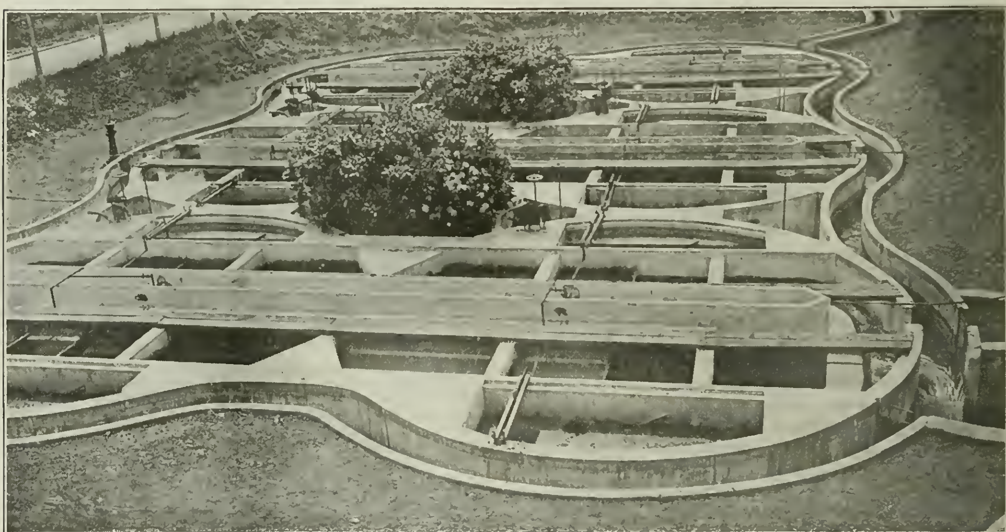


FIG. 1—IMHOFF TANKS PIPED FOR COLLECTING GAS
The first large municipal plant in the Ruhr coal district, Germany, with provision for collecting all the gas produced.

Figs. 1 to 7 show one of these plants (Essen-Rellinghausen of the Ruhr association) from which all the gas produced during the several months of its operation has been conducted to the city gas plant.

The new type of vent chamber, as reconstructed, is shown in the cuts. About 3 ft. below the water level there is constructed a nearly horizontal concrete roof which has an opening in it about 3 x 2 ft. in size. Over the opening a funnel-shaped gas hood is placed, the bottom edge of it projecting about 1 ft. below the surface of the water. To keep the coarse parts of the scum away from the gas collector a sloping fine screen is used which can be reached through an opening for cleaning. The screen is necessarily made of wood or a resisting metal, as iron bars would be quickly destroyed. The scum collecting under the screen can be removed through the opening at the side without interfering with the

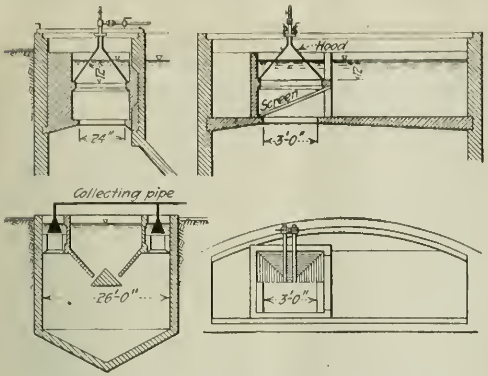


FIG. 2—DETAILS OF GAS HOODS AND PIPING
Concrete roof and water-sealed hood built in gas vent, with inclined screen to exclude scum from hood. Top of each hood connected to piping system.

collection of the gas. From the upper end of the hood small iron pipes lead the gas to the place where it is to be used. From time to time the particles of scum which have collected under the hood must be removed. For this reason the gas hood is made removable (Fig. 6). While the hood is turned back the piping is kept closed by means of a stop cock near the top of the hood. When the hood is again replaced a blowoff valve on the top of it is opened for a short time to let any air escape which may have gotten underneath it. As soon as all the air is forced out of the hood the blowoff valve is closed and the stop cock in the pipe line is opened again. In this way even a small amount of air is absolutely prevented from getting into the piping. The depth of the hood noted above, 1 ft. below the water level, is, in the present case, sufficient to overcome the gas pressure necessary to force the gas into the city gas system. In every case this depth must be computed.

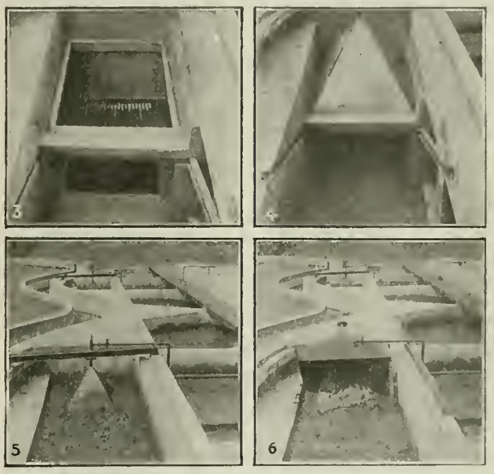
If the gas piping is shut off, or if a pipe becomes blocked for any reason whatever, the pressure under the gas hood will become greater and the gas will pass under its edge into the open. The gas hood therefore works exactly like a safety valve.

Fig. 7 shows the secondary sludge digestion tank which, in the Essen-Rellinghausen plant, as in most of the newer Imhoff tank plants, is located near the sludge drying bed. Its purpose is to restore to the sludge the gas content which has been lost by pumping, so that it will dry more readily on the drying beds. A gas roof is placed over the entire surface of this tank. In the middle of the roof is an opening for the gas and at the outer edge is a small circle of slots through which the sludge can pass as the surface of the sludge is lowered.

Amount of Gas—In a year's time a quantity of gas equal to 0.3 cu.ft. per capita per day can be assumed. A city of 100,000 inhabitants can therefore figure on 11,000,000 cu.ft. of combustible gas per year. In summer the quantity of gas is greater than in winter. It also increases if for any incidental reason the amount of sludge brought to the tank increases. If no fresh sludge is added to a tank the production of gas stops for fourteen days.

Composition of the Gas—In general the mixed gas which results consists of the following components in percentages: Methane (CH_4), 65-90; Carbon dioxide (CO_2), 5-35; Hydrogen (H), 0-10; Nitrogen (N), 0-8. In a well ripened Imhoff tank one can usually figure on the following percentage combination: Methane (CH_4), 80; Carbon dioxide (CO_2), 20; Hydrogen (H), 0; Nitrogen (N), 0 to 8.

The most important thing is the proportion between the methane and the carbon dioxide, as the latter greatly decreases the value of the gas mixture. Apparently this proportion depends principally upon the water. That is readily explained as the two gases act very differently with water; methane dissolves in it only with difficulty, but carbon dioxide is readily soluble. The carbon dioxide is taken up by the sludge chamber water almost to saturation and only the excess over this amount appears as carbon dioxide in the mixed gas escaping from the sludge chamber. If the sludge chamber water is restored with fresh water it again has the power to absorb large quantities of carbon dioxide and little of this appears in the escaping gas. This clearly explains why the content of carbon dioxide in the mixed gas in separate sludge digestion tanks is much higher (up to 35 per cent) than in Imhoff tanks, where the sludge water has the chance to equalize itself, through the sludge slots, with the water in the settling compartment. Also it is readily understood that shortly after drawing off sludge from an Imhoff tank (during which process a quantity of water corresponding to the amount of sludge drawn off is forced into the sludge chamber) little carbon dioxide is, for some time, to be found in the mixed gas.



FIGS. 3 TO 6—VIEWS SHOWING ARRANGEMENT AND OPERATION OF GAS HOODS, SCREENS AND PIPING
3. Gas opening with sloping bar screen. In foreground, side opening for scum.
4. Gas hood over gas opening; underneath, side opening for scum.
5. Gas collector in operation, with scum showing at top of vent.
6. Gas hood turned back for cleaning.

The *hydrogen* content of the mixed gas is particularly interesting. Hydrogen is most generally not found in good Imhoff tanks. On the other hand it is known that fresh fæces decompose first into an acid fermentation which develops only hydrogen and carbon dioxide, but no methane. In accordance with this, hydrogen is found in large quantities in the first stages of operation of Imhoff tanks. Likewise hydrogen can appear later when there are disturbances in the operation.

The reasons for the presence of *nitrogen* in the mixed gas have not yet been clearly explained. The nitrogen has no bearing on the utilization of the gas.

The *heat value* of the mixed gas is generally 7,000 to 9,000 calories and varies principally and inversely with the content of carbon dioxide. The high heat value is explained by the methane. In this respect the gas is superior to the city gas, for the gas of the city of Essen, for example, has only 4,200 calories, which are principally due to hydrogen.

Cleaning—As the sludge chambers are fairly warm, water separates out from the gas in the cold pipe lines. It is therefore necessary to provide the pipes with drip-pots.

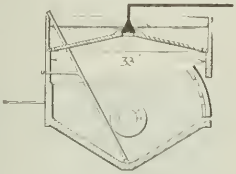


FIG. 7—SECONDARY SLUDGE DIGESTION TANK
With gas roof built under surface of sludge.

As a rule *hydrogen sulphide* is not found in the mixed gas and is undesirable as it corrodes the pipes and gas meters. As an exception, this gas may appear in those plants which have to receive very foul sewage from cesspools. It is then advisable to construct in the pipe line a filter of bog-ore such as is also found useful in municipal gas plants for the retention of hydrogen sulphide.

The content of *carbon dioxide* is, for many purposes, such as the delivery of the gas at the municipal gas plant, unharmful. If it is ever for any reason necessary to free the gas of carbon dioxide it can very easily be done by making use of its previously mentioned easy solubility in water. For example, the mixed gas might be pumped through certain sludge chambers where the sludge water has been frequently renewed. If the gas is to be delivered under pressure the necessary high pressure can be utilized for the elimination of the carbon dioxide. It is then only necessary to insert several bottles filled with wash-water between the compressor and the tanks for the receipt of the gas; the carbon dioxide must be removed from these bottles from time to time. Such a plant has been in operation in Essen for over a year.

A surprisingly simple method of freeing the mixed gas of *hydrogen* has developed from the observation already referred to above—that hydrogen arises only in the decomposition of fresh fæces, but not in a well-seasoned Imhoff tank. It must nevertheless be admitted that, with the fresh sewage, there are always received new particles of sludge which are already more or less in acid fermentation and therefore contain hydrogen. The fact that none of this hydrogen generally appears above the surface of the water forces one to the conclusion that biological forces must be at work in Imhoff tanks to convert the hydrogen into methane. To verify this by a practical experiment an artificially prepared gas mixture, to which 20 per cent of hydrogen had been added, was blown into the bottom of a well functioning Imhoff tank. The experiment succeeded fully, for *no trace of hydrogen was found* in the gas mixture coming from the tank, but only methane and carbon dioxide. It must be accepted that *the bacteria of ripe sludge convert the hydrogen,* in the presence of *carbon dioxide,* into *methane and water* in accordance with the following formula: $4\ H_2 + CO_2 = CH_4 + 2\ H_2O$. Thereby it is possible to obtain a mixed gas entirely *free from hydrogen* if the gas, just as soon as it comes from tanks which have not yet been ripened or where the operation may for some other reason be disturbed, is *blown again through ripe sludge.*

By the use of the methods outlined above for the removal of the carbon dioxide and hydrogen from the mixed gas it is possible, according to our experience, to be assured of obtaining continually a cleaned gas which contains 92 to 98 per cent methane, 0 to 8 per cent hydrogen and perhaps some carbon dioxide.

Use of the Gas—The most natural use is for the needs of the disposal plant itself, for heating and the generation of power. For instance, in several plants of the Ruhr association the chlorine disinfection houses are heated with sludge gas. If the municipal gas works, or at least a city street main, is near and accessible it is planned to deliver the gas to the gas works. Where neither of these methods of utilization is possible it is practicable to compress the gas in drums under about 150 atmospheres pressure and to sell it in this way for burning. This gas is, for example, very useful for welding and cutting, particularly as it is free from hydrogen.

For certain purposes it is desired that the gas shall not only be free of hydrogen but also of carbon dioxide. This is especially important in its applications in the chemical industry, where methane has recently been very much wanted for many purposes.

Cost—The construction cost for the entire gas collecting apparatus, including the piping on the disposal plant grounds, amounts to only 1 per cent of the cost of constructing the Imhoff tank plant. In those cases in the Ruhr coal district where the gas is delivered to the municipal gas plant the price paid by the city amounts to two-thirds of the cost of the regular municipal gas. In spite of this low price the receipts cover half of the total operation costs of the Imhoff tanks. As the price paid by the city is still much too low in comparison with the calorie content, it is assumed that the price can later be raised so that the entire operation cost will be covered. Based upon the dealings which have up to this time been carried on with chemical works, it is expected that, with the delivery of the gas for special scientific purposes, a still higher return can be received.

In any case present experience justifies a recommendation that all Imhoff tank plants be equipped with gas collecting apparatus. This is warranted not only when there is need for the gas at the plant itself but also if the gas can be delivered to the municipal mains or if it is possible to make an agreement with a chemical works. On the other hand every municipal gas plant should consider the question whether it is possible to obtain from the municipal sewage-works gas to augment and improve that in their mains. Also many chemical plants will find it advantageous to seek a connection with a large sewage-works which can furnish them with a continual and inexhaustible supply of the valuable methane.

Railway Electrification in Central Africa

The conditions under which the Leopoldville-Metadi R.R. will be electrified have been announced by a statement from the Belgian Minister of Colonies, which has been received by the Department of Commerce. The company has available 30,000 hp. for the first electrification work and can obtain 100,000 hp. more. The electrification will cost 150,000,000 francs. The gage of the line will be changed from 0.75 to 1.06 meters.

Problems and Progress in the Field of Water Supply

High Points in the Papers and Discussions of the Annual Convention of the New England Water Works Association

AT THE forty-second annual meeting of the New England Water Works Association at Burlington, Vt., Sept. 18 to 21, some fifteen papers and lantern slide talks were presented. In addition to these were a few topical discussions on Superintendents' Evening. Some of the high points in the technical proceedings are given below. The business proceedings and the presidential address—the latter dealing with society affairs—are outlined in the news section of this issue.

Filtration of Burlington's Water—Appropriately, the first paper to be presented dealt with the water supply of Burlington, Vt., the city in which the convention was held, and the second one with Vermont water supplies. Oliver J. Channing, pumping engineer, and in charge of the Burlington filters, outlined the benefits of filtration and chlorination at Burlington.

Notwithstanding a two-mile extension of the waterworks intake into Lake Champlain, Burlington continued to have much typhoid. In the period of 1904-08, there were 151 cases. Mechanical filters were put in operation on April 15, 1908. For the two years 1909-10 there were 29 cases of typhoid. In December, 1910, the use of hypochlorite was begun. The following year the typhoid cases were seven, of which six were classed as contracted out of town. In 1921, liquid chlorine was substituted for hypochlorite. In 1922 there was only one case of typhoid in Burlington.

In the discussion of Mr. Channing's paper, M. N. Baker, associate editor, *Engineering News-Record*, said that when he entered the University of Vermont, in 1882, the members of his class were warned by the president to drink sparingly of the city water until their systems became accustomed to it, lest intestinal disturbances be caused.

Public Water Supplies of Vermont—Most of the water supplies of Vermont are from surface sources, according to a paper by Charles P. Moat, chemist, Vermont State Board of Health, Burlington. The only filtered supplies are those of Burlington and St. Johnsbury. At the latter place slow sand filters were installed many years ago. Only a few supplies are chlorinated but more of the surface supplies might well be. High B. Coli counts in one of the Vermont supplies were apparently traced to droppings from deer in the drainage area. The Burlington filtered supply rarely shows taste or odor although the service reservoirs are uncovered. However, much of the supply goes to consumers, direct, and the stored water is frequently freshened, as the pumps deliver through the distribution system to the reservoir.

Sub-Surface Supply, Newton, Mass.—A paper sent by Edwin H. Rogers, city engineer, Newton, Mass., brought out the fact that after many years of use the driven-well supply of Newton had not deteriorated in quality nor given trouble from iron. This was attributed to the moderate draft upon the wells.

Reservoir Covering—A lengthy paper on "Covering Open Service Reservoirs, in Which Filtered or Ground Waters Are Stored" was sent by George C. Bunker and August G. Nolte, in charge and assistant engineer in charge of water purification, Panama Canal, Ancon, C. Z., and was read in abstract by R. S. Watson. The main point of the paper was not only that such reservoirs should be covered but also that covering them as a part of the original construction will reduce first cost. Where covers have not been provided they should be added. Experiences with open and covered reservoirs in the canal zone, showing the benefits of covers, were cited. Attention was called to the fact that at St. Louis, Mo., E. E. Wall, water commissioner, has in seven successive annual reports, advised covering the Baden and Bissell's Point reservoirs, with repeated failures to get the necessary money from the city authorities.

C. W. Sherman, of Boston, after referring to reports that the Boston Metropolitan Commission is planning to filter the Sudbury and Cochituate supplies, raised a question as to what would happen to the water thus filtered during storage in uncovered reservoirs. He thought that the present Chestnut Hill reservoir and Spot Pond are already polluted by sea-gull droppings.

Some Additions to New England Water-Works Plant—A paper by Allen Hazen, New York City, on "Some Additions to New England Water-Works Plants" was read by one of his associates, H. M. Pirnie. At New Britain, Conn., some impounding reservoirs have been built to utilize the entire economical surface yield of the drainage area and wells and pumps have been installed from which water is being pumped to a reservoir with capacity in excess of its tributary yield. At Springfield, Mass., which has had a more rapid and continuous growth than any other city in New England, and which supplies water to other municipalities, the capacity of the slow sand filters is being doubled. Studies are being made for the filtration of the new gravity supply, now under construction, for Providence, R. I. Tests show more color in the water than was expected. Because of this and of site conditions unfavorable to the large area required for slow sand filters, mechanical filtration is considered better for Providence. To avoid red water troubles, a large coagulation basin, well baffled, is proposed. Aeration both before and after filtration is also proposed, both to remove taste and odor and to reduce carbonic acid so as to get a "quieter water." Near the New England territory are Poughkeepsie and Albany, N. Y., both of which are using Hudson River water. These supplies are badly polluted and must ultimately be abandoned. It seems advisable to continue their use for some years longer, and to continue to make the river water safe by the present method of double filtration—scrubbers or rapid filtration prior to slow sand filtration. With prefiltration, the slow sand filters can be used for long periods without being cleaned. The Albany plant is now being overhauled, particularly the prefilters, which had been "demoralized" and become badly clogged.

Care of Large Watersheds—A general review of the forestry work, sanitary control and other matters per-

taining to the surface water supplies of the Boston Metropolitan District was given by Frederic I. Winslow, an engineer of the district located at South Framingham.

Rapid Sand Filtration at Cambridge, Mass.—The first mechanical filters for improving the sanitary quality of water, said Col. George A. Johnson in a paper on the Cambridge filters, were put in operation on April 14 of this year. The plant has a capacity of 14 m.g.d. In the main it follows standard practice. A feature that is uncommon but not new is the return of the washwater to the sedimentation basin. The water is chlorinated after filtration. The construction details of the plant were described in a supplementary paper by Mr. Stevens who was in charge of construction for Colonel Johnson. A paper describing the Smolski system of reinforcement for the concrete roof was sent by Mr. Smolski.

In the discussion of the main paper, W. C. Hawley, Wilkinsburg, Pa., said that in his filters, built in 1909-10, the washwater is also returned to the sedimentation reservoir, but not until after detention in a separate settling basin. The net washwater at Wilkinsburg is only 0.1 per cent of the amount filtered. Frank A. Marston, Boston, commended the use of the Venturi meter for washwater control, used at Cambridge, as a means of guarding against the wrecking of the filter underdrainage system. As to the Smolski roof being cheaper than the groined arch, as indicated in the papers on the Cambridge filters, Mr. Marston said that relative costs varied with local conditions, including the experience of contractors bidding on a job. In one case Metcalf & Eddy had found one of these systems and in another case the other system to be the cheaper.

Laying a 16-In. Main in Portland Harbor—H. V. Fuller, chief engineer Portland Water District, described the laying of a 16-in. cast-iron main from Portland across the harbor to South Portland. Flexible joints of the improved Boston Metropolitan District type were used for every third length. The harbor water has a temperature of 28 deg. F. in winter. Cans of fresh water buried in the marshes showed that a 6-in. clay cover would prevent freezing, but it was decided to give the submerged pipe a 3-ft. cover for protection against dragging anchors.

The pipe was laid in water ranging from shallow to 45 ft. deep. For laying, a curved cradle or chute of yellow pine timber, suspended between two floating pile drivers, was used. Before the pipe was placed in the cradle, three joints were poured on a lighter lashed to the pile driver floats—one joint gave a 24-ft. section and two joints a 36-in. section. These two sections were hoisted to the pipe-laying chute and connected by pouring the joint, thus providing a 30-ft. section. After a connection had been made between the shore and the lower end of the pipe in chute, the whole rig was moved forward. Progress was by 24-ft. hitches. The cost of the job (not including pipe) was $7.75 per lin.ft. as follows: trenching, $2; pipe-laying, $5; covering, $0.75. The contractor did not make a profit commensurate with his risk. Leonard Metcalf, Boston, was consulting engineer for the work.

Selection of Pumping Equipment for Station Economy—The economics of pump selection was reviewed in considerable detail by Frank A. Mazzur, Boston, taking one type after another. The author's data pointed to the Diesel engine as affording a high duty and being well suited to medium and small plants. In the discussion, the Diesel engine seemed to meet with general favor. Several speakers agreed that the electric-driven pump has more need of attendance than is often represented.

Worcester's Reservoirs—The nine reservoirs of the Worcester water-works were described by George W. Batchelder, water commissioner, and possible ways and means to meet the need for additional reservoirs were outlined.

Applications of the Venturi Meter—A recently discovered portrait of Venturi, high spots in hydraulics antedating and accompanying the development of the Venturi meter and an outline of progress with Venturi meter registers were presented in a paper by Frederic N. Connet, chief engineer, Builder's Iron Foundry, Providence. Among the registers described was one for use where reverse flows occur, as where water passes through a distribution system to a reservoir, then from the reservoir back into the system.

Superintendents' Session—An evening was set apart for papers and topical discussions designed to appeal to the superintendent. Two papers were read, and eight subjects listed for topical discussion. Four were taken up and the other four postponed to one of the winter meetings.

Hydrant Connections: F. A. Marston, Boston, read a paper on "Hydrant Connections for Fire Engines." There is a tendency, he said, to omit steamer connections. Against this Mr. Marston presented his own ideas and also the results of correspondence with fire underwriters, insurance, and water-works engineers, practically all in favor of at least one 4½-in. steamer connection. This may be combined with two 2½-in. outlets, or in large cities there may be two 4½- and one 2½-in. connections. The paper and discussion indicated a growing use of "pumpers" in place of the old-time fire engines, and also a tendency to lower pumping station pressures, to be made good by the use of "pumpers." The discussion also indicated a strong general opinion that fire department men do not know how to use fire hydrants and that water departments should always have men at fires to make sure there is no improper manipulation of the hydrants.

Water Hammer from a High Pressure Regulating Valve: Sydney Lee Ruggles, city engineer, Barre, Vt., recounted unfortunate experiences with a regulating valve having a very heavy unbalanced pressure. There was such severe water hammer that, year after year, weeks were required altogether to repair leaks in the pipe line. After Mr. Ruggles took charge of the works he put in a relief valve and adjusted the lever arm and float and later put on a 400-lb. weight. The final result was the almost complete elimination of the water hammer and resultant leaks.

Universal Pipe on Curves: Cement-lined wrought-iron pipe at Barre, Vt., laid as long ago as thirty-five years, is being replaced gradually with universal pipe. The flanged, machined and bolted joints on this pipe have been found readily adaptable to curves and the work has been tight.

Standard Water Meter Register: A topical discussion opened by W. C. Hawley showed that in a few

places water-works have followed gas company practice in leaving post cards, with meter dial diagrams on them, for householders to fill in and mail when meter readers find the house temporarily closed. The variety of meter dials encountered has led to an appreciation of the need for standardization of meter dials. The convention authorized the Executive Committee to revive the meter specifications committee of the Association in order that it may take up dial standardization with the similar committee of the American Water Works Association.

Brass Pipe for Services: The discussion on this topic indicated that a few works are using brass in place of steel or lead services, but the discussion ran off into the relative life of wrought-iron and steel pipe, electrolysis and other side questions.

Protection of Water Mains Crossing Bridges: A few examples were given but the consensus of opinion seemed to be that except where the circulation of water is very slight no protection from freezing is needed. The difficulty of getting an airtight protection was emphasized.

Valve Boxes at Main or Curb: No one seemed to know of any New England city except Worcester where valve boxes are set at the main (in the street) instead of at the curb and there was but little sympathy expressed for such a departure from common practice. The argument for location at the main is that by that means only can the entire length of the house service be controlled.

Supply Men Papers—Friday morning was given up to four papers which were essentially supply men or manufacturer's papers, although one dealt chiefly with steam gaging practice.

Manufacture of Wrought-Iron Pipe: A. A. Getheman, of A. M. Byers Co., showed by films the whole process of making wrought-iron pipe, from loading ore at the mines through to galvanizing and testing the pipe.

Testing, Maintenance and Operation of Large Gate-Valves: Allegations of no material improvements in the design and manufacture of large gate-valves since 1880, of careless maintenance once the valves are buried, and of serious mishaps when attempts are made to operate these buried valves were made by Payne Dean, New York City, who also described his motor-truck-mounted and motor-operated valve, opening and drainage pump equipment and his electric control system by means of which one or more valves may be closed or opened from a distant point.

Records of Steam Flow: With the substitution of local examples (New England) C. C. Covert, of W. L. & L. E. Garley, Troy, N. Y., gave much the same paper as he presented at the A. W. W. A. meeting at Detroit, last June. In general, the steam gaging methods of the U. S. Geological Survey were illustrated and explained.

Chlorine Control Apparatus: Something of the evolution of chlorination apparatus for water disinfection, and the latest improvements in this field were described by Gilbert H. Pratt, New England Agent of Wallace & Tiernan. Among the lantern pictures were two showing the largest chlorination plants in the world. These are at the Cleveland sewage-works, the latest one, recently put in operation, having a capacity to feed eight tons of chlorine in 24 hours.

New Engineering Organization on a British Railway

EXTENSIVE changes in the engineering departments of British railways have been made necessary by the consolidation of all the several lines into four great systems. The new administration and engineering organization of the Southern Ry., which is the smallest of these systems, with 2,200 miles, has been announced recently and a summary of this organization is given below:

Administration—The Board of Direction consists of twenty-one members, including the chairman, and has the following committees to deal with the various matters incident to the business of the company: (1) Law and medical, (2) traffic, (3) engineering and real estate, (4) locomotives and passenger and freight cars, (5) docks and marine, (6) stores, (7) finance and rates. The departmental system of organization comprises the following departments: (1) Executive, (2) secretarial, (3) legal, (4) accounting, (5) real estate, (6) rating, (7) operating, (8) commercial, (9) civil engineering, (10) locomotive and car construction and maintenance, (11) docks and marine, (12) electrical engineering, (13) purchase and supervision of horses (for cartage service), (14) stores, (15) medical, (16) police. All department heads report to the assistant general manager.

Engineering—The chief engineer, as head of the civil engineering department, has under him the following assistants: deputy chief engineer, chief assistant for parliamentary purposes, permanent way engineer, new works engineer, engineer of bridges and roofs; engineer for heating, lighting and water service; architectural assistant; quantity surveyor; signal engineer; telegraph and telephone assistant; and several district engineers.

The staff of the docks and marine manager includes an engineering assistant in charge of the maintenance of the works and the preparation of plans and estimates for improvements and new works. The electrical engineer is an independent officer, mainly in charge of the supervision and control of the power houses in connection with the electrically operated lines. This does not include power plants under the control of the chief mechanical engineer and the works and marine manager, but he must be consulted in regard to maintenance, renewal and extension of these latter plants. He is also to be consulted upon all questions affecting the purchase of electricity and electric equipment for power and traction on all schemes involving the employment of electricity other than those affecting signals, telegraphs and telephones.

Hetch Hetchy Water Used in Storage Batteries

For six years water taken from the Tuolumne River, which is the Hetch Hetchy source of supply, has been used in storage battery locomotives and automobile storage batteries on the project in preference to distilled water which the city formerly purchased for storage battery use. Before the change to the river water was made the city chemist made comparative analyses and placed his O.K. on the river water and after six years experience the batteries are still giving excellent service.

Large Open Air Swimming Pool at Camp Dodge, Iowa

Walls and Floor of Reinforced Concrete—Three Million Gallons Capacity—Bath House of Concrete and Hollow Tile

By L. N. Hintgen
City Engineer, Sioux City, Iowa

CAMP DODGE, Iowa, has recently been provided with an outdoor swimming pool which is unusual on account of its size and the completeness of its equipment. Its construction is the result of a decision on the part of the state authorities to maintain the camp as a permanent training camp for state troops. The pool is so located that it forms a nucleus around which an undeveloped part of the reservation is to be made over into a park.

GENERAL VIEW OF SWIMMING POOL AND BATH HOUSE

It is one of the largest in the middle west, being 350 ft. long and 150 ft. wide and holding more than 3,000,000 gal. of water. When filled to the overflow the water is 2½ ft. deep at one end and 9 ft. at the other. The wading end runs to 3½ ft. deep at a distance of 85 ft., and then deepens at a more rapid rate until it reaches the diving area, where eight wide springboards form convenient jumping off places for the divers. A large float has been placed in the center of the deep water section and a diving tower located on the float. The diving tower and float may be removed to clear the water for swimming races whenever desired. The great length of the deep water makes the place ideal for 100-yd. swimming races as it provides a long straightaway before the starting line is reached.

The walls and the entire floor of the tank are of reinforced concrete. Expansion joints are provided between each 90-ft. section of the side walls and between the 50-ft. squares in the floor. The water is supplied through a 12-in. cast-iron main; the fresh supply entering at the middle of the shallow end. The outlet which is at one corner of the deep end consists of a 15-in. main which empties into an artificial pond. The overflow is immediately above the outlet, and takes the water when a continuous flow exists. The flow of water from one end of the pool to the other insures fresh, chilled water at all times. Under full pressure about six hours are required to fill the pool to its capacity, and it requires a similar length of time to empty the entire basin. The outfall water as it leaves the outlet pipe passes into an artificial channel where falls have been made by two dams of a construction resembling the natural outcropping of sandstone. There is also an artificial spring cropping out of the high embankment at the outlet. On the east side there is a natural amphitheater on each side of a road, located 100 ft. from the walls. A fence marks the border of the road, and the interior grounds are sodded and planted with shrubbery. On the high ground toward the southeast is an electric light unit, equipped with reflectors, which will illuminate the entire site. Drinking fountains and a pebble beach have been provided.

The bath house is of hollow tile construction with stucco exterior, and a red tile roof in Spanish mission style. The floors are of concrete. The building is divided into two dressing rooms and two shower rooms. There are two locker rooms, the one for enlisted men containing 1,008 baskets, and the one for officers having 182 baskets. The dressing rooms are arranged to accommodate 2,000 persons a day. A heating plant is located in the basement. As the pool can accommodate more than 600 persons at one time it was decided to equip the bath house with 100 showers.

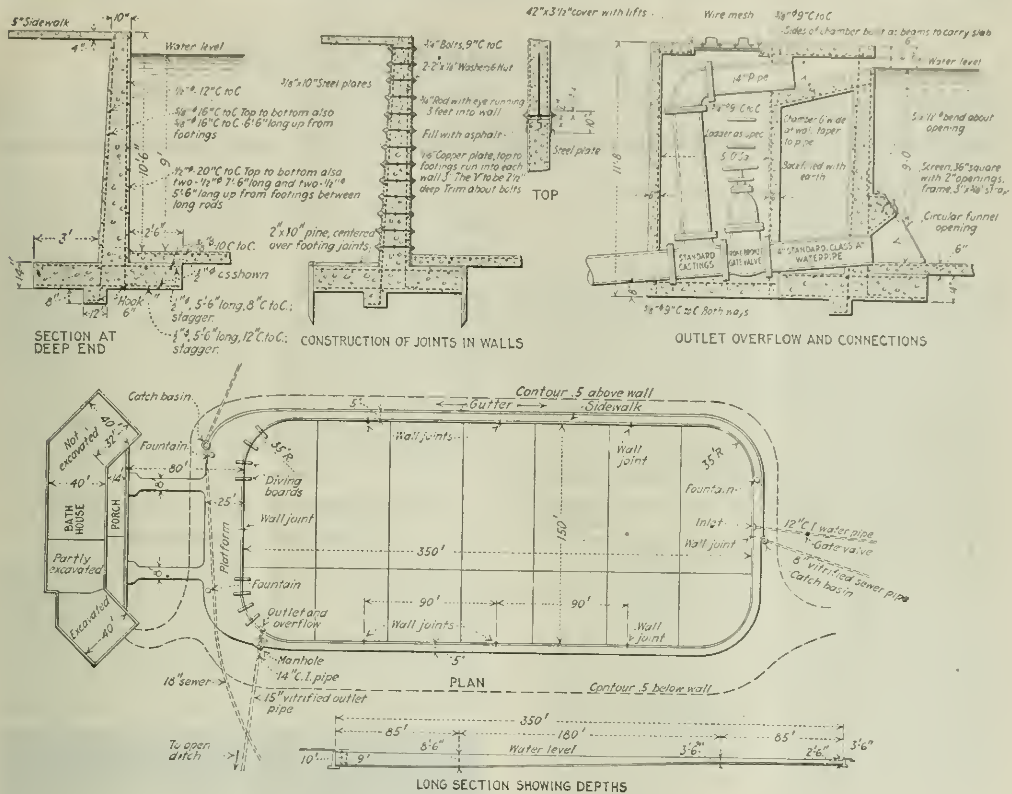
In the design of the tank walls the effects of earth and water pressures were assumed to act independently. Possible surcharge condition on the earth side was disregarded. Equivalent horizontal earth pressure was taken at 30 with assumed weight per cubic foot of 100. Water was taken at 62½ pounds. Variations from sections required by formula were based on requirements for watertightness, and on local soil and ground water conditions. Added stability to walls was given by the circular form chosen at the corners. These large sections being free from joints resisted horizontal forces easily. This was also found to form a means of equalizing and disposing of temperature difficulties. Thickness of walls had to be held at a minimum on account of available funds, but the dimensions chosen were ample to prevent seepage. A rough construction joint was formed at the junction of walls and footing by pulling out an irregular groove between vertical steel before final set.

The steel content averaged about 67 lb. to the cubic yard. Closely spaced small section steel was considered preferable for the floor on account of the lightness of construction. Concrete strips 4x18 in. were poured in trenches cut in the subgrade of the floor and centered under the joints to keep the asphalt filler in place.

The original specifications called for 1:2½:4 concrete, using stone up to 1½ in., with an addition of 10 per cent of hydrated lime by volume of cement. But as the stone first delivered contained undesirable particles, this mixture was changed to 1 : 4 made up of bank gravel containing 55 per cent of materials over ¼ in. and an addition of about 10 per cent of stone. The lime added materially to the waterproof quality of the concrete. The outside of one of the deep walls was exposed to a 6-ft. stand of water after it was a week old and during five weeks showed no signs of dampness on the inside face. The same class of concrete was used for footings, walls, and floors.

The floor was poured by spouting. The lower four inches were spread before the reinforcing was placed. Then the upper 2 in. were poured, the excess water was expelled by roller, and finishing done by heavy wooden floats.

The expansion joints in the side walls were made 2 in. wide with a copper plate bent in the shape of a V set into the adjoining sections to close the opening. A steel plate closer was bolted to the first wall on each side to hold asphalt filling in place and to assist in keeping the walls in line. The bolts and anchor rods running back into the wall, and one edge of the copper,



PLAN AND DETAILS OF THE TANK

were set before pouring the first wall. After pouring the second wall about the copper and allowing time for set the forms were removed and the outside plates fastened. A plate of this kind should not have holes punched until after bolts have set since it is difficult to maintain them in exact positions. Asphalt was poured as soon as plates were set.

The handrail consisted of 1¼-in. gas pipe placed three inches above the waterline. The brackets were set six feet apart. Diving boards were first designed according to American standard but this was varied later. It was found that eight boards were sufficient for a pool of this size. Ladders were made of one inch round steel.

The pool was not intended for ice skating purposes and it has been found desirable to drain it in fall and cover the floor with straw. A certain amount of tile drain was placed about the footings and below floors but it will not contribute very greatly to the safety of the bottom.

During the bathing season a small, continuous flow of water is kept up from inlet to overflow. The bacterial count has been found to be very low under such conditions. A purifying system has been inaugurated by means of daily trips of a "chlorinating boat." This method proves to be simple and inexpensive.

The cost of the pool proper and certain extras in the immediate vicinity was $33,422.03. It was built by Stark & Knotts of Des Moines, Iowa. The writer designed the pool in the offices of Pearse, Robinson & Sprague, of Des Moines, and was later sent out by the adjutant general as construction engineer. The bath house was designed and built by the Sugarman Construction Co. of Des Moines, who also had charge of landscaping and plans for the development of the camp.

To Prescribe Way of Computing Depreciation

The Interstate Commerce Commission will hold a series of public hearings starting on Oct. 1 before Examiner Fowler at Washington, upon the matter of prescribing depreciation charges for the railway properties in this country. This is being done to comply with the requirements of paragraph 5 of Section 20 of the amended Transportation Act in which the commission is directed to "prescribe for carriers subject to this act the classes of property for which depreciation charges may properly be included under operating expenses, and the percentages of depreciation which shall be charged with respect to each of such classes of property, classifying the carriers as it may deem proper for this purpose." The depreciation section of the Interstate Commerce Commission has prepared a tentative report which will be presented at this time for discussion. At the close of the hearing the Interstate Commerce Commission will give a final report upon which the depreciation accounts of the railways will thereafter be based.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Expansion Details for Concrete Bridge Railing

By O. W. Gatchell
Office Engineer, Phoenix Utility Co., Sanford, N. C.

SUBSTANTIAL railings are the rule for present-day concrete bridges, and for a beam type, two-span skew structure as shown, with railings continued outward over wing-walls to the limits of the roadway, the expansion movement at end seats and center pier precludes pouring the railing entirely monolithic with rail posts and curbs.

The main feature of the railing design here shown lay in making every third post an expansion point for both sets of entering rails, intervening posts being poured integral with rails. A panel length was adopted such that the larger posts near abutments and pier were expansion points corresponding to joints between deck beams and abutments and wing-walls. The bottom rails in the two panels adjacent to each expansion post were separated from the bridge or wing-wall curb by ½-in. tarred felt. Freedom of movement of rails in expansion posts was secured by a tarred felt joint surrounding the sides and the end of the entering portion of the rail. The reinforcing for rails was continuous through those posts without joints.

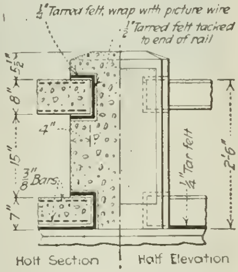


FIG. 2—DETAILS OF EXPANSION POST

Precast railing not being advisable for the structure in question, forms for all posts and rails on one side of the roadway were built at a time. After the shores under the bridge deck had been removed, all concrete for the side was poured except in expansion posts. Following a minimum set of four days the form construction in the interior of these posts was carefully removed from around the ends of the entering rails, tarred felt was applied around the bottom set of rails first, and then concrete was poured up to the top rails, whose ends were similarly protected, and the pouring was completed.

FIG. 1—LOCATION OF RAILING EXPANSION POSTS

By compensating for deck movement and rail expansion proper in every third post, only ten expansion posts were needed for 215 ft. of railing, thus avoiding the questionable construction of an entirely rigid railing on a multi-span bridge while saving in construction time and expense as compared to a design using an expansion joint in every post.

The design presented was developed by the writer for federal-aid work in Hocking County, Ohio.

Bunk House Sterilizer Uses Live Steam and Creosote Oil

A PIECE of apparatus has been built and is being used on the Big Creek project of the Southern California Edison Co. which has been found very effective in disinfecting dormitories and bunk houses in construction camps. The device consists of a 10-hp. vertical boiler, mounted on a steel wagon frame, and is fired with wood or coal, building steam pressures up

PORTABLE STERILIZER FOR USE IN CONSTRUCTION CAMPS

to 110 lb. per sq.in. An old locomotive air compressor mounted on one side of the boiler is used to maintain a pressure of about 90 lb. per sq.in. in a reservoir fastened to the wagon frame on the opposite side of the boiler. A 10-gal. tank also attached to the wagon frame is used as a storage tank for creosote oil. Air pressure is admitted to this tank so that the creosote can be forced out as desired.

The device is arranged for operating two hose lines, one direct from the boiler for the use of live steam, and the other fitted with a combination nozzle taking air pressure from the air reservoir and creosote from the storage tank, the arrangement of the nozzle being such that the creosote oil is delivered in a fine spray.

Steam may be substituted for the compressed air in the combination nozzle.

When a building is to be treated by this method all contents are removed, including building paper or other wall coverings. The base boards, door, and window frames are also loosened. The entire interior is then given a thorough treatment with live steam, special attention being given to cracks and corners. Next, all surfaces are given a light coating of creosote oil by using the combination nozzle. After drying for 24 to 48 hours, according to atmospheric conditions, the building is ready to be re-equipped for occupancy.

The live steam kills all vermin and eggs, and the creosote oil, which impregnates the wood, tends to prevent the re-entrance of pine bugs or vermin. While the creosote jet is being used a fine vapor of creosote oil fills the building and if left closed it is untenantable for several hours. Operators must wear gas masks and can work only for short periods. The machine is towed from job to job by motor truck and requires three men in its operation: a fireman, operator, and helper.

"Do you remember—"

Weather conditions will soon drive construction men and engineers, who have been working long hours on a thousand projects throughout the country, indoors. Reminiscence will replace actual experiences: and numberless conversations during the coming winter months will begin with:

"Do you remember—"

In many instances the query will doubtless recall a particularly hard job solved through someone's ingenuity or quick thinking. *Engineering News-Record* invites its readers to translate such reminiscences into "copy." Potential *Job and Office* articles are frequently contained in a conversation which begins with:

"Do you remember—"

Laying Pipe in Unstable Soil

By McKean Maffitt

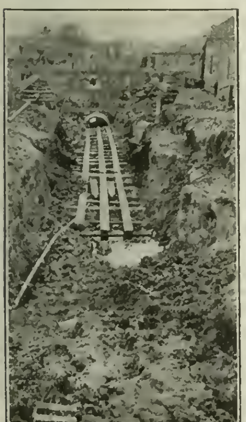
Superintendent, Department of Public Works, Wilmington, N. C.

In cutting an open ditch recently for drainage purposes such unusual soil conditions were encountered that it became necessary to use large concrete pipe and then refill the ditch. The soil proved so unstable that backfilling became necessary as each short section of pipe was laid.

The average depth of cut was about 8 ft. with side slopes of 1 to 2. For about 5 ft. of the depth a stiff yellow clay was encountered which was most stable, but underneath this was a stratum of oozy blue clay which the upper layers of stiff clay forced out into the excavation, thereby throwing the ditch out of alignment and filling it up. In some instances the ditch filled 3 or 4 ft. overnight, and the sides settled nearly as much, leaving berms at the excavation's sides from 3 to 5 ft. wide.

To lay the pipe a 12x12-in. timber set upon a track was placed across the ditch. Lengths of pipe were lowered by a chain hoist suspended from the timber. The excavation was made large enough for the pipe, with an allowance for sliding. After the pipe was picked up by the improvised traveling crane and moved to within 4 ft. of final location the final excavation was made and the pipe lowered to grade and immediately covered with enough mud to hold it in place. In several instances the movement of the ground was so rapid that the crane settled with the banks and the process had to be repeated.

The usual day's run was from four to five lengths of pipe with one foreman and nine workmen, but in some cases the sliding of the earth was so troublesome that not more than one length of pipe could be laid.



LEFT—IMPROVISED GANTRY HANDLES PIPE LENGTHS
RIGHT—GENERAL VIEW OF DITCH

The stump in the foreground moved horizontally 3 ft. in one night. The berm at the side is about 3 ft. deep, and was formed the same night.

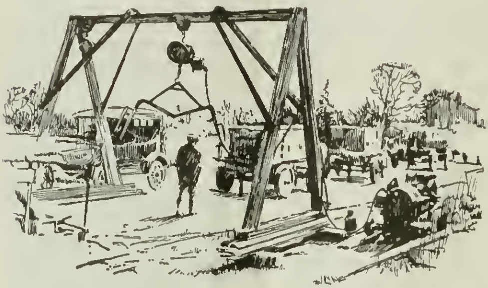
Light Gantry Used in Transferring Batch Boxes on Road Job

Construction of a 10½-mile concrete road in North Carolina, known as State Aid Project No. 533, involved some rather unusual difficulties due to the fact that the only available materials shipping point was one mile from the end of the road. This necessitated unloading of all concrete materials at a siding near where the job began and hauling preproportioned batches in steel boxes on motor trucks and trailers over as much of the concrete road as was opened to traffic and then transferring the batch boxes to industrial cars for transportation past the new pavement to the mixer

In order to avoid turning the trailer around, the truck-trailer unit ordinarily continued past the aggregate bins and drew up at the cement shed, where four bags of cement were placed in each batch box on the truck. The truck was then uncoupled from the trailer and driven to the aggregate bins, where stone and sand were added. Meanwhile cement had been placed in the batch boxes carried by the trailer. The truck then backed up to the cement house, and was coupled to the other end of the trailer, which was then pulled up to receive the aggregates.

With paved streets and the concrete road to haul over, the trucks made good time en route to the transfer station where they stopped under a light gantry crane which carried a pneumatic hoist. The gantry spanned the concrete slab and the track of 24-in. gage along the shoulder. Lifting tongs suspended from the hoist were hooked into holes at the sides of the batch boxes, and they were quickly lifted and moved sidewise to position over an industrial car truck. When enough boxes had been transferred to make up a train load, the cars were pulled to the mixer by a gasoline locomotive.

According to a recent issue of *Concrete Highway*



GANTRY MOVES BATCH BOXES FROM TRUCK TO TRAIN

Magazine, eight cars, each carrying two boxes, was a standard train, though on grades, of which there were several ranging from 3 to 5 per cent, the train length was cut as low as five cars.

The work was done by the Royer-Ferguson Co., Inc., of Roanoke, Va. John D. Waldrop, of Greensboro, N. C., was district engineer in charge of the work for the state.

Welded Tank Joints

A PROCESS of electric welding in the field for the joints of the large steel plates used for the bottoms and roofs of oil storage tanks is a new development in tank work which is being introduced by the Chicago Bridge & Iron Works, Chicago. For an ordinary 80,000-bbl. tank, 117 ft. in diameter, the ¼-in. bottom plates are

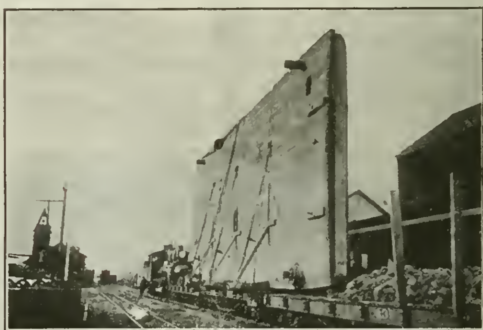
WELDING STORAGE TANK

From Job and Office

Hints that Cut Cost and Time

about 19x6 ft. These are assembled on a leveled surface and tack-welded to hold them in position while the regular welding is being done. The operation is said to be quicker than riveting and more fully to insure oil-tight joints. In the roof also, usually of 3/16-in. plate, it is easier to secure gas-tight joints for the roof itself and for the connection of the roof to the shell. Test specimens are said to have shown ample strength, and in tests continued to failure the break is often through the solid metal instead of at the welded joint. Around the tank bottom is welded an angle-iron ring, to the upstanding leg of which the first course of shell plating is riveted. In the same way the roof is welded to an angle-iron ring on the top of the shell. With the tank bottom laid on the ground for welding, it cannot be tested by filling with water after the first shell course is placed, as is done with riveted tanks in which the bottom is built on blocking to permit of bucking up the rivets from below. As an alternative, oil is pumped under the tank bottom and though only a light pressure can be obtained in this way, the method is considered sufficient to develop any leaks.

Up-ended Barge Moved 43 Miles by Rail



A BARGE, built to be used in dam construction on a stream flowing into Lake Labarge, Alaska, was recently moved 43 miles by rail. Being 21 ft. x 60 ft. in size the barge had to be upended as shown herewith. It was braced by 8 x 8-in. timbers resting on cantilevered beams, three braces being placed on each side of the barge. Additional ties were provided through use of rope lashes and turnbuckles.

Radiation Reduced by Aluminum Paints

The aluminum or bronze paint generally applied to radiators greatly reduces their effectiveness and makes it necessary to have a larger surface for the same heating effect, according to experiments performed by Dr. W. W. Coblentz of the Bureau of Standards. Dr. Coblentz finds that the heat radiated from an aluminum painted radiator surface is less than a third of that emitted by a radiator of the same size painted with a non-metallic paint, enameled, or simply allowed to rust

From Job and Office

For Contractor and Engineer

Finding Yardage in Circular Excavations

By W. F. Schaphorst
Newark, New Jersey

THE CHART herewith will be found convenient for quickly estimating the number of yards to be removed from any ordinary sized circular excavation. To use the chart simply run a straight line across from Column A to Column C and the number of yards is immediately given in Column B. For example, the chart shows 8,700 cu.yd. for an excavation 30 ft. deep and 100 ft. in diameter. The correct answer, making the actual computation, will be found to be 8,720, showing that the chart is surprisingly accurate as well as quick.

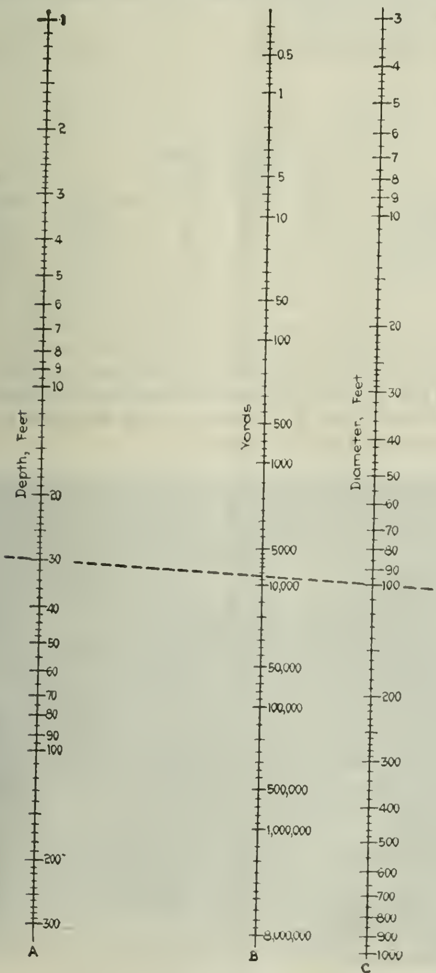


CHART GIVES EXCAVATION YARDAGES

The range of the chart as will be noted, is very great. It will take care of any depth of excavation from 1 to 300 ft. and any diameter from 3 to 1,000 ft. The maximum number of yards is 8,000,000.

The chart can be used as well for determining cubic contents of cylindrical tanks.

Bridge Fills Temporary Construction Use

TO transport material from the river bank to a cofferdam on a hydro-electric project at Gorham, N. H., the contractor, the Sanders Engineering Co., of Portland, Maine, constructed this simple suspension bridge.

Transporting 68-Ton Girders for a Chicago Building

ALMOST the largest steel girders ever hauled into the business district of Chicago for building construction were two 68-ton plate girders which were moved from railroad yards to the site of the new Straus Building at Jackson and Michigan Aves., on Sept. 9. These girders, which will be placed between the fifth and sixth floors and will support the steel frame over the main entrance, are 55 ft. long and 11½ ft. deep. It took practically all day to unload the girders from cars, transport them about half a mile and unload them at the building site.

A railway wrecking car of 150 tons capacity was used by the Chicago, Milwaukee & St. Paul Ry. to load the girders on flat cars at the Goose Island yard for transfer to the team yard of the Michigan Central R.R. at Michigan Ave. and South Water St. There a wrecking crane of the Illinois Central R.R. picked up each girder in turn, as shown in Fig. 1, and placed it on a special combination truck. This truck, shown in Fig. 2, consisted of a heavy drop-frame truck having its front end carried by the rear of a four-wheel tractor and having coupled on to its rear end a trailer with four wheels in a row on two short axles. Wide tires were used on all the eight load-carrying wheels, with ordinary tires on the front wheels of the tractor. About 42 tons or 62 per cent of the total load was carried by the trailer. For hauling such loads it has been usual to employ teams of 50 to 70 horses, but in this case two tractors rated at 40 hp. each were used. These tractors were placed side by side. One was an integral

FIG. 1—WRECKING CRANE HANDLES 68-TON GIRDER

part of the truck and the other was attached to the truck by a heavy chain.

It is stated that the only heavier girder handled in Chicago was a 70-ton girder for the Stevens Building. Two 63-ton girders were used in the Chicago Theater. The 68-ton girders were built by the Phœnix Bridge Co., Phœnixville, Pa., and will be erected by the Thompson-Starrett Co., which has the general contract. This company is using two large steel guyed derricks with 125-ft. masts and 115-ft. booms in the erection of the steelwork of this 32-story building for S. W. Straus & Co. These derricks swung the girders from the truck and will place them in position later.

The transportation of the girders was handled by the Pennoyer Merchants Transfer Co., Chicago.

From Job and Office

Hints that Cut Cost and Time

Cost of Ballast Cleaning: Santa Fe Ry.

FIGURES from work done with five of the Harris-Muff ballast cleaning machines on the Atchison, Topeka & Santa Fe Ry. indicate a cost of 25c. per cu.yd. In the accompanying table the cost is given per mile, and it is estimated that the ballast cleaned would approximate 2,500 cu.yd. per mile. This machine, described in *Engineering News-Record* of March 8, 1923, p. 468, consists of a rotary screen mounted on a small car and driven by a gasoline engine. Men shovel ballast from the track into a long trough having a belt conveyor which delivers it to the screen. The cleaned stone passes out through a chute to the track while the dirt goes to a lateral belt conveyor which discharges it clear of the track.

The work shown in the table covers a little over nine miles and represents an average section of 12 in. of stone ballast. The ballast between ties to level of bottom of ties and that on both shoulders was cleaned and replaced. No complete records have been kept of the cost of cleaning ballast by hand labor, handling it with forks, but it is estimated that this hand work costs about $1,500 per mile.

COST OF CLEANING BALLAST BY MACHINE

Division	Mile of Ballast Cleaned	Both Sides and Between Ties, Depth, In.	Average No. of Men in Gang	Total Cost	Cost per Mile
Eastern	2.73	9	18	$1,788.76	$655.22
Middle	1.77	12	16	943.45	533.02
Western	1 70	14	21	603.27	354.80
Panhandle	2 41	12	50	1,231.49	510.98
Albuquerque	0 52	8	18	997.77	1,918.79
Total or average	9.13	12	20	$5,564.74	$609.50

FIG. 2—TRACTOR-TRUCK-TRAILER CARRIES HEAVY GIRDER

From Job and Office

For Contractor and Engineer

Removing Rails and Restoring Paving at Everett

THE PUGET Sound International Railway & Power Co., operating the local transportation system in the city of Everett, Wash., completed in the month of August the removal of 10 miles of single-track line which has been superseded by motor buses. The city ordinance permitting the company to remove these rails has required that the paving be so restored that after the removal of the rails the portion of the street where the track formerly was located should have a surfacing equally as good as that in the remaining part of the street. The reconstruction of the paving has been done by a single crew divided into squads which followed one another closely so that a minimum length of the street would be torn up at one time.

The first or advance squad consisted of several men using picks, claw bars and shovels. The header bricks outside the rail were not disturbed, but the bricks on the inside were removed, spikes on the inner side of the rails were pulled, and the rails were removed and placed on the pavement alongside. All débris and loose paving was removed and piled on the street and the channels thus left in the pavement were brushed clean ready for surfacing material. The work of this crew was supplemented by trucks which hauled away the rails and piles of débris.

Following this advance squad came a four-man concrete crew with a small portable mixer pouring concrete into the trenches left by the removal of rail and brick. These trenches varied in width but averaged about 18 in. Where the ties were imbedded in concrete they were not removed and hence the depth of the trench was the same as the rail height. In pouring concrete in the trenches a ¾-in. tarred paper joint was put in at right angles to the street center line every 15 ft.

Where necessary, and this constituted a large part of the reconstructed pavement, a three-man asphalt crew followed the concrete squad, using a portable tar kettle and tool-heating rack. The work of this crew was chiefly with square-nosed shovels and hot irons patching small depressions or worn places in the line of header bricks or other parts of the surfacing.

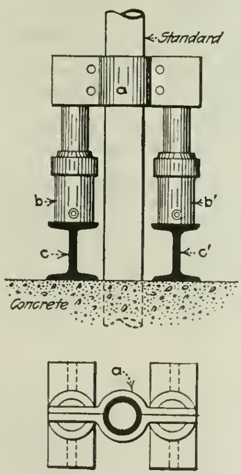
Laying Pipe-Line Under Panama Canal

A 20-in. pipe to carry water from the Rio Grande reservoir to the east bank of the Panama Canal under the Pedro Miguel locks developed a serious leak in April. As the line was embedded in the concrete of the locks the leak could not be located and repaired without keeping the west lock unwatered an indefinite time. In consequence a new line in another location at Paraiso, where formerly the pontoon bridge of the Panama R.R. crossed the canal, was chosen. Cast-iron screw pipe, 12 in. in diameter and 459 ft. long, was assembled in one section on the pontoon of the former bridge and dropped into a trench 5 ft. deep and 25 ft. wide. The ends projected out of the water at each bank and, according to the *Canal Record*, were found tight on test.

Drawings Which Fold to Letter Size—George C. Love, of Newport News, Va., submits a detail of office routine that should prove interesting to those who have in charge preparation of plans which must accompany letters to be sent through the mail. Often odd-sized maps arrive at their destination in bad condition, due to the fact that folding was of a hit or miss nature. Mr. Love finds that by employing the following outside dimensions, maps fold naturally into an 8½x11-in. sheet; 42½x55 in., 34x44 in., 25½x33 in. and 17x22 in. The title is at all times to be found in the lower right hand corner, and the blueprints are to be folded in such a manner that the title card is always visible.

Well Water Level Indicator With Telephone Attachment—Referring to the article in the "From Job and Office" section of *Engineering News-Record* last week, describing a method of discovering the water level in a well by means of a pocket electrical device, S. P. Baird, engineer with The Jennings-Lawrence Co., civil and municipal engineers of Columbus, Ohio, has suggested that a variation of these devices, two of which were described in *Engineering News-Record* several months ago, is secured by the use of an ordinary telephone receiver, high and low resistance coils, and a vibrator. Instead, therefore, of having to watch to discover when the water surface is reached, when the exposed end of the wire touches the water the telephone emits a sound like an auto horn. The sound from the receiver can be stopped or started by raising or lowering the wire $\frac{1}{16}$ in.

Removing Old Tramway Standards—Removal of old trolley-wire standards may often necessitate breaking up by hand the concrete blocks in which they are usually embedded, but a more effective method is removal by means of two small hydraulic jacks and a portable hydraulic pump as described by an English correspondent. Referring to the sketch: Bearer-plate *a* is bolted to the standard at a suitable height from the ground and under each end of this one of the jacks is placed as shown at *b* and *b′* on two short lengths of I-beam, *c* and *c′*. Forcing water into the rams causes the pole to be ripped out of its foundation but in a steady noiseless manner and when the full stroke of the rams is reached the bearer-plate is lowered down the standard and the process repeated.



Plan

Welding Lugs on Sections of Artesian Well Casing—Instead of the usual screw joints used in connecting sections of artesian well casing, a contractor drilling a well in New Jersey recently conceived the idea of applying oxyacetylene methods of welding lugs to pipe sections. The well required nine 20-ft. lengths of steel pipe 18 in. in diameter with walls $\frac{5}{16}$ in. thick. In accordance with plans worked out in the shop, four lugs 1½ in. x 8 in. x ⅝ in. thick were welded on the outside of one end of each section of pipe with half the length of the lug extending beyond the length of the pipe. The lugs were so fastened that a pipe section fit inside of the next successive section, holding the pipe in a perpendicular position while being sunk. This suggestion for artesian well contractors is contained in a recent issue of the house organ published by the Linde Air Products Co., New York.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Shaded Topographic Maps

Sir—An erroneous impression is given in your issue of Sept. 6, 1923, p. 382, that there is something new in the idea of a shaded topographic map. It may be new to the Geological Survey but not new to the Corps of Engineers. The current issue of *The Military Engineer* contains an excellent description by Major A. M. Walker of the work now being done at the engineer reproduction plant at Washington in the production of contour maps with shaded relief and an account of French army map work as developed during the war. The French army maps of 1912, scale 1:200,000 printed in four colors, use shading to bring out the relief as shown by contours. The new series of eastern France, scale 1:50,000, begun in 1914 and not completed by 1918, show the same system much improved and permit an excellent visualization of the terrain.

They give also, what the Geological Survey maps omit, all forested areas in green as well as cultivated areas shown by appropriate marking, thus conveying much more information to the map user than can be obtained from any maps available in this country.

Admitting all the well-known reasons why our country has not yet been mapped as thoroughly as Europe, there should be no reasson why our present mapping should not equal theirs in quality. Perhaps a little team-work between different government departments could help out. At present it would appear as if the War Department could give a tip or two to the Geological Survey. It certainly could in the use of durable paper.

Sandwich, Mass., Sept. 15, 1923. HENRY WELLES DURHAM, Lt. Col. Engr. O. R. C.

[It was not our intention to give the impression that the shaded topographic map was new to either the Geological Survey or to the Corps of Engineers, for it is our belief that both these agencies have been working on this type of map since war days. What we did wish to do was to draw the attention of engineers in general to the shaded topographic map as a new type of U. S. G. S. map in order to draw out some constructive criticism for the benefit of the Geological Survey.—EDITOR.]

Concrete Borers Not Active

Sir—During the current year a number of articles concerning "concrete borers" have appeared in the technical press. The subject is of general interest to the public because concrete is considered one of the best examples of a hard, enduring, all-resisting material; consequently we find references to the borers appearing in numerous non-technical magazines and newspapers.

There has been a wide range in the interpretation of the extent of the observed work of the borers. The most pessimistic would have it that all concrete is doomed when placed in water infested with them. The writer recently had the opportunity of inspecting concrete at a number of points along the coast of California and is very optimistic concerning this threatened scourge of concrete in sea water.

At La Jolla near San Diego there is a concrete pier at the Scripps Institution for Biological Research. This should be an excellent place to obtain information, but inquiries revealed that while the borers are numerous in the locality and can be easily located in the shale cliffs none have ever been found in the concrete.

At San Pedro the borers are found in only one locality in the harbor and the writer was told that considerable time would be required to find any of them.

The borers are known to be present in San Francisco Bay, but according to engineers of the California Harbor Commission no concrete has been found attacked by them.

Chicago, Sept. 10, 1923. J. C. WITT, Structural Materials Research Laboratory.

The Right Way to Help the Japanese

Sir—I wish to voice my hearty approval to your note to Dr. Waddell's letter published in the issue of Sept. 6, 1923.

My experience in France and Italy during the late war and the personal contact I had with engineer and architect refugees from the invaded zones lead me to think that having passed the first short period following the calamity our colleagues' desire is not to have the little financial help which the more fortunate colleagues can give, but opportunity to work and provide their own livelihood.

It seems to me the Japanese have plenty of work in their own country provided they have the means to go ahead with the rebuilding of their devastated cities. What they will need most are the materials and machinery for their work.

It is admitted that most of the materials and machinery will have to come out of the United States. And here is where we engineers, manufacturers and dealers on these goods can help them, and helping them help ourselves with no injury to anyone.

We note already an increase in price of the very goods most needed.

Here is where we can serve. Let us sound a clarion note to be heard all over the world that any increase of price in the line of goods needed in Japan is not justified by any economic reason but is the consequence of the greed of the manufacturers, merchants, and transportation companies, and will result in defeating our noble purpose of helping Japan and be very serious to our industries.

With the exception of wheat there is ample margin of profit with the present prices, and this profit will be greatly increased with the increase in the volume of business. Let us distribute our production throughout the entire year. Let us take advantage of this opportunity to fill in the gaps on the production year, and everybody will be better off, and we shall surely help not only our Japanese colleagues, and their fellowmen, but our own people as well.

I am tempted to comment more fully on this topic, but I think I have said enough. Let us work hard at it in true patriotic American spirit. FRANCESCO MAURO, Engineer and Architect.

Birmingham, Ala., Sept. 15, 1923.

Water Economy of Ash Pits

Sir—Referring to the abstract of report of the A.R.A. committee on Engine Terminal Design, page 424 of the Sept. 13 issue of *Engineering News-Record*, there has been a great deal written, published and read before societies in recent years about railroad terminal design, dwelling largely on capacity, equipment and economy, describing in detail the design of terminal, enginehouse, turntables, coaling stations, cinder pits, etc., but not a word on an economical water service to cinder pits.

Why stop part way on the subject of economy? Do the engineers and designers *know* the difference between an economical cinder pit hydrant service and a wasteful layout? There is a difference and a big one and I am sorry to say from twenty years of close observation of this subject that very few do. True, most engineers know that all water to railroad terminals is metered, but that does not mean that the meter is considered—waste goes on regardless because of the absence of a preventive.

I know of many instances, one in particular, where the water engineer put his economy program into effect down to the smallest hydrant, including the cinder pit hydrants, and caused a saving of some $30,000 in metered water in the city of Chicago. This same practical water-works engineer extended that hydrant economy program to all parts of his road with an unprecented record in economical water service. WILLIAM VOLKHARDT, President, Volkhardt Co., Inc.

Stapleton, N. Y., Sept. 15, 1923.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Four Killed in Explosion at Bureau of Standards

Washington Correspondence

No official information is yet available as to the cause of and the responsibility for an explosion in the dynamometer laboratory of the Bureau of Standards on Sept. 20, resulting in the death of four employees and injury to six. The coroner's jury pronounced the death of the victims to have been due to "an accidental explosion of gasoline and air mixture in the altitude chamber."

The dead are Logan L. Lauer, assistant physicist; Urvan J. Cook, machinist; Stephen M. Lee, mechanical engineer; J. E. Kendig, assistant electrical engineer. Among the injured Herbert K. Cummings, an associate physicist, continues in a critical condition.

An exhaustive investigation of the accident is proceeding as rapidly as possible but no announcement will be made until the investigation is completed. It is expected, however, that the investigating committee will find that the cause of the accident was due to leakage of gas fumes from the engine that was being tested.

Secretary Hoover referred to the dead as "martyrs to science." The damage done to the building can be repaired for less than $10,000. No important delay will take place in the testing of airplane engines.

It is pointed out that this accident will tend to emphasize the importance of the resolution adopted by the executive board of the American Engineering Council at its meeting in Cincinnati on March 23. In that resolution, it was pointed out that the government "is paying heavily in the form of employees' compensation, as well as in loss of time and efficiency, for its failure to adopt a thorough-going safety program." Attention is called to the fact that the government falls far short of the standard set by many private employers, the more progressive states and some of the municipalities. Federal safety standards were drawn up during the war, but there is no officer having the authority to enforce such standards, the resolution states.

Federal Permits Granted for Two San Francisco Bay Bridges

Permission has been gr nted by Secretary of War Weeks for the construction of two vehicular bridges across the lower end of San Francisco Bay, one to Frank Eldridge Webb, to have its western end at Little Coyote Point, and the other to John Lyle Harrington for a bridge at Dumbarton near the site of the present railroad bridge. Franchises for both these bridge projects have already been granted by San Mateo County. A résumé of the discussion about the two bridge sites was published in *Engineering News-Record*, Sept. 7, 1922, p. 411.

Steel Frame and Reinforced Concrete Structures Survive Japan's Earthquake

Refugees Arriving in Seattle Sept. 16, Tell Special Representative of "Engineering News-Record" Details of Disaster

By W. A. Gleason
Port of Seattle Commission, Seattle, Wash.

When it was learned that the first refugees from the earthquake-stricken cities of Japan were due to arrive in Seattle, Wash., Sept. 15, "Engineering News-Record," through the co-operation of George F. Nicholson, chief engineer of the Port of Seattle, arranged with W. A. Gleason, a member of his staff, to board the "President Jefferson" as soon as she should dock and secure from such engineers as might be among her passengers information regarding the effect of the quake on the engineering structures in Tokyo and Yokohama. Mr. Gleason undertook this assignment as the special representative of this journal; his report follows.—Editor.

Following the receipt of your telegram on Sept. 12, I made arrangements through the traffic manager of the Admiral Oriental Line to meet the ship *President Jefferson* due to dock in Seattle, Sept. 15, with the first group of refugees to reach the United States from the cities of Japan devastated by the earthquake of Sept. 1. On Sept. 14 I lunched with an American engineer who returned from Japan in 1920. He acquainted me with the geography of the territory in the earthquake zone and with the character of some of the engineering structures. Additional information was secured from Mr. Shivagaki, Seattle manager for Mitsui & Co., Ltd.

The *President Jefferson* was reported due at Seattle at 11.30 p.m. Sept. 15. I reached the dock at about 10 p.m. where I learned that the boat was expected to arrive about 3.30 a.m. Sunday, so I returned home for a few hours' sleep and was back at the dock at 7 a.m., before the refugees not on stretchers came off the ship. I passed the outer guard successfully but the guard at the gang-plank insisted that none could pass without a permit from the manager or the customs collector. The manager was not there as agreed, but by interviewing one of the refugees I learned the name and room number of "just the engineer you want." I was permitted to send a message to him, with the result that he promised me an interview the following day. He was too busy that day with another engineer in connection with a hospital for the wife of one of them. However, I met both of these engineers and also a college professor who was hurrying to make train connections. Although provided with a list of all engineers aboard and although I approached each person as he had his baggage inspected, I did not meet more than the aforementioned three. Sunday evening I was granted an interview with the two engineers in a local hotel. The following notes summarize their statements regarding the effect of the earthquake in Yokohama and Tokyo:

In Yokohama

The reinforced-concrete skeleton of the Russo-Asiatic Bank Building, three stories high, remained after shedding its coat of stone and brick. The heavy timber and stone Thomas Cook & Son Building was completely wrecked and every human being within lost.

The masonry walls of many buildings withstood the earth shocks while their floors and roofs were precipitated to the ground.

The six-story Telephone Building with steel skeleton frame withstood the earthquake.

The breakwater in the harbor disappeared except its ends, which remained with their lighthouses erect.

A dock with reinforced-concrete deck lost about ¼ mile of its length, while about 600 yd. remained standing. The details of the underpinning of this dock were not observed.

A reinforced-concrete locomotive roundhouse remained standing and without a noticeable crack, while across the turntable the earth was badly fissured and sunken.

(*Continued on p.* 531)

Real Progress in the Development of the Port of New York

The second joint hearing of the Interstate Commerce Commission and the Port of New York Authority at which the railroad companies having terminals on the west side of the Hudson River at New York were called upon to show cause why the port authority's proposed marginal railroad on that side of the river should not now be made effectual, has ended in an unexpected and promising way. From an attitude of being openly hostile to the proposed belt line at the hearing last spring the railroad companies have come forward with a plan for operating it and have outlined certain improvements in the existing tracks which they think should be made. This change of front made a continuation of the hearing unnecessary at this time, consequently it has been indefinitely postponed while the railroads and the Port Authority get together and outline the manner in which the belt line will be made up and operated. The details of the proposals of the railroads and their relation to the plan of the port authority will be given in next week's issue.

Binghamton Brick and Tile School Building Fails

Investigations May Show Removal of Supports Under Green Concrete, or Weak Tile Wall, to Blame

Special Correspondence

The Daniel S. Dickinson School, a 40-room, three-story grade school under construction at Binghamton, N. Y., failed just after workmen had left in the afternoon of Sept. 18. The portion of the building which collapsed included an area in plan about 60 ft. x 75 ft., comprising the external wall and two interior walls from the roof to the basement. Estimates of damage have been placed anywhere from $20,000 to $80,000.

Rudolph P. Miller is investigating the failure for the city authorities. Investigations to date from others have tended to narrow possible failure to two causes: premature removal of wooden supports from under fresh roof concrete, and structural weakness of one of the interior tile bearing walls. The supports for the concrete floors and roof consisted of two 2 x 4-in. pine timbers, spiked together in the form of "T's" and spaced on an average of 4 ft. 6 in. across the rooms and 5 ft. 6 in. along the rooms, each support thus carrying about 25 sq.ft. of roof or floor. The supports were from 13 to 15 ft. long and were supported at about mid-height by 1 x 8-in. braces in each direction. They were capped along the long dimension of the room by 2 x 6's. About half the supports under the green roof concrete had been removed prior to the pouring of the roof.

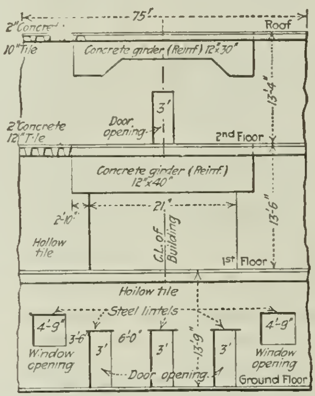
If failure occurred in any of the interior walls it was probably in the first wall inside the enclosing wall. This wall was 26 ft. in from the exterior wall and parallel to it, and was of 12-in. tile. It was pierced by numerous openings as shown in the accompanying figure. It also included the rather peculiar feature of a 30-in. concrete girder resting on it and extending partially along its top. The failure was so complete it will be difficult to decide which of these causes may have been responsible, if either.

Cause Yet Unknown

No definite decision as to the cause of the failure has yet been reached due to the completeness of the failure and the danger of further collapse of portions of the front wall. Workmen refuse to start the demolition from scaffolds of such portions of the front wall as remain standing and the city is unwilling that any more wreckage be added to the mess in the building until every effort has been made to establish the responsibility. The contractors will attempt to remove the dangerous portions of the wall by means of derricks.

Exterior walls of the building were of interlocking tile with a brick facing and interior walls were of tile. Exterior walls were 16 in. thick from the basement to the first floor and 12 in. thick from there to the roof. These thicknesses included the brick facing. Interior bearing walls were 12 in. thick, except for one 8-in. wall extending from the second floor to the roof. This 8-in. wall was not completed when the failure occurred. Specifications provided that these walls should be laid up in cement mortar and that in portions subject to heavy bearing the tile should be filled with concrete or the space laid up with brick. A subsequent agreement required the brick veneering to be bonded into the tile by a header course every seven courses.

Floors of the building were of the steel-pan concrete type, the pans being 10 in. and 12 in. and covered with a 2-in. concrete slab. Over the corridors



ELEVATION OF INTERIOR WALL BEFORE FAILURE

the pans were being removed for the most part for reuse. At the time of failure the first floor had been placed about three months and the second floor about six weeks.

Proposals for the construction of the school were received by the City on December 20, 1922. Five contractors submitted figures for the general construction work, the bids ranging from $329,700 to $426,700. The work was awarded to the low bidders, Kirkpatrick and Stento of Binghamton, their proposal being $26,255 under the next lowest figure. Construction was started early in the Spring and the work was progressing in a fairly satisfactory manner.

The building was designed by Dickerman and Bartoo, Binghamton architects, and the building was being constructed under their supervision.

Bayonne, N. J., Rejects Proposal for Shipping Terminal

The $150,000,000 shipping terminal and industrial center proposed for Bayonne, N. J., has been rejected by the board of city commissioners on the ground that the bond offered by the New York Port Terminal Co. is inadequate. The project has received considerable publicity as it is reported to be backed by William B. Franklin, brother of P. A. S. Franklin, president of the International Mercantile Marine; Gen. Wiliam M. Black; and William Coyne, vice-president of the du Pont de Nemours Co.; John G. Gray of Wilmington, Del.; and Henry J. Hemmens of New York.

The objection to the bond is made on the basis of the fact that under the proposed agreement the city is required to issue $20,000,000 worth of bonds with an annual interest rate of $1,200,000 and that the bond offered by the company would only pay this interest for a few months in case of default.

Convention of New England Water Works Men

Forty-Second Meeting Held at Burlington—Business Proceedings—David Heffernan President

Engineering News-Record Staff Report

After a lapse of 28 years the New England Water Works Association met last week for the second time at Burlington, Vt. About 400 members and guests were registered. The Water Works Manufacturers Association provided an all-day visit to Au Sable Chasm, reached by boat across Lake Champlain.

At the opening session honorary membership was conferred on John R. Freeman. The Dexter Bracket medal was awarded to Charles W. Sherman, of Metcalf and Eddy, Boston, for his paper on "The Proper Term for Which Water-Works Bonds Should Run"—printed in the *Journal* of the association last December.

The tellers' count showed that 419 ballots had been cast and that the principal officers elected were: President, David A. Heffernan, Milton, Mass.; vice-presidents, Theodore I. Bristol, Ansonia, Conn., and Stephen H. Taylor, New Bedford, Mass.; and treasurer (re-elected), F. I. Winslow, Framingham, Mass.

President's Address

The chief feature of the address of the retiring president, Percy R. Sanders, Concord, N. H., was the experience of the association as one of the nine organizations composing the Affiliated Technical Societies of Boston. Before the affiliation the association employed an assistant to the secretary, at a salary of $1,200 a year, and rented quarters in Tremont Temple, Boston, at $750 a year, making a total of $1,950 for these two items. Since the affiliation the assistant secretary has been clerk of the affiliated societies and is paid by that organization. The headquarters are unchanged. The association pays to the affiliated societies $3 per member with adjustment for duplicate membership. For the year ended May 31 these payments totalled $1,983 as compared with $1,950 previously paid for rent and assistant secretary.

The membership of the association was 1,043 on Jan. 1, 1917 and on Sept. 1, 1923, it was 769, a loss of 274 members. During the year the association lost by death Rudolph Hering, honorary member, and Lewis M. Bancroft, treasurer.

Secretary's Report

The report of the secretary, Frank J. Gifford, Dedham, Mass., showed a net membership loss of 59 during the eight months ended Sept. 1. Some of this loss is due to the annual dropping of members for non-payment of dues which will be partly made up before the full calendar year has been completed. The association year begins Sept. 1 instead of Jan. 1 under recent changes to the constitution. The report of F. I. Winslow, treasurer, showed a substantial balance both in ready cash and in invested funds. The net cost of the *Journal* for the year according to the report of Henry A. Symonds, editor, was $341.

The technical proceedings of the convention will be found on p. 515.

Am. Soc. C. E. Announces Fall Meeting Program

Highway Engineering Transport and Port Problems Are Chief Topics of Discussion

Highway engineering and transport problems and special sessions by the power and highway divisions of the society, together with a full discussion of Norfolk's port problems and the development of Hampton Roads, Va., comprise the technical features of the fall meeting of the American Society of Civil Engineers to be held in Richmond, Va., Oct. 17-20. Not all of the time will be spent in Richmond as excursions have been planned to include Norfolk and Washington, D. C., Oct. 19 and 20. In addition to the technical discussions, there are the usual social features, and numerous excursions to various points in historic Virginia have been planned.

The morning session on the first day will be called to order by James A. Anderson, associate professor of civil engineering of the Virginia Military Institute, who will be followed by Governor E. Lee Trinkle, who will give the address of welcome. A response by Charles F. Loweth, president of the society, will follow.

Group of Highway Papers

The following highway papers will be delivered: "Fundamental Principles of Highway Financing," by Thomas H. MacDonald, chief, Bureau of Public Roads; "Road Service in Industrial Regions," by George E. Hamlin, of Hartford, Conn., superintendent of repairs of the Connecticut Highway Department. Various short discussions will follow these speeches.

C. M. Upham, chief engineer of the North Carolina State Highway Commission, will read the principal paper at the meeting of the highway division in the afternoon of Oct. 17. "Development of State Highway Systems" will be his topic. At the meeting of the power division at the same time, "Interconnection of Southern Appalachian Power Systems" will be the principal paper and will be read by W. S. Lee, of Charlotte, N. C., chief engineer of the Southern Power Co. and of the Quebec Development Co.

Will Discuss Norfolk's Port

The morning session on Oct. 18 will be given over to the following papers: "The Port Problems of Norfolk and Vicinity," by Homer L. Ferguson, president of the Newport News Shipbuilding & Drydock Co.; "Norfolk's City Plan in Relation to Its Port Development," by George B. Ford, New York, president, National City Planning Conference; "The Railways' Part in the Development of Hampton Roads," by Charles S. Churchill of Roanoke, Va., vice-president of the Norfolk & Western Ry. Following these will be given a paper on the "Program and Results of the Research on Structural Design of Roads by the Bureau of Public Roads," by A. T. Goldbeck, in charge of tests, U. S. Bureau of Public Roads, Washington.

On the trip to Norfolk and Washington stops will be made at Norfolk Army Base, Hampton Roads Naval Base, including the submarine base, the training station, the aviation station, and the supply base. The party will then be shown around the harbor on government and harbor tugs, visiting the Portsmouth Navy Yard, the naval hospital, and the coal piers of the Norfolk and Virginian Rys. The next stop will be at Old Point Comfort. From there Yorktown will be visited and then the party will pass up Chesapeake Bay and the Potomac River to Washington, D. C. One of the most interesting of the trips in Washington will be a visit to the Arlington Experiment Station, U. S. Bureau of Public Roads.

Coal Commission Urges Supervision of the Industry by Commerce Commission

Final Report Summarizes Previous Reports—Recommends Action by Government, the Industry, and the Public

The United States Coal Commission selected by the President on October 10, 1922, has given nearly a year to collecting facts concerning the industry and to the study of the data so gathered. During that time it has submitted numerous reports dealing with various phases of the industry and now it has concluded its work by submitting a final report to the President and Congress. This report is abstracted below.

Both to protect the public and to promote the normal development of coal mining as one of the great basic industries of the country, the Coal Commission in its final report recommends the use of the powers of the federal government over interstate commerce by the creation of a division of the Interstate Commerce Commission to exercise the necessary administrative and quasi-judicial functions required for the coal industry. "The function of the government is that of supervision, with substantial powers of regulation. The same principle has been applied for a longer time to the railroads and this may be regarded as the characteristically American and constitutional method of dealing with such a national problem as is now presented in the coal industry. The commission has aimed to make such proposals as will increase rather than decrease the sense of responsibility within the industry. A legitimate pride in workmanship, in fair practice, in operating and commercial enterprise will be developed not by taking over from an industry its own natural functions and placing them in the hands of the government, but by such measures as will insure public knowledge and will create public confidence that abuses are in a fair way to be removed, and that service is constantly improving. This means drastic regulation when necessary as a last resort for those who will not voluntarily give the service on reasonable terms; but it means also a reasonable attitude on the part of the government and the public toward investors who risk their capital either in operating or in marketing, and toward miners who risk their lives in a laborious and hazardous occupation."

The commission goes on to say that it realizes that it is passing upon an economic fact and not upon a law, and that the government can act only through administrative agencies, that if anything is to be done an effective agency with sufficient funds, experience, and powers at its disposal must be charged with the direct responsibility for such regulation and supervision. It believes that the logical and appropriate agency to exercise the necessary administrative and quasi-judicial functions already exists in the Interstate Commerce Commission. "The regulation of commerce in coal involves the right to know the cost of its production, whether the investment on which a return is claimed is fairly estimated or inflated, and what profits are made by owners, operators, and the dealer, and what are the earnings and working conditions of the miners."

Under the proposed arrangement the whole responsibility for the administrative correction of abuses, the regulative function, will be placed with the Interstate Commerce Commission and the fact finding and interpretation of the facts might be divided between the Geological Survey and the Bureau of Mines.

The first step toward the protection of public interest in the mining and marketing of coal will be the publication of facts concerning the industry so that the people will be able to exercise wisely the power of government over this type of private business. Both the government and the leaders

Fire Sweeps Thirty-Seven Blocks in Berkeley, Calif.

Special Correspondence

Thirty-seven city blocks in the residential district of Berkeley and joining the University of California campus were swept clean by fire on Sept. 18 when a strong wind drove a brush fire from the hills into the city. Averaging the value of the 640 buildings destroyed at $7,000 each the total structural loss is estimated at $4,500,000. The district burned was exclusively residential containing practically no fireproof construction. The destruction was complete, only brick chimneys were left standing in the path half a mile wide along which the fire advanced for about three-quarters of a mile. There were no fatalities.

The striking feature of the fire was the rapidity of its advance due to a strong wind which carried burning embers to dry shingle roofs, repeatedly causing roofs in an entire block to blaze up almost simultaneously. Firefighting equipment was sent in from neighboring cities and dynamite was used to raze buildings in the path of the flames, but the fire advanced steadily until the wind abated. There was ample water in the reservoir but due to the failure in recent years to meet needed increases in the distribution system the amount of water delivered was inadequate and at some points the supply failed altogether.

Conclusions are that fire breaks must be provided to keep brush fires from residential districts and that a fire advancing along a wide front with a strong wind in such a district is at best extremely difficult to check, and without adequate water will be beyond control.

of the coal industry will then be responsible if the public has no proper conception of what coal means to the country, what conditions have to be met in the mining and distribution of coal, what economies can be effected, and what advance is needed for bettering the working conditions of the miners. Such publicity will make it possible for the consumer to judge whether a fair price is being charged for his coal, and to form a judgment as to the equities of disputes between operators and miners over the renewal of wage agreements.

Use of Federal Powers—But the government, according to the commission, to fulfill its obligations to the people must go beyond continuous fact finding and publicity. It must regulate and supervise. "In the anthracite industry, the fundamental evil is monopoly—the treatment of limited natural resources as if they were like other private properties." This industry has been stabilized but at a high cost to the consumer and with such inequalities in the wages of the miners as to require a thorough revision of the wage scale. The special report on anthracite disclosed these conditions as well as excessive royalties and differential profits. These disclosures demonstrate the necessity of "limiting the margins to a reasonable return on legitimate investment and the elimination of monopoly profits.

"One remedy, short of price fixing or public ownership, remains in the hands of the government for the protection of the public interest. This is the levy of a graded tax on royalties and differential profits. This would not lower the price of coal, but would secure a public revenue without increasing the price of coal. The present sales tax imposed by the State of Pennsylvania on anthracite gives no such protection, . . . since it is a percentage on the f.o.b. mine price . . . and is therefore passed on to the consumer in the form of still higher prices. An excess profit tax, . . . under these monopolistic conditions, would not be added to the price of coal . . . as it would only fall on those who have differential advantages.

"The main remedy, however, against extortionate prices lies in the consumer himself. There are substitutes for hard coal and a readiness to resort to them is the ultimate and effective defense against an unreasonable price."

In the mining and marketing of soft coal which "from the point of view of national economic life is the more important industry has the fundamental evils of overdevelopment, and irregularity of operation, and consequent enforced idleness of the miner and the invested capital. This problem can be solved by the federal government . . . through the granting or withholding of transportation service and the consequent establishment of an equilibrium between demand and output.

"The most convenient and practicable of the various possible methods of exercising the right of control over the interstate commerce in coal would appear to be the licensing of all who desire to ship coal from one state to another or to buy and sell in interstate commerce, whether as operators, wholesalers, or jobbers. Reasonable conditions . . . would naturally be attached to the granting of the license and violation of them would be cause for suspension or revoking the license."

General Recommendations—The commission's findings of fact and its conclusions based thereon have been given in a number of preliminary reports dealing with both the anthracite and the bituminous industry, and appendices to these reports and on other subjects resulting from the commission's studies will be transmitted to Congress at a later date. This final report summarizes the recommendations already made and concludes with three general recommendations made to the parties in interest, namely, "the general public in its governing capacity, whether represented by Congress or other legislative bodies; second, the coal industry itself — operators, mine workers, and retail and wholesale dealers; and, third, the great body of coal consumers—railroads, public utilities, and the millions of citizens who buy coal. These general recommendations are (1) governmental actions; (2) actions by the industry, and (3) actions by the consumer."

Governmental Actions—This first recommendation of the coal commission is that Congress make definite provisions on a permanent basis for continuing the collection of coal facts by the Interstate Commerce Commission, as outlined above, and the determinations by Congress under what conditions the products of these mines may pass in interstate commerce. The river movement of coal, considerable at one time, but since discouraged by artificial rail rates, would help to get more coal to market with less coal cars. "Economy in the use of transportation also demands that the long haul of coal be no longer encouraged by favoring rates established without adequate regard to the cost of the transportation service rendered." In order to furnish "an economic incentive for regular, off-season purchase and storage of bituminous coal, thus increasing the length of the average working year for both miner and mine and so reducing the cost of production, the controlling influence should be given to the commercial factor in the distribution of railroad cars to coal mines in times of transportation shortage. By this change in practice, first consideration would be given to the commercial ability of the producer to sell coal rather than to mere ability to produce and load it into railroad cars.

"As administrator of the public estate which includes 50,000,000 acres of coal land . . . the federal government has a direct responsibility in restraining overdevelopment . . . and should amend the leasing law to give the Secretary of the Interior full discretion to make his approval of the opening of a new coal mine . . . contingent on the showing before the Interstate Commerce Commission that such a mine would serve the public and not involve a needless investment and excessive cost of operation."

The commission also recommends that Congress designate an agency to unite with the industry in continuing studies of unemployment, of the rate structure, and serving as a medium of publicity for all basic facts on which industrial relations depend. Such an agency would best be prepared to make special compulsory investigations whenever the prospect of failure to renew an agreement is imminent. In all the investigative work relating to mining it recommends that the federal government should continue to co-operate with the state governments in inspection, revision of mining codes, supervision of compensation insurance, and in safety education, and should see that state inspection is freed from politics, that some state codes are revised, and that the regulations of the Bureau of Mines are rigidly enforced.

"The consolidation, grouping or pooling of bituminous mining operations should be not only permitted but encouraged, with a view to securing more steady production, less speculative prices, a wider use of long-term contracts with consumers, better living conditions, more regular employment, and lower cost. The existing legal barriers to such an economic arrangement should be removed, retaining, however, the necessary protection to the public interests, by requiring supervision of the financial structure of the consolidation as is prescribed in the Transportation Act for railroad consolidation.

"There is neither constitutional nor economic warrant for the federal government undertaking the distribution of coal in the several communities of the country. . . . Therefore, it is the function of each community by licensing retail coal dealers, by organizing co-operative associations, by establishing municipal fuel yards, . . . to take the necessary steps that after the coal reaches the railroad siding the distribution thereof is made to the consumer upon a fair and equitable profit to the distributing agency whatever it may be."

Action by the Industry—"The commission realizes that the largest opportunity and the largest responsibility for putting the coal industry in order lies with the industry itself. The coal industry reveals . . . two distinct and contrasting tendencies in management. There is one that is animated by a purely inquisitive and exploiting spirit that has no other apparen end in view than to make money for the owners. Quick to make most of any panic among buyers, of any opportunit, to pyramid sales, to sell adulterated coal or to cut the wages of miners. This type of operator and dealer resents public interference or public knowledge of his business. He is rightly called a profiteer. . . . But besides profiteering there is also in the coal industry . . . a less conspicuous but equally unjustifiable element in the cost to the consumer." It is "a substantial part of the amount paid in royalties and in excess profits to owners of wealth who perform therefore no useful social service and who take no part in production. . . . There is no way in which this first deduction from the value of the product can be forcibly prevented, as far as the commission is aware, except through government ownership, which we believe to be both undesirable and impracticable, or by taxation on the excess profits and royalties, which we recommend."

The second class of operators and owners are those that are commencing "to realize their duty as citizens and who by their enlightened self-interest are establishing a spirit of co-operation that will promote the prosperity of the industry. They aim to pay fair wages.

to remove the cause for the sullen hostility which prevails to an astonishing extent among workers . . . to make mining a safer occupation even if this means lowering down production, to sell at a reasonable price that will bring a fair return to the investors with steady operation of the mines, to establish a reputation for clean and well prepared fuel, to standardize fair practices in contracts between sellers and buyers, to lay out and develop the mines in such a way as to conserve and economize the coal and to bring it to the market at the least expense, and to come through clean as an industry capable of solving its own problems, with a minimum of governmental supervision—all this is already clearly in the minds of many operators, miners, and dealers." The commission has greater confidence in such internal organization and such educational work as will promote these remedies than in any which is within the power of the Congress or legislatures to apply.

Opportunity for co-operative effort is in bettering conditions outside of the mines by providing better sanitary arrangements, by better roads and streets and schools, by improvements in the food supply, and in the facilities for healthy outdoor recreation. In their labor relations, common interest should lead both operators and miners to study the problem of unemployment and to seek to stabilize the industry. Joint committees should study the whole rate structure and its relation to the different jobs in the mines, perfect the machinery for settling disputes through conciliation or voluntary arbitration, and in the non-union field see that adequate check is kept on the right of discharge. "The operators need more effective organizations for labor relations and we recommend district and national labor commissioners, men of the highest type, who can work out a national labor policy. If the Sherman Anti-Trust law prevents the operators from combining together for the purpose of collective bargaining with the miners, which the commission does not believe is the case, then Congress should exempt them from the operation of the law for that purpose.

Discussion of Checkoff

"There are valid objections to the checkoff, especially in the collection of fines and assessments, and it has also injurious effects upon the union in divorcing the problem of income from the winning of membership, and in the resulting lack of closeness of contact and of educational service and control by the higher officers to the lower officers, and to the rank-and-file members of the unions; yet the checkoff is not vital enough to justify a suspension of operations, whether the union is seeking to extend its use or the operator seeking to throw it out.

"The history of the past 30 years affords conclusive evidence that the United Mine Workers of America has been the potent agency in the betterment of the miners' working and living conditions, and it is necessary today for the protection of standards that have been obtained. However, unless the union accepts in practice the principle that the public interest is superior to that of any monopolistic group, whether employers or employees, and gives satisfactory guarantees of a fair and orderly adjustment of controversies in other ways than by the exercise of economic force, the public will not view with sympathy the efforts of the union to extend itself over the whole field of the industry."

Action by the Consumer—The commission believes that part of the cure for the existing bad conditions is in the hands of the consumer, and that much can be done by preventing peak demands through systematic storage of coal along the lines indicated by the Federated Engineering Societies. It also believes that a further remedy lies in the purchase of coal by contracts which are more than mere options, and in the proper use of coal through careful studies as to the best grade of coal to suit the needs of both large and small consumers.

An executive order of the President has been issued which transfers the records and property of the commission to the Department of the Interior, and designates the Director of the Geological Survey to perform the administration duties incident to closing the work of the commission.

U. S. Sells Gorgas Steam Plant to Alabama Power Company

Secretary of War Weeks on Sept. 24 sold the Gorgas steam power plant on the Warrior River to the Alabama Power Co. for $3,472,487.25. This plant was built during the war by the government on land belonging to the power company, with a contract provision that the company could purchase it at a fair valuation. It was built as an addition to the Muscle Shoals plant to which it was connected by a transmission line. The total cost to the government was $4,750,000. Much interest has been attached to the plant because Henry Ford in his offer for the Muscle Shoals development has contended that he must have the Gorgas plant to make the development complete.

Drinker Becomes Chief Engineer of New York Port Authority

The chairman of the Port of New York Authority has announced the promotion of William W. Drinker to be chief engineer to fill the vacancy created by the death of B. F. Cresson, Jr., last January. Mr. Drinker began active engineering work as a resident engineer and inspector on the Lackawanna R.R., 1893-1898. From 1898 to 1900 he was construction engineer for the Delaware & Hudson Company's coal department. In 1900 he returned to the Lackawanna R.R. as an assistant engineer on yard and terminal work. In 1902 he went to the Erie R.R. as an assistant engineer on yard and harbor terminal work, which position he held until he was made assistant chief engineer of the same road in 1913. When the New York-New Jersey Port and Harbor Development Commission was created in 1918 he was made terminal engineer, remaining with that commission until its work was taken over by the present port authority in 1921. Since that date he has been terminal engineer and latterly acting chief engineer of the port authority.

Rigid Structures Survive Japan's Earthquake

(Concluded from p. 527)

In Tokyo

The Imperial Hotel of reinforced concrete and fireproof construction withstood both the quake and the fire and stands in good condition structurally.

The Marunouchi Building, of steel-frame and brick construction eight stories high, stood well with the loss of a few bricks. The Mitsukoshi Building, six stories, carrying a tower of three stories, of reinforced concrete, stood well with the possible and doubtful exception of one story, as reported by a very excited Japanese woman who was in the building at the time. The Marut Building of reinforced concrete is reported standing but cracked.

The Shimbashi Railway Station, with steel skeleton and brick walls, is intact.

The Nuzin Building of reinforced concrete and steel is reported standing but probably cracked.

The three story Healing Building of wood and brick was entirely wrecked while a reinforced-concrete building across the street was not damaged. A one-story wooden building next to this reinforced-concrete building was not damaged, so the fact that a building in Tokyo was not damaged is not necessarily any indication of earthquake-resisting qualities but the fact that the only buildings to stand in Yokohama were of steel or reinforced concrete is conducive proof that these materials are the best in use today for such emergencies and that they have excellent quake-resisting qualities.

Two reinforced-concrete bridges about 100 ft. in length of three spans each at Saguragicho withstood the quake. Many steel girder bridges of one span between Tokyo and Yokohama were shaken from their foundations and dropped into the river, always without failure of the steel. Many very heavily constructed wooden temples were totally demolished.

Railroad tracks were shifted from side to side several feet in waves of perhaps 300-ft. lengths.

The water system in Yokohama was destroyed by the first shocks causing geysers a foot in diameter, in places. The water system in Tokyo, while damaged, was still available for fighting fires.

Japan has no extensive municipal sewerage systems.

The electric wires in Yokohama were completely thrown to the ground, electrocuting great numbers of people.

Earth Cracks Open

When asked as to the depth of the earthquake crevasses, the engineer could not say as he did not take time to examine but rather ran and jumped as occasion required to escape. In places, he said, he saw the earth on one side of a crack move in one direction while the earth on the other side moved in the opposite direction parallel to the other movement and to the fissure.

Seismograph records indicate a maximum movement of the earth of about 3 in. vertically and 7 in. horizontally. Such records have little value in view of actual photographs showing uplifts and depressions of many feet—5 ft. certainly, perhaps 10—and horizontal movements of 2 to 4 ft. or more.

American Construction Council Has Annual Meeting

At its annual meeting in New York City on Sept. 21 the American Construction Council paved the way for an increased activity in the coming year on certain subjects which have been selected as outstanding in the building industry. Work is to be carried on under the direction of new committees, which are now in process of selection. The problems, as stated by the Executive Committee ofthe council are as follows:

"The promotion of and co-operation with local building congresses, a national survey of apprenticeship needs and conditions of labor supply, promotion of the stability of employment and reduction of unemployment, comprehensive steps toward the determination of the causes and the elimination of waste in all its phases throughout the industry, a general educational program as to the problems of the industry and its development, and the promotion of the concept of construction activities as a great American industry." The public meetings were confined to general discussion of these problems.

Three resolutions were adopted. In the first it was stated that while the collection and distribution of statistics to serve as a barometer of building were most necessary, the council will defer action toward such an effort. The second resolution favors co-operation of all members of the council with all the agencies now promoting apprentice training, and the third authorizes such sums as may be available up to $25,000 "to be used in the promotion of building congresses in various centers."

D. Knickerbacker Boyd, of Philadelphia, has been made executive vice-president of the council and Dwight L. Hoopingarner, executive secretary, with offices at 28 West 44th St., New York City.

Contract Awarded for Delaware River Bridge Cables

At a meeting of the Delaware River Bridge Joint Commission on Sept. 22, award of Delaware River Bridge Contract No. 8, for construction of the two main cables, was made to the Keystone State Construction Co. of Philadelphia. The award was made upon the basis of bids opened Sept. 19, as follows:

Item	Classification	Estimated Quantities for Comparison	Keystone State Construction Co. Unit Price	Keystone State Construction Co. Amount	Fred'k Snare Corp. New York Unit Price	Fred'k Snare Corp. New York Amount
1	Wire cables	13,500,000 lb.	$0.18	$2,430,000	$0 184	$2,484,000
2	Suspender ropes	50,000 ft.	1.60	80,000	1.90	95,000
3	Steel castings	180,000 lb.	0.15	27,000	0 20	36,000
4	High tensile bolts	6,000 lb.	0.15	900	0.20	1,200
5	Structural-steel shims	30,000 lb.	0 20	6,000	0.12	3,600
6	Cast-iron separators	30,000 lb.	0 10	3,000	0.15	4,500
	Total bid			$2,546,900		$2,624,300

These are the second bids submitted for the construction of the cables, the first opening having been held on Aug. 15, 1923, and bids rejected because they were in excess of the funds available for the work, as noted in *Engineering News-Record* of Aug. 23, p. 322. This contract is the fourth Delaware River bridge contract secured by the Keystone State Company. They constructed the main piers under Contract 2, and they are building the two anchorages, Contracts 4 and 5. The work under Contract 8 will require in the neighborhood of 18 months.

Officials Deprecate Report That Birdseye Party Is Lost

Publication in the daily press of a sensational article suggesting that C. H. Birdseye, the chief topographer of the United States Geological Survey, and his party have been lost while engaged in a survey of the Colorado River, is deprecated by the Director of that Bureau. The article apparently is based entirely on the discovery of wreckage of a Survey boat. Survey officials are confident that this is the boat lost recently by the Water Resources branch, when it was carried from its moorings by high water. Col. Birdseye and the members of his party are thoroughly familiar with the vagaries of the Colorado River and there is no evidence that they have been in any danger.

Kansas Society Starts a "Journal"

The monthly news-letter which the Kansas Engineering Society has been publishing for the past few months is now styled the "Kansas Engineering Journal" and its August number appeared under the new name. It is a 16-page publication 9 x 11½ in., with local news and some of the papers read at the annual convention of 1922. The journal, which supersedes the former annual volume of "Proceedings," is published at Wichita, Kan., under the direction of P. L. Brockway, president, and C. V. Waddington, secretary, of the Kansas Engineering Society.

Contract Awarded for Driving Moffat Tunnel

On Sept. 18 the Moffat Tunnel Commission entered into a contract with Hitchcock & Tinkler, of New York and San Francisco, to construct the Moffat tunnel on the line of the Denver and Salt Lake R.R. The contract price for doing the work is $5,250,000, and the contractors are to do the work for a fixed fee of $140,000.

The contract stipulates that the work shall be completed in 46 months, that should the cost be less the saving shall be equally divided between contractors and commission, that should the 46-month limit be exceeded the contractors shall be penalized $1,000 per day and that should the work be done in less time than is stipulated, the contractors shall receive a bonus of the same amount.

Hitchcock & Tinkler are well known in the west for tunnel work, that firm having but recently completed the 18-mile Hetch-Hetchy tunnel for San Francisco's water supply. The firm also built 16 miles of the Denver and Salt Lake road, including 15 tunnels, and some 500 miles of railroad in the Southwest for the El Paso and Southwestern Ry.

Arizona Presents State Plan To Develop Colorado Power

Washington Correspondence

A plan for the development of the power resources in the Arizona sector of the Colorado River by the state was laid before the Federal Power Commission Monday. Arizona was represented by Governor Hunt and a committee of nine. State Senator Elliott, acting as spokesman for the committee, denounced the Colorado River compact as unfair to Arizona. He said Arizona was asked to agree but got nothing in return. He intimated that federal officials had attempted to coerce Arizona into signing. Arizona is not objecting to granting the Girand license and the development of the power at Diamond Creek by the copper companies, it was explained. The state feels that it will be able to take over those developments when it is prepared to proceed with its comprehensive development of the river's power resources. The upstream states are scheduled to reply to the Arizona contention at an early date.

Railway Roadmasters Hold Meeting at Chicago

Few and short reports, active discussions and a large attendance marked the forty-first annual convention of the Roadmasters and Maintenance-of-Way Association, held at Chicago on Sept. 18 to 20.

In a report on "Track Maintenance in Large Yards," R. W. E. Bowler, division engineer, Pennsylvania R.R., pointed out that with modern heavy cars and heavy switch engines it is not economical to use light or worn rails or to neglect maintenance work. Somewhat the same view was taken by W. F. Muff, roadmaster, A., T. & S. F. Ry., in a report on "Maintenance of Branch Lines." Although traffic may be light as far as number of trains is concerned, the weight of cars is likely to be much the same as on main lines, and even heavy engines may be operated. He considered second-hand 80-lb. rail from main track to be advisable, rather than the 56- to 60-lb. rails sometimes used.

Labor saving devices were reported upon by A. M. Clough, roadmaster, New York Central R.R., who referred to the increased weight of modern track material. Cranes and hoists for handling material, ditchers, ballast cleaners and track shifters represent the larger class of machinery, while for ordinary track work there are numerous electric and pneumatic tools for tamping, drilling, sawing and similar operations. Methods of tie inspection, treatment, distribution and renewal on the Atchison, Topeka & Santa Fe Ry. were reviewed by S. D. Cooper, assistant manager of treating plants, who showed that under these methods the number of ties renewed per mile has been reduced from 336 in 1898 to 158 in 1922. Maintenance of rail joints was the subject of a paper by R. S. Cochran, assistant engineer, A., T. & S. F. Ry.

The new president is J. B. Martin, New York Central R.R.; vice-presidents, W. F. Muff, Santa Fe Ry., and G. W. Morrow, New York, New Haven & Hartford R.R.; and Secretary J. P. McAndrews, C. & N. W. Ry., Sterling Ill. The 1924 convention will be held in New York.

Engineering Societies

Calendar

Annual Meetings

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; Annual Conference, Chicago, Sept. 27-28, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga., Nov. 12-16.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Meeting, Washington, D. C., Nov. 13-15.

The Boston Society of Civil Engineers Sept. 19 considered the subject: "Apprenticeship in the Boston Building Trades," with discussion of the recently-adopted system for the enrollment of apprentices by several of the building trades: by William S. Parker on the situation leading up to the system; Major H. S. French, speaking from the employer's standpoint; and James M. Gauld and George Thornton representing the views of the trade unions and employees.

The Colorado Section, American Society of Civil Engineers, were hosts at a banquet given Sept. 13 to Charles F. Loweth, chief engineer of the Chicago, Milwaukee & St. Paul R.R., and president of the Society. More than 100 members of the society were present, the principal speaker being Mr. Loweth. Other out-of-town engineers present were: Leonard Metcalf, of Metcalf and Eddy, Boston; and J. Vipond Davies, and J. Waldo Smith, of New York, and Chief Engineer Keays of the Moffat Tunnel Commission. John S. Means, president of the Colorado Section, presided.

The Engineering Society of Western Massachusetts held its monthly meeting Sept. 25 at the new power development of the New England Power Co. at Whitingham, Vt., the motor trip starting from Springfield, Mass.

The New York Section of the American Water Works Association will hold its annual meeting Oct. 6 at Watertown, N. Y. Charles R. Bettes is president and Burt B. Hodgman is secretary of the section.

Personal Notes

LEWIS B. SMITH, Rochester, N. Y., has been appointed assistant office engineer of the municipal engineering department of Rochester. Mr. Smith has been in this department since 1919, at which time he was transferred from the water-works bureau. He at one time superintended the construction of the conduit line from Rush to Rochester.

PROF. A. DIEFENDORF has assumed his new duties as assistant professor of civil engineering at Rose Polytechnic Institute, Terre Haute, Ind. The past two years Prof. Diefendorf has taught in the University of Illinois. He is a graduate of Ohio Northern University.

DANIEL B. LUTEN, of Indianapolis, Ind., president of the Luten Engineering Co., has been appointed a member of the Indiana state board for the registration and examination of engineers and land surveyors, succeeding R. L. MCCORMICK, of Terre Haute.

HENRY RIEGER, for several years assistant city engineer of Phoenix, Ariz., has been appointed city engineer of that city.

JOSEPH H. STEPHENS, president of the Merchants National Bank of Sacramento, has been appointed a member of the California State Reclamation Board, succeeding PETER R. GADD, who recently resigned.

CHARLES F. ABBOTT has been selected by the American Institute of Steel Construction to assist LEE H. MILLER, who was made managing director of the organization last January, in the technical work of the institute, which centers around the adoption of a standard specification. Mr. Miller will continue his work of direction from the Cleveland office, as chief engineer of the organization, and Mr. Abbott will direct the affairs of the institute from an office soon to be located in New York City.

GEORGE LAMPING, Seattle, Wash., was elected president of the Pacific Coast Association of Port Authorities at its annual convention at Seaside, Ore., last week.

WILLIAM H. CARTER, commissioner of public wroks at Santa Monica, Calif., for the past twelve years, has resigned his unexpired term to accept the position of business manager of the Pacific Palisade Association.

H. E. SPRY, formerly construction engineer with the Genesee Construction Co., Rochester, N. Y., has joined the organization of the Mamer Co. for work in designing and estimating, and is located at Benton Harbor, Mich.

R. L. HOCKETT has been appointed an assistant engineer for the Kansas State Highway Commission, located at Topeka, Kan. He had been supervising plans and surveys for Division 2 of the Missouri State Highway Commission.

JOHN SMALLSHAW, recently made general superintendent of construction for the Smallman-Brice Construction Co., Birmingham, Ala., formerly was superintendent of construction for the Carolina Construction Co.

A. T. FULKERSON is resident engineer on city paving and sewer construction at Newport, Ark., for the Morgan Engineering Co. of Memphis, Tenn. Mr. Fulkerson's previous work was as civil engineer for the Henry W. Horst Co., Rock Island, Ill.

WALTER P. BLOECHER is now engineer in the structural division of Stone & Webster, Inc., in Boston, Mass. He was formerly with Charles T. Main, engineer, and in 1922 joined the Stone & Webster organization in its New York office.

CALVIN CAMPBELL, who is now located at Alamosa, Colo., as superintendent on the construction of railroad shops for Battey & Kipp, Inc., was formerly superintendent of the waterworks and assistant city engineer of Cheyenne, Wyo.

DAVID L. YARNELL, since 1916 senior drainage engineer in the U. S. Bureau of Public Roads, in co-operation with the State University of Iowa is conducting hydraulic research investigations on road culverts, at the university hydraulic laboratory. Mr. Yarnell is a graduate of Iowa State College, has conducted special investigations for the Bureau of Public Roads in reclamation of swamp lands and in hydraulic research, and is the author of many reports of the Bureau on these phases of its work.

F. LAVIS, consulting engineer, New York City, sailed Sept. 19 for Bogota, Colombia, to make an examination of certain railroad projects there which the Colombian government has under consideration.

C. MCN. STEEVES has been appointed construction engineer of the New Brunswick Hydro Commission, under the direction of the acting chief engineer, S. R. Weston. Captain Steeves has two degrees in civil engineering from the University of New Brunswick. Since 1906 he has been engaged successively as assistant engineer of the Federal Department of Public Works at St. John, N. B., chief engineer of the Maritime Dredging Co. in dredging work at St. John, in service in France with the Canadian Engineers, and contractor's engineer on the international bridge between Edmunston, N. B., and Madawaska, Me.

Obituary

LOGAN PHILLIPS, a junior engineer attached to the U. S. District Engineer's office in New York City, was instantly killed last week when an iron bracket became dislodged from the cornice of a six story building at 171 Broadway, and fell, hitting Mr. Phillips upon the head. Mr. Phillips had just left the army engineer headquarters after a conference with Col. J. R. Slattery, regarding the dredging of East Chester Creek, work which was to be under Mr. Phillips' direction.

WILLIAM HENRY MERRILL, founder and president of the Underwriters' Laboratories, Inc., died Sept. 16 in Chicago at the age of 55 years. He was graduated from Massachusetts Institute of Technology in 1898 and has been in fire prevention and fire protection work ever since. The work of the laboratories was organized in 1898 by Mr. Merrill. He was a past-president of the National Fire Protection Association.

BENJAMIN T. FENDALL, formerly city engineer of Baltimore and since 1912 secretary of the Maryland Public Service Commission, died Sept. 18 at his home in Baltimore, aged 72 years. He was a native of Virginia and as a young man was connected with the engineering department of the Baltimore & Ohio R.R.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Japan Faces Gigantic Rebuilding Program

Need for American Lumber and Piling Seen in Reconstruction of Half Million Edifices Razed by Earthquake

HOUSING operations as America knows them even in war times, appear insignificant beside the scope of the building operations Japan now faces in reconstructing the great cities of Tokyo and Yokohama, according to Far Eastern Division of the Department of Commerce. The latest reports place the destruction of buildings in the earthquake-devastated areas at 316,000 in Tokyo, or about 71 per cent of the total number in that city, while in Yokohama, out of the 85,000 buildings standing before the disaster of Sept. 1 only 15,000 are left intact. The destruction in the outlying districts may bring the total of buildings destroyed up to the half-million mark, the large majority of which are homes. This number, added to the housing shortage that existed in Japan before the earthquake, will necessitate the construction of dwelling houses on a large scale. Since Japan normally looks to the United States for about 60 per cent of its lumber requirements it is expected that the demand for American lumber during the reconstruction period will be very heavy.

Prices and Deliveries

The price of Japanese lumber delivered c.i.f. Yokohama or Tokyo has been approximately 20 per cent higher than that of similar qualities of American lumber, and American freight rates have been favorable. The American market also finds itself in a favorable position as regards delivery. It often happens that the Japanese importer can secure delivery from Pacific ports to Yokohama in less time than from Hokkaido, Karafuto, or even from the northern provinces of Japan proper. Japan's preference for American lumber, aside from the price consideration, is due to the fact that our lumber is more nearly like that of Japan proper than the product of any other country from which it draws wood supplies. This similarity of wood makes it possible for Japanese builders to substitute American lumber for Japanese in all building projects. In fact, its use has become so universal that American lumber is now specified in many instances.

Kind of Lumber Imported

The principal lumber imports of Japan consist of fir, hemlock, pine and cedar, about half of which is imported in large squares of from 12 to 24 in. and a lesser amount in small squares of 4½ by 4½ in. The large squares are worked up in the local mills and carpenter shops into the different shapes required for general building, while the smaller squares are used as studs for holding up roofs and for supporting beams. The large squares are very popular among builders in Japan and can only be obtained from America.

The only competition confronting the United States in trade in this class of lumber, according to the Department of Commerce, will come from other parts of North America, as the Siberian, Manchurian, Hokkaido, and Saghalien or Karafuto pines and cedars are all of inferior quality and accepted only as substitutes for Japanese and American woods. At the time of the disaster stocks of lumber in Japan were quite large, especially in Kobe, Osaka, and Tokyo. Assuming that all the stocks in Yokohama and Tokyo were destroyed, it is seen that there is still a fairly good supply on hand for immediate emergency purposes. The real demand will come when the permanent construction of the devastated areas commences. The requirements for home building will no doubt be satisfied first and will take the largest share of the lumber imports.

In comparison with our own homes little wood is required for the construction of Japanese dwellings, in which paper, straw, matting and tile (for roofing) play a large part, but during recent years the tendency has been toward a greater use of wood, especially for ceilings and interiors, as the Japanese are very fond of polished wood in its natural colors. In this respect our lumber has lent itself very admirably owing to its superior quality.

Piling will be required in large numbers, the Department of Commerce states, for reconstructing the destroyed docks and waterside warehouses and sheds in Yokohama and Tokyo, as well as for building subfoundations for industrial buildings, bridges, and construction work in general. The city of Tokyo for some time has contemplated the widening and straightening of its narrow, crooked streets, and many have already been designated for this improvement. This plan will no doubt be carried out in the reconstruction program and the widening of the streets will require enormous quantities of paving blocks. Douglas fir has been used in Tokyo's paving program.

New Tractor Service Schools Are Announced

That the tractor public including owners, operators and others interested may possess more fundamental knowledge regarding caterpillar tractors an extensive educational program is under way, under the auspices of the Holt Manufacturing Co. of Peoria, Ill. and Stockton, Calif.

The "Caterpillar Service School of the North," the first of a series, was held in Wausau, Wis., Aug. 13 to 21, inclusive. Northern distributors for the caterpillars including the E. A. Drott Tractor Co., of Wausau; Lange-Nash Motor and Tractor Co., of Duluth; and the Upper Peninsula Tractor Co., of L'Anse, Mich., co-operated with the Holt company in the conduct of the school.

The school was attended, not only by tractor operators and mechanics, but also by county highway commissioners, superintendents and other officials of various lumber companies throughout that territory. The Wausau school is the forerunner of others to be held this winter at Boston, Richmond, Dallas, Atlanta, Memphis, Minneapolis, Omaha and Peoria.

The operation, adjustment and lubrication of all models of caterpillar tractors were thoroughly explained. Each model was sub-divided into various assemblies, each of which in turn was described in an illustrated lecture following which the students, under the supervision of competent instructors, would totally disassemble these various assemblies and re-assemble them.

The tractor service schools are being conducted by H. H. "Jack" Chambers, director of service for the Holt Manufacturing Co. He is assisted by Herbert S. Hinrichs, Earl J. Howey, Jack Westphal and George W. Rhodes, all men of long years of tractor experience.

Road Show Exhibit Applications Close Oct. 27

Applications for exhibit space at the Good Roads Show to be held in the Coliseum, Chicago, Jan. 14-19, 1924, during the annual convention of the American Road Builders' Association, must be filed at the office of the association, 37 West 39th St., New York, N. Y., on or before Oct. 27. The allotment of space will be made the following week by members of the association's executive committee and the Highway Industries Exhibitors' Association. Demands for space are expected to exceed the amount available. Exhibitors are advised to limit their displays to their latest and most important products.

To fill vacancies on the board of directors of the exhibitors' association created by the resignation of John B. Hittell, C. N. Leet and H. R. Snow the following were elected at a meeting in Chicago Sept. 7: George W. Craig, district engineer, Asphalt Association, Chicago; Lion Gardiner, sales manager, Lakewood Engineering Co., Cleveland; and C. E. Bement, vice-president and general manager, Novo Engine Co., Lansing, Mich.

Construction Equipment Exported

The following exports of American construction equipment were made during July, according to figures collected by the U. S. Department of Commerce:

Seventy-two concrete mixers valued at $55,041; miscellaneous road making and construction equipment, 890,678 lb., valued at $150,407; 38 conveyors at $23,085; 14 power shovels at $71,186; 715,944 lb. of dredging machinery at $45,833; 18 cranes at $88,562; 556 hoists and derricks at $103,438; 13 water wheels and turbines (under 300 hp.) at $9,048.

Shipments of roofing material were valued at $96,341 for asphalt roofing, $57,769 for asbestos roofing, and $54,716 for other types of roofing.

Japan was the largest consumer of concrete mixers during July, with 30 valued at $23,549. One power shovel at $22,300 was shipped to Honduras and 7 power shovels at $17,705 to Japan. Roumania bought one shovel at $9,000.

Paving Contractors Endorse 13-E Mixer

A. G. C. Vote of 2 to 1 Endorses Utility of 3-Sack Capacity for Medium-Sized Machine — Reasons for Preference Stated

BY A VOTE of 2 to 1, the 13-E or 3-sack paving mixer has been designated by paving companies of the Associated General Contractors as the proper size of machine to supply the requirements of a middle-sized paver. On account of a difference of opinion among manufacturers expressed at the meeting of the Joint Committee on Construction Equipment, in Chicago, July 30, this matter was referred to the Associated General Contractors for determination by referendum to members interested in paving work. Certain manufacturers favored the 12-E or 2-sack machine, while certain others favored the 3-sack type.

The opinion of paving companies concerning this matter is indicated by the replies received to the following questions:

(1) Exclusive of type consideration, which size of paver is preferable for work requiring a medium-sized machine? Result: 94 in favor of the 3-sack and 49 in favor of the 2-sack.

(2) If the 3-sack machine sells at a price of $1,500, or less, above the 2-bag, would the price be the determining factor to any great number of construction companies? Result: 49 Yes, and 93 No.

(3) If the 3-sack machine is in your judgment more suitable, should the advantage of capacity be sacrificed to the production of a machine at a relatively lower price? Result: 43 Yes, 96 No.

(4) Is it advisable to have a paver between the 7-E and 21-E? Result: 94 Yes, 49 No.

Reasons for Preference

Reasons assigned for voting in favor of the 3-sack machine are as follows:

Samuel Gamble Co., Carnegie, Pa.—"As the paver in question would be used on city streets, car lines, alleys, and other limited paving jobs where material would be handled almost entirely by hand, we believe that the 3-sack mixer would be preferred by the majority of road and street contractors. It would also be the most practical size for retaining walls, culverts, small bridges usually found in connection with road and street work. The question of price we believe in the past has been too large a factor and if the equipment manufacturers will concentrate on a limited number of sizes, high quality, one hundred per cent service, and sell the machine best required to perform the work which the contractor has to do, the question of price will take care of itself."

Winston & Co., New York — "The specifications of a number of state highway departments now provide that no mixer of less than 3 bag capacity can be used in the laying of concrete surface. It is our opinion that the 3 bag paver will meet the requirements for a small-sized unit on city streets cut by car lines, alleys, etc., and at the same time give the contractor a unit of greater changeability and marketability than the 2-sack paver. This is due to the fact that it will also be suitable for use on highway paving work in emergency, or under particular circumstances which might make a temporary use for such purposes desirable."

Bent Bros., Los Angeles, Calif.—"We like the large paver because it is not likely to be overworked as much as the smaller one. The vital parts will stand up better under the requirements. This condition does not, however, develop while the machines are new."

As the referendum on the middle-sized paver was sent to all members of the Executive and Advisory Boards and Presidents' Council of the Associated General Contractors, a number of ballots were received from contractors not engaged in paving work. Upon request of the manufacturers ballots from those not so engaged were not included in the tabulation of results unless it was specifically stated that they had consulted paving companies and ascertained their opinion. Most of the companies not engaged in paving work did not submit their vote on the grounds that they believed the matter should be determined on a vote of paving companies only.

Next Week

An article discussing some of the problems involved in selling building materials will offer to the purchasers of supplies—contractors, engineers and architects—the point of view of a manufacturer. An understanding of the practices of both maker and user of equipment and materials should be mutually helpful—

Editor

Track Exhibits at Roadmasters' Convention, Chicago

Exhibits of railway track material and appliances at the Chicago convention of the Roadmasters and Maintenance-of-Way Association, Sept. 18 to 20, were numerous and varied but included few novelties. Labor-saving devices were not much in evidence, in spite of the marked development along this line in railway maintenance work.

Various makes of motor section cars were exhibited. Nearly all railways now recognize the advantages of these cars as compared with hand cars. Ballast-tamping machines included the Jackson electric tamper of the Electric Tamper & Equipment Co., Chicago, and the pneumatic tamper of the Ingersoll-Rand Co., New York. Ditching cranes, spreader cars and weed-killing cars were represented by views and moving-pictures, since the exhibits were arranged on a hotel balcony and there was no opportunity to place large machinery.

One novel device was the Mack switch protector, by J. R. Fleming & Sons Co., Scranton, Pa. This consists of a tapered block bolted inside the rail just ahead of the switch, so that wheels with flanges hugging the rail head are prevented from striking the switch point.

A large part of the exhibit consisted of hand tools and the smaller class of track material, such as tie-plates, nutlocks, bolts and rail anchors, together with some derails, switch and frog details and wire fencing. There were also torches for clearing ice and snow from switches. The exhibit, arranged by the Track Supply Association, comprised about sixty exhibitors.

Business Notes

E. L. Sparks, for the past five years New England sales manager for the Erie Steam Shovel Co., with headquarters in Boston, has resigned to open an advertising service agency in New York next month, specializing in machinery and building material accounts. He served for 4 years as copywriter in the advertising service department of the McGraw-Hill Co., Inc., and the McGraw Publishing Co., and prior to that was engineer in charge of various construction projects.

Truscon Steel Co., Detroit, announces that after Oct. 1 its Michigan office will be located in the company's new building at 615 Wayne St., Detroit, occupying the entire second floor. The office includes a service organization and engineering department, equipped to furnish information, estimates and details on all the company's products, including reinforcing steel, metal laths, steel windows and joists, highway reinforcements, standard buildings, inserts and pressed steel parts

Link-Belt Co., Chicago, which for some years has maintained sales and distributing offices in San Francisco, Los Angeles, Portland and Seattle, has just acquired the business and manufacturing facilities of the Meese & Gottfried Co., which for many years has manufactured transmission and conveying machinery on the Pacific Coast. It is the intent of the new owners to increase facilities, enlarge stocks and improve methods of distribution so that the demands of customers can be met promptly and completely.

Joe Glozier, Birmingham Slag Co., with offices in the Walton Building, Atlanta, Ga., has been appointed chairman of the Exhibit Committee which will have charge of the display of equipment and materials at the annual convention in Atlanta, Nov. 12-16, of the American Society for Municipal Improvements. Convention headquarters and the exhibit will be at the Ansley Hotel.

Burton-Townsend Co., Zanesville, Ohio, manufacturer of paving block and building brick, announces the appointment of Arthur M. Crumrine and Samuel A. Kinnear as receivers for the company. Creditors are requested to file proof of claims against the firm with statement of account in detail.

Albert S. Boisfontaine, who has been assistant to the manager of the Southern Pine Association since last June, has been appointed assistant secretary. He has been with the association, serving in a number of capacities, since 1917.

Valley Rolling Mills, Inc., Elmira, N. Y., recently incorporated under the laws of the State of New York to take over a complete merchant bar and light structural shape mill originally built by the Quirke interests, will begin rolling at once. Marcel K. Sessler of New York enters the organization as vice-president and treasurer, and will be actively associated on the business side, with E. F. Quirke and J. S. Quirke, who are experienced and practical mill

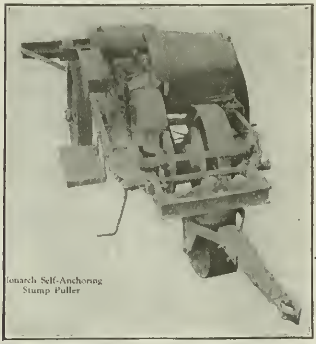
men and will be in charge of the production end of the business. The general negotiations and this consolidation were effected through the Engineering Business Exchange, New York, of which Charles Whiting Baker, formerly editor of *Engineering News-Record*, is director.

Equipment and Materials

Self-Anchoring Stump Puller

A machine for pulling stumps, with a self-anchoring device which makes it unnecessary to tie the equipment to other trees or stumps, has been developed by Monarch Tractors, Inc., Watertown, Wis. The puller is mounted on a three-wheel chassis with a small diameter castor wheel at the front end which permits short turns. Through the two rear wheels passes a large diameter axle which supports a heavy pivoted steel channel frame, the rear end of which carries the anchoring device consisting of a sharp blade. This anchoring blade is forced into the ground as there develops a pull on the machine, holding the latter in place. To counter-balance the heaviest pulls weights in addition to that of the machine itself are hung from a boom held in position by guy wires attached to the frame. The boom serves also as a tongue when using horses to move the machine.

The power plant consists of a Ford motor driving a cable drum 12 in. in diameter and 10 in. wide, holding 50 ft. of cable. The motor is fitted with a special water circulating pump. The equipment weighs 5,000 lb., its length is 16 ft., width 6 ft., and height 4 ft. 3 in.


Monarch Self-Anchoring Stump Puller

With this machine a direct cable pull of 50,000 lb. is secured, or 100,000 lb. with a single block. Field experience by the manufacturer indicates that a crew of four men is required to keep the puller working to capacity. They are distributed as follows: One operator, two men handling cables; one man on tractor or team. It is asserted that half an acre of stump land may be cleared at one setting of the machine. The engine has two speeds forward and one reverse so that the slack in the cables can quickly be taken up with the high speed and the stump pulling operation performed in low gear. For pulling stumps not close to the machine several 50-ft. lengths of cable with open and closed rings are used.

Crawler Tractor Makes Another Long Journey

Another long-distance trip has been undertaken by the Monarch crawler tractor which last year completed a journey of 1,513 miles from Watertown, Wis., to New Orleans, starting Oct. 8 and finishing Dec. 11, 1922, a total traveling time of 399½ hr. The same tractor, on Aug. 24, started from the company's plant at Watertown on a 500-mile route to various state fairs in Wisconsin and Illinois and is scheduled to end its trip at Peoria, Sept. 28, where it will be on display at the National Implement and Vehicle Show.

The tractor is pulling a 5,000-lb. two-wheel trailer. On its trip from Watertown to New Orleans the tractor made an average speed of 3.78 miles per hour and covered an average of 26.6 miles per day. Pulling the same trailer as is used on the trip now in progress, the tractor consumed an average of 3.4 qt. of gasoline per mile. The total gasoline consumption on the 1,513-mile trip was 1,290 gal. and the lubricating oil consumed was 30 gal.

Publications from the Construction Industry

Snow Plows—BAKER MANUFACTURING CO., Springfield, Ill., in a 16-p. illustrated catalog, explains the operation of its snow plows designed for mounting on the front end of a truck. The plows are built in two models, one with a straight blade and the other with a V-shaped blade. The straight blade is protected from damage in striking obstacles by the use of safety tipping blades in the form of hinged sections 2 ft. long held in place by compression springs, which allow the sections to tip backward when they strike such an obstruction as a manhole cover. The springs snap the safety blades back into position after the obstruction is passed. The plows are built in lengths of 8 and 10 ft.

Industrial Trucks—CRESCENT TRUCK CO., Lebanon, Pa., has just issued a catalog explaining the design and illustrating the uses of its electric industrial trucks and tractors for handling material in shops and factories, loading cargoes at docks, etc. The company's general utility truck is designed to carry a pay-load of 4,000 lb. in addition to hauling a trailer. A four-wheel steer insures maximum flexibility of operation, allowing the truck to run in narrow aisles, on small elevators, and around pillars and machines in congested factories. This truck operates at a speed of from 5 to 6 m.p.h. The truck is operated by a 21-cell storage battery and a 36-volt, 35-amp. motor. The truck may be fitted with a crane attachment for special purposes. The height of the loading platform above the floor is 23 in. For handling very heavy and combersome materals a low-platform truck has been designed, the platform of which is only 12½ in. from the floor.

Filtration Equipment—PERMUTIT CO., New York, has issued a 23-p. illustrated pamphlet dealing with its vertical and horizontal inclosed steel-shell pressure filters and its open-top gravity filters of wood or concrete. The smaller sizes of pressure filter of the vertical type have shells from 16 to 24 in. in diameter, built for a working pressure of 100 lb. per square inch. For larger installations the horizontal type with steel shells of 8 ft. diameter and from 10½ to 25 ft. long are recommended. The text explains, in general terms, the various steps involved in the process of rapid sand filtration.

Water Sterilization — WALLACE & TIERNAN CO., INC., Newark, N. J., has issued two technical publications, each of four pages, on its chlorinators for medium-sized and small water supplies. The text explains the application of this equipment, taking up such matters as amount of chlorine required, pressure against which the chlorine can be applied and diffusion of chlorine in the water. Sketches show typical installations.

Drill Sharpeners — SULLIVAN MACHINERY CO. has just issued a new illustrated bulletin on drill sharpeners for hammer forging drill bits and shanks. These machines are operated by compressed air and the sharpening process is done by hammering, with the steel at relatively low temperatures. In connection with the use of the sharpener an oil furnace, insuring uniform temperatures, is recommended. The sharpeners are made in two sizes, A and B, weighing respectively 4,000 and 1,500 lb.

Clamshell Buckets—BLAW-KNOX CO., Pittsburgh, in a 35-p. illustrated pamphlet, features its single-line clamshell buckets, which utilize the same line for both closing the bucket and for supporting it during opening. A feature of the equipment is the elimination of locks, catches, or other sliding parts. The buckets are built in sizes from ⅜ to 3 cu.yd. capacity. The text features also the company's single rope cableway in which only one hoisting drum is required for both hoisting and transporting the load along the cable track.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Structural-Steel Sales

The Department of Commerce announces August sales of fabricated structural steel, based on figures received from the principal fabricators of the country. Total sales of 130,568 tons were reported for August by firms with a capacity of 224,305 tons per month.

Tonnage booked each month by 176 identical firms, with a capacity of 230,475 tons per month, is shown below, together with the per cent of shop capacity represented by these bookings. For comparative purposes, the figures are also prorated to obtain an estimated total for the United States on a capacity of 250,000 tons **per month.**

1922	Actual Tonnage Booked	Per Cent of Capacity	Computed Total Bookings
April	200,968	87	217,500
May	185,065	80	200,000
June	168,894	73	182,500
July	158,012	69	172,500
August	156,559	68	170,000
September	146,827	64	160,000
October	133,037	58	145,000
November	112,367	49	122,500
December	138,737	60	150,000
1923			
January	173,294	75	187,500
February	184,887	80	200,000
March	218,400	95	237,500
April	186,117	81	202,500
May	131,875	57	142,500
June	118,063*	51	127,500
July	116,774**	51	127,500
August	131,770***	56	140,000

* Reported by 174 firms with a capacity of 230,460 tons.
** Reported by 169 firms with a capacity of 229,815 tons.
*** Reported by 158 firms with a capacity of 224,305 tons.

Production of Brick

Regarding domestic production of brick during July the following comment is made by the Common Brick Manufacturers' Association: The brick shipped from plants in July was approximately the same as in the preceding month, and the production of brick showed a slight increase. Ninety-three firms reporting, representing practically every section of the country, show unfilled orders on the books amounting to 342,719,000, brick, which is a little more than 50,000,000 less than was recorded in the Aug. 1 report, which reflected conditions on July 1. This drop is not serious at this season of the year. There is nothing discouraging in the current reports from manufacturers, and out of 76 who indicated future outlook for business, 20 were found in the "good" column, 48 viewed the outlook as "fair" and only 8 say it is "bad." Among the firms reporting only one plant was shut down during the month of July, all others shut down being for less than the full month and that principally for repair. The decrease in unfilled orders is quite evenly distributed over all of the Eastern, Southern and Middle Western territory. In California there is shown an increase in orders on the books and a better condition is reflected in the other coast states and in the Southwest. No price change is recorded.

Wholesale Prices in August

Wholesale prices in August averaged slightly lower than in July according to information gathered in representative markets by the U. S. Department of Labor through the Bureau of Labor Statistics. The Bureau's index number, which includes 404 commodities or price series weighted in proportion to their relative importance, sank to 150 in August, a drop of 1 point from the figure of the month before.

The largest decrease from the preceding month is shown for the group of fuel and lighting materials, due to further declines in bituminous coal, crude petroleum, and gasoline. The decrease in this group was 2¾ per cent. Building materials and housefurnishing goods each declined 2 per cent from the July level.

In the group of farm products increases in corn, rye, wheat, cattle, hogs, eggs, hops, and hay brought the level of prices nearly 3 per cent higher than in July. Foods also averaged higher than in the preceding month. No change in the general price level was reported for cloths and clothing and for metals and metal products.

Of the 404 commodities or series of quotations for which comparable data for July and August were collected, decreases were shown in 137 instances and increases in 110 instances. In 157 instances no change in price was reported.

INDEX NUMBERS OF WHOLESALE PRICES BY GROUPS OF COMMODITIES

(1913 = 100)

Group	1922 August	1923 July	1923 August
Farm products	131	135	139
Foods	138	141	142
Cloths and clothing	181	193	193
Fuel and lighting	271	183	178
Metals and metal products	126	145	145
Building materials	172	190	186
Chemicals and drugs	122	128	127
House furnishing goods	173	187	183
Miscellaneous	115	121	120
All commodities	155	151	150

Comparing prices in August with those of a year ago, as measured by changes in the index numbers, it is seen that the general price level has declined 3¼ per cent. This is due entirely to the great decreases among fuel and lighting materials, which averaged 34⅓ per cent less than in August, 1922, at which time a strike was in progress in the coal fields. In all other commodity group prices were higher than in August of last year, ranging from 3 per cent in the case of foods to 15 per cent in the case of **metals and metal products.**

Bookings of Steel Castings

The Department of Commerce announces August bookings of steel castings, based on reports from principal manufacturers. The bookings in August by companies representing over two-thirds of the commercial-castings capacity of the United States amounted to 50,515 tons, as against 52,066 tons in July. The following table shows the bookings of commercial steel castings for the past eight months by 65 identical companies, with a monthly capacity, of 96,900 tons, of which 38,300 tons are usually devoted to railway specialties and 58,600 tons to miscellaneous castings.

BOOKINGS OF COMMERCIAL STEEL CASTINGS

Month 1923	Total Net Tons	Total Per Cent of Capacity	Railway Specialties Net Tons	Railway Specialties Per Cent of Capacity	Miscellaneous Castings Net Tons	Miscellaneous Castings Per Cent of Capacity
January	100,605	103.8	47,879	125 0	52,726	90 0
February	90,152	93 0	39,845	104 0	50,307	85 8
March	143,564	148 2	76,409	199 5	67,155	114 6
April	90,968	93 9	39,610	103 4	51,358	87 6
May	89,493	92 4	38,788	101 3	50,705	86 5
June	84,878	87 6	42,773	111 7	42,105	71 9
July*	52,066	53 7	16,741	43 7	35,325	60 3
August	50,515	52.1	18,332	47 9	32,183	54 9

* Two companies with a capacity of 785 tons per month on miscellaneous castings now out of business.

Federal Reserve Statistics on Business Conditions

Production of basic commodities and employment at industrial establishments decreased in July and there was a further decline in wholesale prices, according to the monthly review of business and financial conditions by the Federal Reserve Board. The distribution of goods, as indicated by railroad freight shipments, maintained record totals and the sales of merchandise, though showing the usual seasonal decline to be relatively heavy.

Production in basic industries, according to the index of the Federal Reserve Board, declined 1 per cent in July. New building operations showed more than the usual seasonal decline.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 173 to 185, are the following:

Distributing Station, Middletown, Conn., to R. H. Beattie Constr. Co., Fall River, Mass., $1,000,000.

Store and Club, San Francisco, Calif., to R. McLeran Co., $1,000,000.

Home and Infirmary, Wende, N. Y., to H. Shenk, Erie, Pa., $1,079,000.

Grain Elevator, Oswego, N. Y. to James Stewart Co., New York City, $1,119,959.

Tunnel, Colorado, to Hitchcock & Tinkler, Denver, $6,075,000.

Cables, Philadelphia bridge, Keystone State Constr. Co., $2,546,900.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 173 to 185, are the following:

Hotel, Hot Springs, Ark., Arlington Hotel Co., $2,225,000.

Apartment, New York, N. Y., Octo Building Corp., $1,500,000.

Dam, Little Rock, Ark., Arkansas Power Corp., $1,787,600.

Bridge, Portland, Ore., Comrs. Multnomah Co., $4,000,000.

Industrial Movements Shown by Commerce Dept. Figures

The Department of Commerce announces the following further figures covering industrial and commercial movements in July:

Total stocks of Lake Superior iron ore at the end of July, amounting to 27,503,000 tons registered an increase of 21 per cent over the inventory of June 30 and may be compared with the holdings on July 31, 1922, of 31,127,000 tons. Imports of iron and steel totaled 113,000 tons as against 72,000 in July, 1922, while the exports of iron and steel amounting to 141,000 tons, may be compared with 128,000 tons a year ago. Production of sheets by independent steel mills totaled 174,910 tons as against 218,432 tons in June and 179,100 in July, 1922. In terms of per cent to mill capacity the production of sheets amounted to 65 per cent as compared with 80 in June and 73 per cent in July a year ago. Unfilled orders for sheets on July 31 amounted to 404,868 tons as against 503,175 on June 30 and 409,885 on July 31, 1922.

A total of 551,000 employees was on the payrolls of representative New York State factories as compared with 555,000 for June and 490,000 for July, 1922. The index of employment in Wisconsin factories stood at 128 on July 15, based on the first quarter of 1915 as 100, as compared with 124 on June 15 and 107 on July 15, 1922. The average weekly earnings in New York State were computed at $27.54 for July as against $27.85 for June and $24.77 for July, 1922. For Wisconsin the index of weekly earnings was 209 for July 15 as compared with 226 for June 15 and 186 for July 15, 1922.

Bradstreet's index of wholesale prices at 139 for Aug. 1 may be compared with 142 for July 1, and 131 for Aug. 1, 1922. The index of retail food prices at 147 for July compares with 144 for June and 142 for July, 1922.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Sept. 6; the next, on Oct. 4.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.00
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.25	5.30	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.80	3.20	3.45	3.85	3.65	4.10	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	45%	43%	47%	53–5%	36%	33.2@42.2%	35%	47.42
Cast-iron pipe, 6 in. and over, ton	63.60	60.00	63.00	60.20	60.50	69.00	62.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.70@2.80	3.00	2.25	2.20	2.50	2.84	2.63	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	1.89	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.38	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	61.00	—39.00	52.25	58.50	46.75	44.25	+42.00	29.00	70.00
Lime, finishing, hydrated, ton	18.20	22.50	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	1.75	1.50	1.50	+2.70	2.10	+2.80	10.00
Common brick, delivered, 1,000	23.65	11.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	.115	.0724	.0816	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1263	.102	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.95	—.96	1.04	1.14	.99	1.09	—1.02	.86	1.22
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.50@.55	.35@.50	.50	.50@.62½	.35@.40

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.10). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.42; 6-in., $119.

Changes Since Last Week

Although price irregularities prevail in most commodities at present, with advances very nearly equalling declines, the construction materials market continues to retain that show of stability which has characterized it since the collapse of the "buyers strike" movement. Buyers are still cautious and the increased activity, particularly in iron and steel, that was expected to develop has not yet completely materialized.

Lumber shows increasingly firm tendencies, particularly in the West. Steel, lime, clay products and concreting materials fluctuate little.

Linseed oil, however, continues to decline. Raw oil dropped 2c. in Atlanta and 7c. per gal. in San Francisco during the week.

The iron and steel situation in brief: Pig-iron stocks accumulating; market weak. Iron and steel scrap adversely affected by weakness in pig iron. Fair volume of new buying in fabricated structural steel, particularly for schools and commercial buildings. Plate demand somewhat slower. Prices holding firmly to the $2.50 base for plates and shapes; bars, $2.40 per 100 lb., f.o.b. Pittsburgh.

A Consolidation of Engineering News and Engineering Record | McGraw-Hill Company, Inc.—James H. McGraw, President

Engineering News-Record

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor
Frank C. Wight, Managing Editor

Volume 91 | NEW YORK, OCTOBER 4, 1923 | Number 14

A Useful Service

A MOST necessary service can be rendered by the committee just authorized by the American Society of Civil Engineers to collect data on the behavior of structures in the Japanese earthquake. There were enough modern buildings and other engineering works in the stricken zone to provide information far ahead of anything hitherto available and it is imperative that some orderly and authoritative means be provided to secure this information, digest and analyze it and put it before the profession. This the civil engineers, with the co-operation of other technical societies where they can co-operate, purposes to do. The earthquake zones of the world are comparatively limited but they embrace some of the best and most livable country in the world. Engineers need all the knowledge they can acquire as to the best way of providing the people of these zones with safe and durable structures.

Road Taxes

LESS than 5½c. of the general taxpayer's dollar in 1921 went to highways. During that year about one billion dollars were spent in highway construction and maintenance. These figures are given by John E. Walker, former tax adviser to the United States Treasury. They are of vital significance to highway officials. If reports from Washington forecast accurately the attitude of members of Congress, there will be a strong effort at the coming session to curtail highway appropriations, on the plea of tax reduction. The reaction against highway expenditures, of which *Engineering News-Record* sounded a warning a year ago, has lost none of its impetus in state legislatures. Of the many causes which have led up to this reaction, the greatest is the growing tax burden. How small a portion of this is imposed by highway improvement is not generally realized. This is largely the fault of highway officials. They have not told the people plainly who is paying the bulk of the cost of our improved roads.

Fining Winter Idleness

UNEMPLOYMENT is becoming more generally considered the responsibility of employers. Wisconsin will this winter, according to press dispatchers, discuss in its house of representatives an act providing unemployment insurance. The act has already passed the state senate. Nominally it is an insurance act. Virtually it is a penalty on employers for not eliminating seasonal business. In essence it compels an employer who lays off an employee not because of the employee's fault, to pay him a dollar a day for thirteen weeks. Obviously a big sociological problem is involved. As engineers and contractors, however, the readers of *Engineering News-Record* are chiefly concerned in the effect of the law on seasonal construction. The construction industry has been the most callous of employers in turning loose its workmen when the busy season of summer had passed. There is no work in winter, it has said, and complacently distributed quitting checks. Getting the industry to think that winter idleness is not a divine ordinance is a hard task. Perhaps a ninety-dollar fine for each employee discharged will bring a more open mind. One is inclined to applaud the experiment.

Farmers Want St. Lawrence Canal

BECAUSE the agitation for the St. Lawrence ship canal is not getting quite as much publicity as it did some years ago it must not be thought that the project is dead. The fact is that conditions of the past few months have only added fuel to the flame of the demand for the waterway. Although wheat constitutes a very small part of the revenue producing crops of the nation and a smaller part of the income of the average farmer it has become the index by which farm prosperity is popularly measured. This is notoriously a bad wheat year and whatever the cause the farmer is pretty well persuaded that high rail rates make up the major part of the trouble. The St. Lawrence shipway would be pre-eminently a wheat-carrying channel. Whether or not it will ever prove profitable for other kinds of freight is something only operation—with its possible relocation of freight routes and development of economical transfer machinery—can tell, but for wheat, which can as readily be brought to lakeside elevators as to any other central distributing point, carrying charges will certainly be lower. That being the case, the farmer sees in the canal the way out of his difficulties. It does not matter whether or not it may be cheaper in the long run for the country to build more railroads or for the railways to reduce rates, this appears to be the easy way out, just as for the last fifty years the waterway has appeared to be the easy way out of all high transportation rate difficulties. So far the waterway has disappointed its advocates. Possibly the St. Lawrence route will, too. But the opponents to the scheme will do well to reckon with the western farmers who are now more than ever in a mood to demand the experiment.

Delusions of Persecution

ONE of the most characteristic exhibitions of the waterway mania is that now being given by the advocates of the New York State Barge Canal. For nearly ten years that much-advertised waterway has been struggling to demonstate its usefulness. For a large part of that time the state officials in charge have been favorable to water carriage and have done all in their power to promote the use of the canal, but the results have been disappointingly small. There has been some increase in freight carriage, but certainly not enough to prove that the canal will ever be worth

the $170,000,000 it cost the State of New York. Now the waterway enthusiasts have taken a new tack. Their pet project, they say, is about to become the prey of the politicians of both parties who are engaged in devious effort to scrap the canal entirely or else to convert it into a water-power scheme. The case of the waterway men is pathological. For years they have suffered from delusions of persecution. If either on the Mississippi or the Mohawk they spent nearly the energy to prove by service the economies of water transport as they do in complaining of the unfairness of their competitors, inland waterway freight carriage would today be more than the academic proposition it really is.

Red Tape and a Pontoon Bridge

THE War Department has announced that government material cannot be used without sanction of Congress to build a pontoon bridge across the Connecticut River at Springfield, Mass., to relieve the situation caused by the burning of the North-End bridge on Sept. 8. Evidently there must be some sharp distinction between letting army engineers practice at bridge building by using this sacred government material to build a bridge across the Potomac at some point where it is of no use to anyone and letting them do the same thing across the Connecticut at Springfield, where the bridge would be of great value to a large community. The War Department might well arouse itself to aggressive action in such peace-time emergencies, instead of hiding behind a screen of red tape and precedent. This is an admirable opportunity for the department to go before the people with a much better face when it has to appeal to them for funds to carry on just such work as training men to build pontoon bridges.

Sheets and Pillow Slips

MANY comforts and conveniences have been provided in recent years for common labor in Western construction camps. There is a limit beyond which this cannot be carried, although the demands of labor organizations have sometimes raised the question as to where it could be fixed. Good food, bunk houses with good light and ventilation, handy hot and cold showers, have all been requisites of the successful camp. In recent years contractors found it necessary to keep these facilities up to par to avoid an excessive labor turnover because labor knew where to find camps that *did* provide good food and quarters.

On some jobs now the contractor has gone even further; he provides bed linen. Formerly all laborers carried a blanket roll commonly called a "bindle," or, "turkey," and it was the universal custom for every man to take care of his own bed. When one large camp equipped all bunk houses with sheets and pillow slips the experiment was watched with much interest. Now, a number of large projects with anywhere from one to eight or ten camps provide every man on the job with complete beds, including mattress, blankets, pillows, sheets and pillow slips, the camp organization changing and washing the sheets and inspecting blankets at stated intervals. The Big Creek project of the Southern California Edison Co., operating under this system, does not allow a blanket roll to come into the camp. The Skagit project of the City of Seattle, from the start of the first camp, has provided bed linen for common labor. More recently even smaller contractors, in order to attract men to short-time jobs, have frequently made it a practice to provide fully equipped bunk houses.

The plan has a two-fold value; it (1) maintains self-respect of the men and makes them feel that they are having the best of care and it (2) improves sanitary conditions by preventing the spread of vermin and disease that would otherwise go from camp to camp in the blanket roll. After a year or two of experience in supplying bed linen and including the maintenance of clean beds as part of the camp organization duties, the consensus of opinion among those who use this plan is that *it pays*. The charge made to the men for linen and blankets—say about $1 per month—may not cover the actual cost, but any small loss is much more than made up by the improved attitude of labor.

Valuation Principles Still Vague

ON THE correspondence page of this issue Prof. C. C. Williams, of the University of Illinois, makes a plea for the reproduction-cost-new theory of valuation as opposed to the prudent-investment theory which has been tentatively advocated by the minority justices in several of the recent Supreme Court decisions and which, the professor thinks, was defended in an earlier editorial in this journal. That editorial was not intended to support the prudent-investment theory at the expense of the reproduction-cost-new theory, but it was meant to show the complication in trying to set up one base method of valuation.

Unfortunately, it appears that the process of valuation cannot be reduced to any simple formula. It is true that the Supreme Court rulings for many years have leaned toward the reproduction-cost-new method, but they have by no means pronounced it absolute. The cost today to reproduce the property has been advanced as one of the elements—occasionally a governing element—in determination of fair value; but even where it is possible simply to arrive at that cost (which it rarely is) the court has not always accepted it as the final value. Justification for the investment, the degree of use, the market value of the property as expressed in the securities—all elements in the so-called prudent-investment theory—have always entered into the determination of value as reached by the highest court. That court has always recognized, we think, that the public should not be made to pay a toll for the mistakes which public utility promoters have made.

No better example of the fog that surrounds valuation or of the difficulty of arriving at an exact figure in valuation could be found than the report of the Interstate Commerce Commission on the final valuation of the San Pedro, Los Angeles & Salt Lake R.R. just made. The commission in this case gives as $45,000,000 the final single-sum value of the property for rate-making purposes as of July 1, 1914. This is a majority report concurred in fully by eight of the eleven members and partly by two others, and yet the report itself shows that there were as many methods of arriving at this exact sum as there were members of the commission. The sum of $45,000,000 does not represent prudent investment. It does not represent reproduction cost new, or stock value, or selling price, or any other one thing. It is merely a figure which ten men are willing to agree

upon as the value in 1914 of a small railroad, that figure to be used as a base for rate making at some date years after 1914, with the method to be followed in bringing the value up to the rate-making date left unsettled. It is, as Commissioner Meyer says, the approximate investment on which those devoting this property to common carrier service were entitled to a fair return in 1914.

While, therefore, engineers will heartily concur in Professor Williams' suggestion that an adherence to one method of valuation would remove much of the fogginess which now beclouds the whole subject, there is little chance, it seems to us, that it can be made a simple process. There is a chance as time goes on and the records of public utilities are kept more precisely and the current prices of material and labor are more fully a matter of record, that a fair value will be more readily established than it is now when records are scarce and past unit prices doubtful. In the future, with the reproduction-cost-new theory governing, as it has been in the past, but not absolute, there should be a more close agreement between the public idea of the value of a utility and the idea of the owners themselves.

A Step Ahead in a Major Problem

A MAJOR problem in both local and national transportation is moved appreciably nearer solution by the agreement last week between the railroads and the Port of New York Authority in the matter of the New Jersey marginal railroad. The agreement is important in that it breaks a deadlock which has been hampering the proper delivery of freight into New York—which means that the whole country as well as New York has been hampered—but it is equally important because it marks the acknowledgment by the railroads of the force of public opinion and a definite step ahead in the establishment of the power of the Port of New York Authority.

Heretofore, despite the wording of the treaty which established the authority, there had been some doubt as to how much pressure it could bring to bear in case its powers were in question. Just such a doubt was in the minds of the railroad officials when the hearing on the marginal belt line opened before the Interstate Commerce Commission last spring. But the recent about face of the same officials, representing the most powerful railroads in this country, is ample evidence of how definitely the powers of the port authority were established at that hearing. Such being the case the authority is now in a much better position than ever before to proceed with its "comprehensive plan for the development of the Port of New York."

The marginal belt line in New Jersey, the subject of the recent action, is only a small part of that plan. There are other details that call for immediate action. The chief one is the so-called middle belt line No. 1, a belt line starting from connections with the New Haven and the New York on Long Island and running down to Bay Ridge and across by a tunnel to the New Jersey and thence up to connect with all the trunk lines on that side. The railroad companies have already taken steps toward building this latter section but the connection across the bay to Brooklyn is badly needed to divert the through traffic for New England away from the congested areas along the west shore of the Hudson. The port authority's plan calls for the construction of this connection as a tunnel under the Upper Bay from Bayonne to Bay Ridge. But under legislative enactment the City of New York is now building a tunnel for similar purposes under the Narrows from Staten Island to Bay Ridge. Obviously both tunnels should not be built, at least not for many years to come, and the railroad connections for the two tunnels can be altered to suit whichever tunnel it is deemed most advisable to construct. Either route can be made to suit the needs of traffic. And as far as immediate needs are concerned the Narrows tunnel has the advantage over the Upper Bay tunnel in that it is only half as long and is already under construction.

Now that the port authority has its feet on solid ground it would seem that it should take some definite action towards completing this major belt line. The conditions are most favorable. The city government is determined that the Narrows tunnel shall be built and it has legislative "mandate" to support its action. But it lacks the one thing needful—money. If it spends the necessary millions on this tunnel it will have little left for other needed utilities such as subways. It is here that the authority can display its usefulness to the city and at the same time perhaps remove much of the antagonism towards it that now exists in the present city administration. It can, under the laws which created it, revise its plan to make the Narrows tunnel a part of that plan, issue bonds to finance its construction, and take over the construction from the city, thereby allowing the city to use its moneys for other purposes.

But before the port authority can take this step the city administration must publicly abandon the idea that the Narrows tunnel can be used as a combined freight and passenger tunnel which will be able to handle the great volume of freight that will be routed through it and at the same time give Staten Island a frequent passenger train service to Manhattan Island. The passenger use of the tunnel has been minimized in the engineering reports but has been played up very strong by the political friends of the city administration, obviously with an eye toward the votes to be had on Staten Island. The residents there would do well if they were to recognize the hopelessness of traffic relief through this tunnel and ask the city authorities to let it stand on its merits as a freight tunnel to develop the industrial potentialities of the Island.

The Narrows tunnel issue is one which the port authority must meet no matter what the city may do, for if the Narrows tunnel is built by the city with freight connections to the Baltimore & Ohio on Staten Island a large part of the freight which would otherwise have gone through the port authority's proposed tunnel will be diverted to the Narrows tunnel and the port authority will hardly be able to demonstrate the economic necessity for its tunnel under the bay, a demonstration it is required by law to make before it can issue bonds to finance the tunnel. Just how it meets this issue will be a fair indication of whether it intends to carry out the spirit or the letter of the treaty which created it. Some years ago we pointed out that the Narrows tunnel controversy between city and the interstate body afforded a fine opportunity for the art of compromise. Now that the authority has won its first skirmish it is in an exceptionally strong position to initiate a move toward an adjustment which will work to the benefit of both sides.

Solve Complicated River Crossing with Double-Deck Bridge

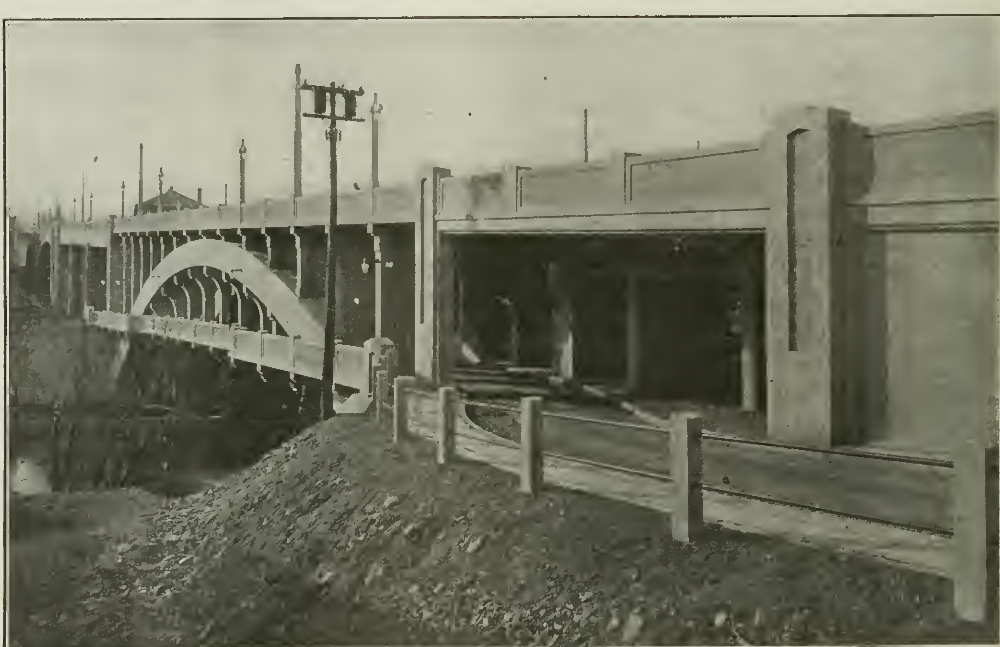
New Reinforced-Concrete Bridge Across Black River at Watertown, N. Y., Has Upper and Lower Decks —Concrete Arch Design and Construction Complicated by This Arrangement

BY E. H. HARDER
Concrete-Steel Engineering Co., New York City

A DOUBLE-DECK reinforced-concrete arch is one of the outstanding features of a grade-crossing elimination project recently completed in the city of Watertown, N. Y. This bridge, known as the Court Street Bridge, eliminates a dangerous crossing of one of Watertown's crowded thoroughfares over an important branch line of the New York Central & Hudson River R.R.

An 86-ft. flat barrel arch span of reinforced concrete now carries Court St. over the same tracks at a location a little to the east of the former grade crossing. From a point over this arch, the new grade of Court St. is stream. With the abandonment of the old steel truss across the river, a detour would be necessary which would have greatly reduced the value for business purposes of the above-mentioned property. A lower deck carried by this 195-ft. span readily solved this problem since this deck virtually replaced the above-mentioned truss.

The double-deck arch has four ribs, each 6 ft. wide, except for a slight increase of width at the ends. The clear distances between these ribs are 13 ft., 3 ft. and 13 ft. The spread of 3 ft. between the inner pair of



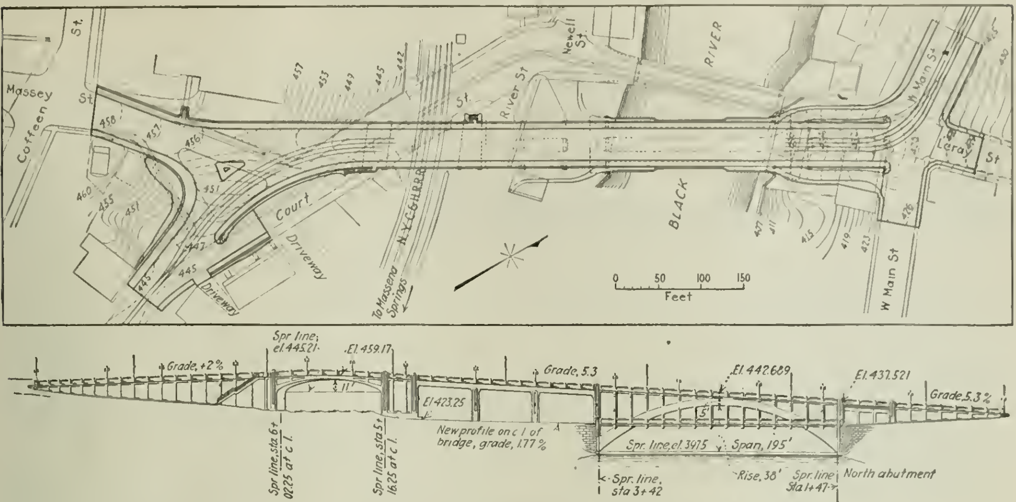
BRIDGE ACROSS BLACK RIVER, WATERTOWN, N. Y., WITH TWO DECKS

4.5 per cent to the south, toward the center of the city, and 5.3 per cent toward the north and over the Black River. From the north end of the north abutment of the arch over the railroad tracks to the south bank of the Black River, a distance of 150 ft., the structure consists of three continuous girder spans. Each span measures 48 ft. 8 in. center to center of supports.

North of these girders and spanning the river is the double-deck reinforced-concrete arch of 195-ft. span length between abutment faces. The grade of the upper deck is 5.3 per cent, and carries the new realignment of Court St. over the Black River. As so far described, this elimination project would have deprived property owners between the railroad tracks and the south bank of the river of easy access to the north bank of the ribs provides ample room for a 10-in. gas main, a 12-in. water main and several 3-in. conduits. The city has erected a wooden enclosure to protect these mains against the extreme cold of winter.

The roadway over the upper deck is 38 ft. wide from curb to curb flanked by a 7-ft. sidewalk along each side of the bridge. Straight slab work was used throughout the upper deck because of the simplicity of construction. These slabs are supported on the four arch ribs by thin transverse walls. Reinforced-concrete girders, built into these walls, bridge the 3-ft. and 13-ft. gaps between arch ribs and carry the upper deck slabs above the lower roadways. Expansion joints were provided in these slabs at the points shown in the drawings.

Like the upper deck, the lower one also consists of



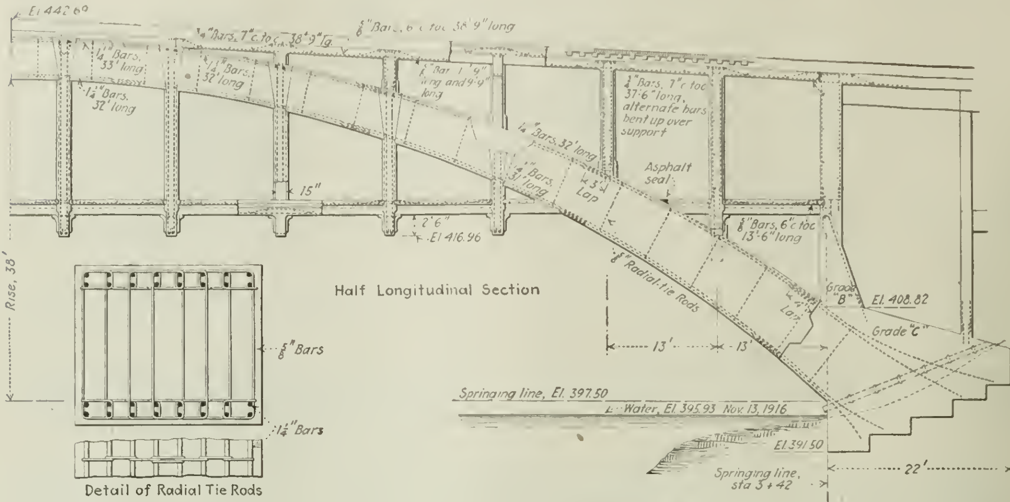
PLAN AND ELEVATION OF DOUBLE-DECK COURT STREET BRIDGE, WATERTOWN, N. Y.

slabs supported on transverse girders which in turn are hung from the four ribs. Near the abutments, the lower deck lies above the extrados of the ribs, and at such panel points the construction is supported on walls and transverse girders in the same manner as described for the upper deck. The lower deck sidewalk slabs are carried on cantilevers which are really continuations of the suspended transverse girders. At the ends of the arch, these sidewalks project beyond the faces of the outside rib, while at the center of the span they lie directly beneath the ribs. This arrangement saves weight and unnecessary sidewalk space. The lower deck is level from abutment to abutment.

In order to avoid undue tensile stresses in the hangers, it was decided to design the entire structure so that most of the dead-load of the lower deck would be carried by the hanger bars before these bars would be surrounded by concrete. With that object in mind, the upper ends of the eight 1-in. square hanger bars were secured in the concrete of the arch rib. At one side of the hanger a wedge-shaped opening was made through the arch rib. The hangers were then designed with a curbed flare which completely covered the intrados end of this wedge-shaped opening. After all the dead-load of the lower deck had been applied, except the weight of the parapet and the pavement, forms for the hangers were built and filled with concrete through the opening in the arch. Since this procedure necessitated that the arch be freed from its centering, an analysis was first made to determine the strength of the rib with openings 2 ft. wide and supporting the weight of the rib and the entire lower deck minus the weight of pavement and parapet.

The centering for the arch was built in two parts. The lower one consisted of pile bents with timber caps and stringers thoroughly cross-braced and built to the elevation of the bottoms of the lower deck girders. Above this part, the centering was built to conform to


LEFT: INSIDE VIEW OF ROADWAY. RIGHT: LOWER SIDEWALK CUT IN TO SAVE SPACE AND WEIGHT

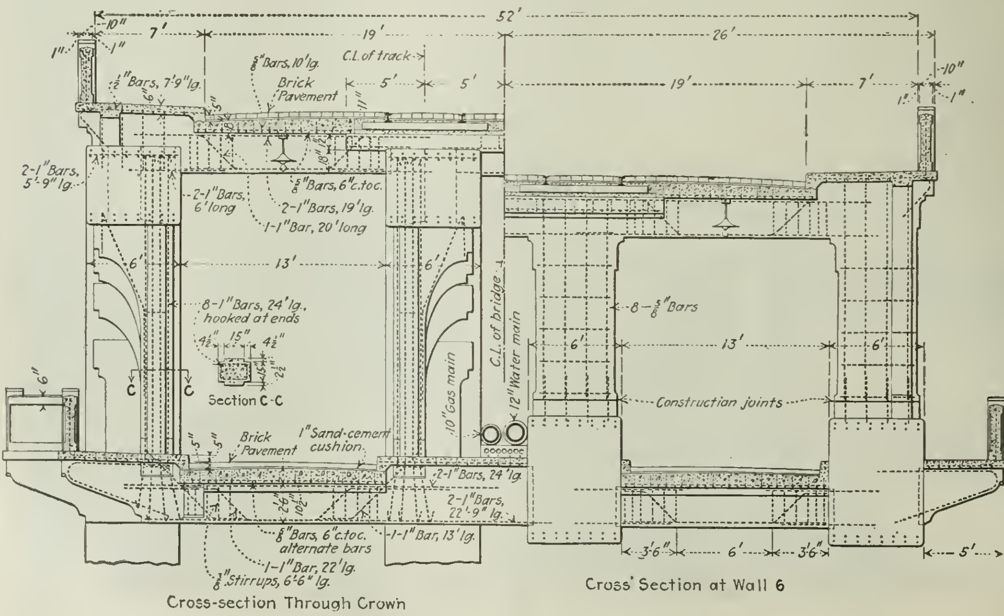


ELEVATION OF THE DOUBLE-DECK ARCH

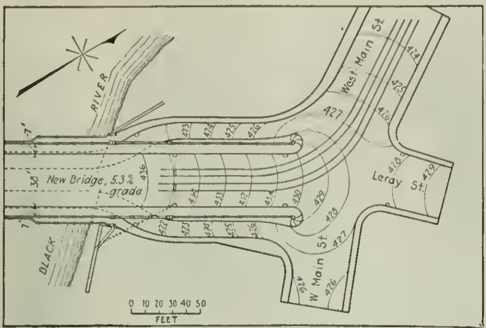
the shape of the arch. The posts were so arranged that they did not interfere with the hanger rods, whose upper ends were concreted into the arch ribs. After the arch had sufficiently hardened to permit the centers to be struck, the upper portion was removed and the formwork for the lower deck was built on the lower portion of the arch falsework. Upon the removal of this falsework, the weight of the lower deck was carried by the rib.

After the hangers were concreted, the contractor was able to proceed with the erection of the walls and girders supporting the upper deck.

Entrances to the lower deck at the south end of the double-deck span and under the continuous girders previously mentioned were readily facilitated and there was plenty of space for all kinds of vehicles coming from Newell and River Streets. The north end of the river span presented a more difficult problem. Here on account of cost and property damages, the designers were cramped for room. Several studies were made before the plan shown was finally evolved and adopted. This figure (on p. 545) is an excellent example of how complicated grade intersections may best be studied by plotting contours. Several examples of the use of



SECTIONS THROUGH DOUBLE-DECK ARCH



METHODS OF LAYING OUT GRADES ON APPROACH

contour lines for solving such problems have been shown in *Engineering News-Record* in the past few years.

Vehicles on the approach grades to the lower deck at the north end pass under a 39-ft. overhead girder which supports the upper deck sidewalk and part of the roadway. The minimum vertical clearance under this girder is 13 ft., while the horizontal clearance was carefully designed for the largest vans now in common use with ample margin for future increase of size.

LOOKING THROUGH THE SOUTH DECK

Each roadway of the lower deck as well as the north approaches to the lower deck is 12 ft. wide between curves except at the above-mentioned underpass where the roadway width increases from 12 ft. to 14 ft., and then decreases to 12 ft. again.

The entire structure, together with the approaches at the north and south ends, was designed by the Concrete-Steel Engineering Co. of New York City, of which William Mueser is sole owner. Mark D. Ewell was resident engineer for the designers. The work was let on a unit price basis to the Peckham Construction Co., Inc., of Buffalo, N. Y., for whom E. C. Boehm was in charge of the work. The city engineer of Watertown is Paul B. Sutton.

The final construction cost of the bridge was $362,000, which was paid by the City of Watertown, the State of New York, and the New York Central & Hudson River R.R., according to schedules agreed upon previous to the letting of the work.

Power Progress on the Saguenay

SAGUENAY RIVER in northeastern Quebec has unusual power possibilities because the total fall from Lake St. John to tidewater, about 320 ft., is concentrated in a distance of 28 miles, and the flow which now ranges from 12,000 to 220,000 sec.-ft. is susceptible of considerable regulation on account of the fact that Lake St. John has an area of over 300 sq.mi., and a drainage area of 30,000 sq.mi. Other power sites in the Saguenay valley are located on the Au Sable and Chicoutimi Rivers, the two outlets of Lake Kenogami. The flow of these two rivers can also be regulated by increasing the storage capacity of Lake Kenogami.

Isle Maligne Power Station—The present development includes the concentration of the power of the Saguenay River in two plants, one located at Isle Maligne, a point on one of the outlets of Lake St. John, called the Grand Discharge, and the other down near tidewater, a few miles above the mouth of the Shipshaw River. Work on the Isle Maligne station, which is to have a capacity of 480,000 hp., was started in January last. Access to this plant required the building of 15 miles of railway including a bridge over both the Little Discharge and one channel of the Grand Discharge.

This development consists of a power house, four spillways, a dam to control the right channel of Grand Discharge at Isle Maligne, one earth dam, and three spillways at the head of the Little Discharge. The power house, which itself is the largest of the dams, will contain twelve 40,000-hp. units.

This work is being carried on by the Quebec Development Co., of which J. B. Duke is president, W. S. Lee and F. A. Cochran, vice-presidents. W. S. Lee is acting as chief engineer and F. A. Cochran as resident manager of the Isle Maligne work.

Chicoutimi Development—Lake Kenogami, at the headwaters of the Chicoutimi River, has a drainage area of 1,450 sq.mi. and a water surface of 12 sq.mi. The present development scheme calls for increasing this storage area to 21 sq.mi. by increasing the level of the lake 32 ft. The lake has two outlets discharging into the Saguenay, one the Chicoutimi River, 15 miles long, with a total fall of 467 ft., and the Au Sable River, 6 miles long, with a drop of 440 ft. Under the proposed storage scheme the minimum dependable flow of 1,800 sec.-ft. will be distributed on the basis of ⅔ to the Chicoutimi and ⅓ to the Au Sable. There are already two developments on the Chicoutimi River, one at the town of Chicoutimi, utilizing a head of 56 ft., and another of a head of 190 ft. at the plant of La Cie de Pulpe de Chicoutimi. A further head of 60 ft. is now being developed by Price Bros. On the Au Sable River, Price Bros. have already developed a total head of 380 ft.

The storage work on Lake Kenogami will necessitate the construction of two concrete dams, one at each outlet, and four earth dikes to keep water from the raised lake from overflowing into other watersheds. The construction of these dams and dikes is to be carried by the Quebec Stream Commission, which has been guaranteed a sum sufficient to cover the yearly interest, operating and sinking fund charges by the companies deriving benefit from the additional storage. O. O. Lefebvre is chief engineer of the Quebec Stream Commission.

Indebtedness to the *Journal* of the Engineering Institute of Canada and to H. G. Cochran, A. F. Dyer and C. N. Shanly for this information is acknowledged.

Highway Traffic Surveys in Nine Tennessee Counties

Determine Kind, Volume and Distribution of Traffic and Gross Load and Unit Wheel Loads on Freight Carrying Vehicles

By N. W. Dougherty
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During the summers of 1921 and 1922 co-operative traffic surveys were conducted in nine Tennessee counties by the Bureau of Public Roads, the Tennessee Highway Department, the University of Tennessee and the several counties. The surveys were planned, first, to determine kind, volume and distribution of travel, and second, to determine capacity and weights of freight vehicles by measuring gross load and unit wheel loads.

Counting stations were established on all the main highways of the several counties. The stations were established at intersections where separate counts could be made on the primary roads and also on the secondary, or feeder roads. Fig. 1 for Knox County illustrates the choice of stations. In this county 64 separate counts were made by placing the counters at 31 counting stations. To obtain weights of vehicles, weighing stations were established on selected roads of each county. Both loaded and empty trucks were weighed in sufficient numbers to give a fair estimate of freight haulage, average load and prevalence of overloading. Two loadometers were used in determining weights.

The traffic counts in the several counties were scheduled over four-day periods, beginning on Thursday and ending on Sunday. On one day of each count automobile and truck license numbers were listed. At many stations the number of vehicles passing was so large that license numbers could not be accurately listed; at such stations the counter recorded the type and direction of vehicles. During the two summers' work

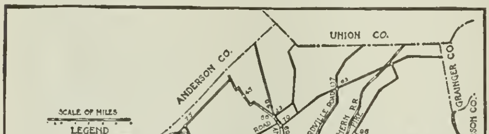


FIG. 1—TRAFFIC MAP OF KNOX COUNTY

more than 28,000 auto-license numbers and 6,900 truck numbers were listed and tabulated. The license numbers were used to determine local and foreign travel.

Kind and Volume of Travel—Traffic information was so listed that analysis could be made of the number of automobiles, trucks, buggies and wagons. A summary for the nine counties, which includes an average daily

FIG. 2—TRUCK HAULAGE OF LIVE-STOCK IS COMMON

number of vehicles passing, of more than 99,000, gives percentages as follows: Automobiles, 69.1, and trucks, 14.0, making a total of 83.1 per cent for motor-drawn travel leaving 16.9 per cent for horse-drawn travel comprising 7.8 per cent buggy and 9.1 per cent wagon.

It will be noted, Table I, that in Hamilton County only 5.5 per cent of the total number of vehicles listed were horse-drawn vehicles. In Madison County the percentage reaches 37.1 for horse-drawn vehicles against

TABLE I—KIND AND VOLUME OF TRAFFIC IN NINE TENNESSEE COUNTIES

County		Autos		Trucks		Buggies		Wagons	
	Total	No.	Per Cent	No.	Per Cent	No.	Per Cent	No.	Per Cent
Cumberland...	380	269	70.8	13	3.4	9	2.4	89	23.4
Davidson..	23,083	15,575	67 4	3,728	16.2	2,096	9.1	1,684	7.3
Hamblen..	3,500	2,322	66.2	373	10.7	314	9.0	491	14 1
Hamilton ..	21,390	16,787	78.5	3,417	16.0	288	1.3	898	4 2
Knox...	11,153	7,614	68.3	1,637	14.7	849	7.6	1,053	9 4
Madison	8,967	4,950	55.2	693	7 7	1,702	19.0	1,622	18.1
Maury	4,017	2,614	65.2	97	2 4	714	17.7	591	14 7
Shelby ..	25,496	17,610	69.0	3,800	15.0	1,537	6.0	2,550	10.0
Williamson*...	1,185	790	66.6	107	9 0	202	17.1	86	7.3
Totals and average per cents..	99,171	68,531	69.1	13,865	14.0	7,711	7.8	9,064	9 1

* Nine stations on through roads.

62.9 for motor-driven vehicles. In the four larger counties, Davidson, Hamilton, Knox, and Shelby, the percentages are, autos 71.0, trucks 15.5, buggies 5.9 and wagons 7.6 making 86.5 per cent motor-driven vehicles against 13.5 per cent horse-drawn vehicles. In the five smaller counties the average is, autos, 60.4, trucks 7.1, buggies 16.4 and wagons 16.1 making 67.5 per cent motor-driven vehicles against 32.5 per cent horse-drawn vehicles.

Local and Foreign Travel—In the nine counties over 28,000 automobile license numbers were listed and classified. Table II shows this classification for the county, adjacent counties, other counties of the state and other states. The total for the nine counties gives 78.1 per cent of the automobiles on the road from the county in which the roads were located; an additional 6.8 per cent were from adjacent counties, making the total local travel practically 85 per cent. The number of cars from other states reached only 2.3 per cent of the total.

Table III shows the sources of truck traffic. Here the tabulation is for seven counties with nearly 7,000 trucks. Of all the trucks listed 75 per cent were from the county in which the roads were located. An additional 7.4 per cent were from adjacent counties, making 82.4 per cent of the truck travel purely local. Only 0.5

TABLE II—TRAFFIC CLASSIFIED ACCORDING TO SOURCE (AUTOMOBILES)

County	Total	County No.	County Per Cent	Adjacent Counties No.	Adjacent Counties Per Cent	Other Counties Of State No.	Other Counties Of State Per Cent	Other States No.	Other States Per Cent
Cumberland...	289	188	65.0	47	16.3	54	18.7	0	0
Davidson..	3,269	2,687	82.3	339	10.3	171	5.2	72	2.2
Hamblen.. ...	1,151	769	66.8	118	10.3	225	19.5	39	3.4
Hamilton... ..	7,752	6,258	80.7	78	1.0	1,193	15.4	223	2.9
Knox.	7,315	6,322	86.5	504	6.8	364	5.0	125	1.7
Madison......	2,832	1,851	65.5	227	8.0	676	23.8	78	2.7
Maury..... .	2,590	2,039	78.7	135	5.2	416	16.1	0	0
Shelby....	2,112	1,525	72.3	94	4.4	406	19.2	87	4.1
Williamson*...	791	302	38.2	371	46.9	101	12.8	17	2.1
Totals and average percents....	28,101	21,941	78.1	1,913	6.8	3,606	12.8	641	2.3

* Through roads.

per cent of the trucks listed were from other states. It will be noted that these trucks were listed in Sheiby and Hamilton Counties whose county lines were also state lines. The truck data for Shelby County is not complete or it would show more trucks from Arkansas and Mississippi. In this county the traffic was so heavy that traffic counters could not make accurate lists of the license numbers of all automobiles and trucks passing the roads. Had such a count been made on many of the roads the percentages would run as high as that for adjacent counties.

Weighing Stations—From two to six weighing stations were established in each county. Three stations were chosen on roads where beam scales had been installed and the vehicles to be weighed were passed over the scales. Weights were determined much more quickly by scales than they could be determined by the loadometers. Stations were so selected that typical information could be obtained for each county. The information taken was very complete, giving make and capacity of vehicle, kind and value of commodity, length and direction of haul, frequency and amount of overload, kind and width of tires, and origin and destination of travel. The scope of this paper will only permit a short discussion of two of these items, namely, kinds of commodities and frequency and amount of overloads.

Commodities—Trucks are used to haul a great variety of commodities, varying from such bulk material as logs, sand and gravel to building materials as lathes, lumber and shingles, to household goods, textiles, foodstuffs, soft drinks and finally passengers. The number of separate commodities listed in each county ranges

FIG. 3—EXAMPLE OF OVERLOADED TRUCK

from thirty to fifty, depending upon the location of the county, the location of the weighing stations and the number of vehicles weighed. Fig. 2 shows a small truck in Davidson County with sheep. Many trucks in this county and adjacent counties are used to haul live-stock to market at Nashville.

Fig. 1 is plotted to show the average daily twelve-hour travel passing the several traffic stations. The width of line is proportional to the total number of vehicles passing; the dotted width is proportional to the percentage of local automobile travel and the shaded area is proportional to the foreign automobile travel. This diagram and Tables II and III show that the great preponderance of travel is local travel. Simultaneous counts taken over as much as 200 miles of roads show similar information. The road problem, therefore, in Tennessee is essentially a local problem. When the 97.7 per cent of State travel is served the 2.3 per cent of travel from other states will be able to get along.

Overloading—Approximately 55 per cent of the loaded vehicles weighed were carrying loads above their rated capacity. Trucks of all capacities from one-half ton up were overloaded. In some of the counties the overload-

TABLE III—TRAFFIC CLASSIFIED ACCORDING TO SOURCE (MOTOR TRUCKS)

County	Total	County No.	County Per Cent	Adjacent Counties No.	Adjacent Counties Per Cent	Other Counties Of State No.	Other Counties Of State Per Cent	Other States No.	Other States Per Cent
Davidson......	772	599	77.5	101	13.2	72	9.3	0	0
Hamblen......	352	221	62.7	36	10.4	95	26.9	0	0
Hamilton......	2,328	1,743	74.9	25	1.1	526	22.5	34	1.5
Knox.........	2,105	1,768	84.0	222	10.5	115	5.5	0	0
Madison......	500	341	68.2	12	2.4	147	29.4	0	0
Shelby........	653	416	63.7	40	6.1	196	30.0	1	0.2
Williamson....	176	70	39.8	78	44.3	28	15.9	0	0
Totals and average percents.....	6,886	5,158	75.0	514	7.4	1,179	17.1	35	0.5

ing for capacities of two tons and over amourted to 68 per cent of the vehicles weighed. Seventy per cent of the vehicles weighed were under two tons capacity while thirty per cent were two tons and over. Of the 30 per cent 19 per cent were of two-ton capacity leaving only 11 per cent for trucks above two tons. The small percentage of vehicles of two tons capacity and above accounts, in part, for the prevalence of overloading for these capacities. Fig. 3 shows a typical heavy load in Knox County. Here a four-ton truck is loaded with logs carrying a gross load of 20,000 lb. and having a concentration of 770 lb. per inch width of tread.

Regulations—The 1921 legislature gave the state highway department authority to regulate traffic on state aid roads and with county co-operation to regulate traffic on the county roads. The regulations issued by the department limit the gross load to 20,000 lb. and the wheel loads to 650 lb. per inch width of tire channel. About 25 per cent of the loaded trucks weighed were violating one or both of these regulations, 23.5 per cent had excessive concentrations on the rear axle and 2.6 per cent had excessive concentrations on the front axle as well. In Shelby County are two pieces of road maintained by the state highway department and in this county the percentage of overloading was considerably lower than in the other counties. On the two roads maintained by the department overloaded vehicles are stopped and required to unload until the regulations are not violated. Enforcement of proper regulations is badly needed in the other counties to protect the roads from the overloading evil.

Canada Spends Ten Million on Roads

Up to Aug. 31, this year, Canada had eighty highway projects totaling 785 mi., costing $9,336,373. Of these, Ontario had fourteen projects totaling 100 mi., and Quebec six projects, totaling 110 mi.

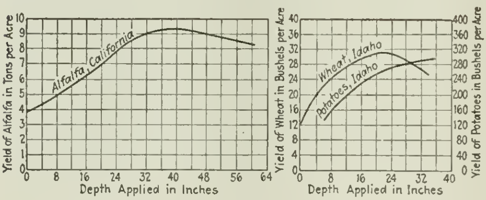
The Economical Use of Irrigation Water Based on Tests

Solution of the Problem Considered When Water Is Available at a Given Price, Land Plentiful, Water Limited and Land Semi-Irrigated

BY HARRY S. CLYDE, WILLARD GARDNER AND ORSON W. ISRAELSEN
Assistant in Physics Laboratory, Associate Physicist, and Irrigation Engineer, respectively, Utah Agricultural Experimental Station

ONE of the biggest single problems confronting the western public is to determine what amount of irrigation water under different conditions constitutes economical use. During the early settlement of the West there was enough water for all and each irrigator could use the amount he wanted. With the growth of these communities more land has been brought under irrigation and nearly all the late-season water has been appropriated, resulting in a need for limiting the amount of water that each farmer may use to the most economical quantity, in order that the greatest possible irrigation development may be made.

To ascertain what constitutes economical use of water numerous irrigation experiments have been conducted in recent years. Competent engineers, agronomists and others directly interested in irrigation differ widely in their interpretation of these experiments and in the application of them to a determination of what constitutes economical use of water. This paper presents a method of interpreting irrigation experiments under various conditions of water supply, irrigable land, cost of crop production and value of crops produced. Before the analysis of the problem, some typical experiments in California, Idaho and Utah are briefly reviewed.



FIGS. 1A AND 1B—YIELDS AT DIFFERENT WATER APPLICATIONS IN IDAHO AND CALIFORNIA

Experiments in California—Adams et al.[1] have conducted extensive investigations with alfalfa on the University Farm at Davis, Calif. During 1910 and 1911 a tract of 8.19 acres was divided into checks averaging 0.28 acre each. From 1912 to 1915, inclusive, 3.48 acres were used for this work. The soil was classified by the U. S. Bureau of Soils as a Yolo loam. The annual rainfall during the six years varied from 12 to 24 in. During the first two years the following total amounts of water were given to different plats: none, 12 in., 24 in., 36 in. and 48 in. In 1912 two additional plats were provided which were given depths of 18 and 60 in. A stream of 0.9 sec.-ft. was used to irrigate the plats, and in most cases it was distributed through a slip-joint pipe to insure even distribution. The yield (y-w) curve for this experiment is given above in Fig. 1A. It shows that the maximum yield was obtained with an application of 36 in. of water, although the increase in yield due to increase in depth of water from 30 to 36 in. is almost negligible.

Experiments in Idaho—Bark[2] made investigations to ascertain the water requirements of various crops and soils in southern Idaho. His studies were continued five years over comparatively large areas. At the Gooding Station the average rainfall for the five years was about 11 in., of which 3 in. fell during the growing season. The experiment farm soil is a medium clay loam, rather impervious, and from 6 to 8 ft. deep. Ninety-six plats were planted with spring wheat of the staple varieties during the five years. The y-w curve given for this experiment in Fig. 1B shows the average results. The yield of grain increased as the water applied increased until a depth of from 16 to 22 in. had been applied, after which more water decreased the yield.

In Figure 1B the y-w curve is given also for potatoes at the Gooding Station. Results are available for applications of water ranging up to 36 in. only. Up to this point the curve shows the yields still increasing with increase in water supplied, but the rate of increase was very small.

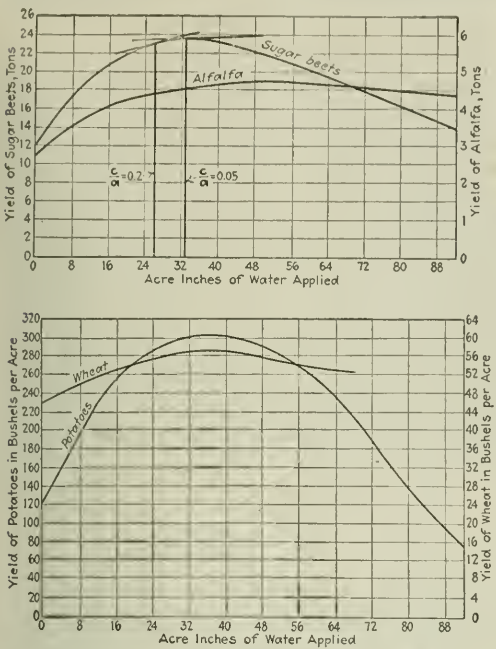
Experiments in Utah—The Utah Experiment Station has done much work on duty-of-water investigations the results of which have been summarized in *Bulletin* 173[3]. The experiments were conducted on a typical, deep, uniform loam having excellent underdrainage. The annual rainfall at the Utah Station varies from 15 to 18 in., of which only about 2 in. comes during the growing season (June, July, and August). The y-w curves for sugar-beets, potatoes, alfalfa and wheat given in Figs. 2 and 3 are the average results of many trials in the Utah experiments.

The tests with sugar-beets, which extended from 1902 to 1919, show that the yield increases with applications up to about 30 in. and then starts to decline. There is quite a range where the yield is not greatly affected by smaller or greater amounts of water. The curve for potatoes shows the results of twenty-six trials covering fourteen years. The most favorable amount for potatoes seems to be between 30 and 40 in. Applications above 60 in. make the yield drop fast. The curve for alfalfa shows that it needs more water than other crops, the highest yield being secured with an application of 50 in. The decline in yields from larger applications was very slow. The experiments with wheat show that it is not nearly so much affected by irrigation as are alfalfa, sugar-beets and potatoes. As the applications were increased above 15 in. the yield increased very slowly.

The solution of the problem concerning the economical use of irrigation water rests upon the experimental determination of the y-w curve, examples of which are shown above. With the exception of the various cost data, the y-w curve gives in condensed form all the information necessary for a practical solution of the problem, which has in reality three possible solutions, one for each of three different cases.

Case 1. Water Available at a Given Price—First, let us consider the case in which there is a limited area of land and a sufficient supply of water to be had at a specified price per acre-inch. The question is to determine how much water should be used to secure the maximum profit per acre of land.

Let c = cost of the water per acre-inch, which cost includes the annual interest on money invested in water rights or shares of water stock, the maintenance of the irrigation system and the application of water. It is realized that c, as here defined, is not rigorously constant. A more accurate analysis, considering c as a variable, is presented later in the paper.



FIGS. 2 AND 3—YIELD-WATER CURVES FROM UTAH EXPERIMENTS

w = number of acre-inches applied per acre.
b = cost per acre for plowing, seeding, fertilizing, tilling, taxes, rental value and such other costs as are proportional to the acreage.
a = price per ton of the crop on the farm, which is the market price minus the cost per ton for hauling. The cost of hauling varies with the yield and therefore could not be counted in b.
i = net income per ton.
y = yield in tons per acre.
Then cw = the total cost of the water per acre.

$$\text{And } i = a - \frac{cw + b}{y} \text{ or } iy = ay - cw - b \quad (1)$$

Stated in words, this equation means that the net profit per acre equals the total return per acre for the crop at the farm minus the acre cost of the water and the costs per acre for plowing, seeding, fertilizing, tilling, taxes, rental value, etc.

The first derivative of iy with respect to w gives

$$\frac{d\,(iy)}{dw} = \frac{a\,dy}{dw} - c$$

which is the slope of the curve representing the profit per acre, iy, as a function of w. At the peak of the profit curve, the slope is 0, and if we equate the right-hand member to 0, the derivative of y with respect to w may be obtained.

$$\frac{a\,dy}{dw} - c = 0$$
$$dy/dw = c/a \quad (2)$$

This derivative gives the slope of the y-w curve at the value of w corresponding to the peak of the profit curve.

If we follow the y-w curve out until we find a point where the slope of the tangent is equal to c/a, that point gives the w for a maximum profit per acre. To determine the economic w it is only necessary to obtain the y-w curve and determine the ratio c/a. As stated above c is considered fixed. The price per ton or bushel is determined by market prices. Whether a is the price per ton or bushel will depend upon whether the y on the curve is in tons or bushels.

Equation (2) shows that the economical w is independent of the cost of plowing, seeding, fertilizing, etc., because the term b is not contained in the ratio c/a, and it is this ratio which determines the economic w. It therefore makes no difference what the price of the land is or how much it costs for plowing, seeding, tilling, taxes, etc., the economic amount of water will be the same. From this solution it may readily be seen that if c is greater than 0, then the peak of the profit curve (iy-w) or the point on the y-w curve where the tangent is equal to c/a will be to the left of the point of maximum yield. This means that where a price is charged for the water the maximum profit per acre will be obtained with some quantity of water less than the amount necessary to obtain the maximum yield.

To illustrate this case, let us consider a sugar-beet farm in Cache Valley. The y-w curve for sugar-beets in this district is given in Fig. 2. The average value of the water right per share in Cache Valley is about $80, which at 7 per cent interest would amount to $5.60 per year. The annual assessments for upkeep of the canals amount to about $1.25 per share. According to Connor,[4] it takes nine hours of man-labor per acre to apply the water and keep the ditches clean. At $0.25 an hour this would amount to $2.25 per acre. Each acre receives approximately 36 in. Using these values the cost per acre-inch would be $0.25 (approximately), which is the value of c for this region. An average price received for the beets is about $5.00 per ton. The value of a is therefore about $5.00 and the ratio of c/a is 25/500, or 0.05, which is the slope of the y-w curve at the economic w. This approaches very closely the w giving the maximum yield.

If the cost of the water were $1 an acre-inch, as it is in some parts of Utah, then the value of c/a would be 100/500, or 0.2. The point where the tangent to the curve has a slope of 0.2 corresponds to 26 acre-inches for w. Clearly the price of the water has a marked influence upon the economical w.

Case 2. Large Area and Limited Water Supply—In many arid region valleys there is insufficient water for the land available and yet irrigation is essential to crop production. Let us consider in Case 2 such arid valleys where land is abundant at a given price but where the water supply is limited. Consider further that it is desirable so to use the limited water supply as to obtain the maximum profit for the entire area. It is clear that in this case a different value of w will be obtained than that under Case 1.

Let w = amount of water per acre in acre-inches.
A = area to be irrigated in acres, which may or may not be the entire area of available land.
Q = total quantity of water available in acre-inches.
P = total profits for the entire area in dollars.
iy = profit per acre in dollars.

Then

$$A = Q/w \text{ and } P = Aiy$$

From which we may write

$$P = \frac{Qiy}{w} \quad (3)$$

By differentiating P with respect to w in equation (3), namely, $P = \frac{Qiy}{w}$, we obtain as the first derivative:

$$\frac{dP}{dw} = \frac{Q}{w} \times \left[\frac{d\,(iy)}{dw} - \frac{iy}{w}\right] \quad (3a)$$

At the peak of the total-profits curve (P-w), the slope is 0. Then, equating the derivative to 0 and dividing out the factor Q/w, we obtain

$$\frac{d\,(iy)}{dw} = \frac{Piy}{w} \quad (4)$$

This gives the slope of the profits-per-acre curve (iy-w) at the w giving the greatest profits for the total

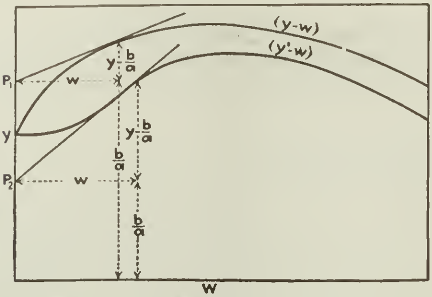


FIG. 4—Y-W CURVE FOR MUCH LAND AND LITTLE WATER

area, but we want the slope of the y-w curve at this economic w.

Expanding equation (4) we obtain

$$\frac{d\,(iy)}{dw} = \frac{i\,dy}{dw} + \frac{y\,di}{dw} = \frac{iy}{w} \quad \text{....................(4a)}$$

The derivative of i with respect to w is

$$\frac{dy}{dw} = -\left[\frac{yc - (cw + b)\,dy/dw}{y^2}\right]$$

Substituting for i and $\frac{di}{w}$ in equation (4a), cancelling, adding and dividing by a, we obtain

$$\frac{dy}{dw} = \frac{y - b/a}{w} \text{ for maximum } P. \quad (5)$$

Equation (5) gives the slope of the y-w curve at the value of w which gives the maximum profits for the total area. That the term c does not appear in equation (5) shows that the price of the water does not influence the amount of water for each acre that will bring the maximum profit for the entire area. However, if the most economical amount of water is used on each acre, then, as the cost of water increases the total profits decrease, and as the water-cost decreases the total profits increase.

Now suppose we have the y-w curve for a given crop in a given locality as indicated in Fig. 4, and we measure off on the y axis a distance equal to b/a. It is obvious that a point on the y-w curve having a slope of $\frac{y - b/a}{w}$ must have a tangent at that point extending through the point P_1 on the y axis marked by the distance b/a. The point P_1 marks this distance for any case where b/a is greater than y when w equals zero. A tangent to the y-w curve through P_1 would then have the required slope, $\frac{y - b/a}{w}$, and the point of tangency would correspond to the economical w. Clearly therefore when b/a marked by any point P_1 is larger than y at the point where w equals zero a line may be drawn through the point P_1 tangent to the y-w curve.

If, however, P_2 is any point in the y axis less than y_0 representing the value of b/a, it can be seen at once that unless there be a point of inflection, as shown in the y'-w curve, a line cannot be drawn through the point tangent to the curve. However, when this condition does arise, as represented by P_2, it means that a profit may be obtained from dry-farming which is contrary to the conditions considered in this case. Such a condition involves other factors which are treated under Case 3.

Should there be a point of inflection on the curve, which is very improbable, a tangent may be drawn through P_2 to the curve as shown on the y'-w curve in Fig. 4, thus showing that a solution would then be possible.

Up to this point the values a, b, and c have been considered as constants, whereas in many cases they are variable and dependent on w. If by chance there should be a scarcity of water over a large area the yield might be decreased to such an extent as to increase the price of the crop. It must be borne in mind, however, that a decrease or increase in yield in one district will not have much effect upon the market price of the crop. The value of b may to some extent be influenced by w, in that w affects the amount of cultivation. Some crops require a cultivation after every irrigation to stir up the soil and prevent excessive evaporation. As more water is applied per acre it may be applied oftener and therefore increase the cost per acre for cultivation.

We may think of the cost of the water, c, as composed of two parts: C_0, the annual charge for construction and maintenance, and C_1, the cost of ditching and application on the farm. The first is known to be a constant as the charge is made equal for every acre-inch. The second depends upon the area irrigated and thus indirectly upon w. The area irrigated depends upon the amount of water used per acre. As the water is spread over more land it requires more ditches and also more attention to spread it evenly. It would require more labor to spread 24 acre-inches over three acres than it would to put it all on the same acre. The value of c is represented approximately by the following equation:

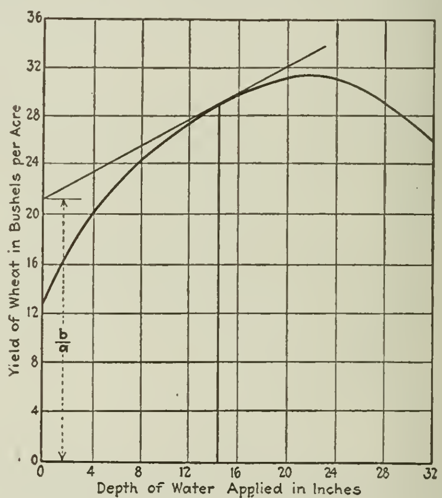


FIG. 5—Y-W CURVE FOR WHEAT IN THE SNAKE RIVER VALLEY

$$c = \frac{C_0 + C_1 A}{Q} \quad \text{....................(6)}$$

Where

C_0 = total annual interest and depreciation on the construction cost and the annual maintenance and operation.

C_1 = cost of ditching and application per acre.

A = area irrigated.

Q = total quantity of water in acre-inches.

If these factors a, b and c vary with w, and we substitute in equation (4a) for i its value obtained from equation (1) and for $\frac{di}{dw}$ its value obtained from differentiating i in equation (1) with

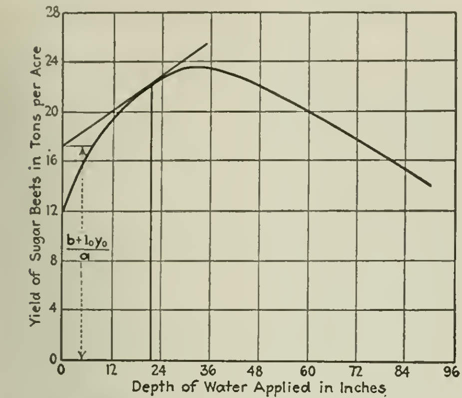


FIG. 6—Y-W CURVE FOR SUGAR BEETS IN CACHE VALLEY

respect to w and simplifying these results, then

$$\frac{dy}{dw}=\frac{y-\dfrac{b+\dfrac{wyda}{dw}-\dfrac{w^2dc}{dw}-\dfrac{wdb}{dw}}{a}}{w}\quad(7)$$

The value of wdb/dw in equation (7) will always be positive because, as stated above, b gets greater as more water is used per acre which makes the slope of the b-w curve always positive. Also the influence of w upon a is very small and therefore may be disregarded. Under that assumption the term $wyda/dw$ in equation (7) becomes zero. Formula (7) then becomes

$$\frac{dy}{dw}=\frac{y-\dfrac{b+C_1-\dfrac{wdb}{dw}}{a}}{w}\quad(7_1)$$

From equation (7_1) it can be seen that increasing C_1 is equivalent to increasing b and thus the economical w is increased. This means that it will pay better to use more water per acre than to spread it over a larger area, which would require more ditches to be built and more labor to apply it.

The Snake River Valley in Idaho presents an interesting example of Case 2. Here there is an abundance of land with a limited supply of water. A large portion of these lands cannot be dry-farmed successfully. The irrigators, irrigation engineers, the water commissioners and the courts are therefore confronted with the typical duty-of-water question, namely, how much land shall the available water be made to irrigate and how much water shall be allowed per acre?

It is recognized that in many parts of the Snake River Valley, and in other similar valleys, water rights have been decreed according to the priority-of-rights doctrine in which economical use as defined under Case 2 is not rigorously required. Nevertheless the analysis is directly applicable in those localities where water-rights are not yet determined and also to readjudications of rights as occasion requires. Moreover it may be applied toward more economical use as between holders of rights to waters recently adjudicated, particularly where the water right is made appurtenant to the land.

In Fig. 5 is given the y-w curve for wheat in this region. To answer the above question for wheat it is only necessary to obtain the values of b and a corresponding to this region, provided of course the y-w curve were fully established.

An approximate average value of the land in the Snake River Valley is $100 an acre. Assuming an interest charge of 7 per cent, this would give a rental cost of $7 an acre. The labor cost of producing an acre of wheat in Cache Valley, Utah, is given by Connor[4] as 29 hours of man labor and 30 hours of horse labor, including the labor used for irrigating. In this paper the labor used in the application of the water has been considered as part of c. Since the yield in the Snake River Valley averages from 20 to 25 bu. an acre and as farming is there conducted on a larger scale than in Cache Valley, thus reducing labor costs, the approximate labor cost for Snake River Valley is assumed to be 20 hours of man labor and 25 hours of horse labor for each acre. An approximate normal value for this labor would be 25c. an hour for man labor and 10c. an hour for horse labor. *Bulletin* 943, published by the U. S. Department of Agriculture (Cooper and Washburn[5]), gives the cost of producing spring wheat for the year 1919. These costs are probably about 50 per cent higher than normal, and this fact has been considered in selecting the values of the various items brought together under the factor b and summarized below:

ESTIMATED COSTS OF PRODUCING ONE ACRE OF WHEAT IN SNAKE RIVER VALLEY, IDAHO, CLASSIFIED AS b COSTS

Use of land or rental value	$7.00
Taxes and insurance	.50
Man labor	5.00
Horse labor	2.50
Seed and seed treatment	2.07
Binder twine	.30
Interest and depreciation on machinery	1.20
Cost of threshing	1.25
Overhead, including minor items	1.30
Total (b costs)	$21.12

A normal price for wheat corresponding to 25c. an hour for man labor is $1 a bushel. This gives the ratio of b/a as 2112/100, or 21.12, which is indicated near the y axis in Fig. 5. A tangent to the curve in Fig. 5 may then be drawn, and the w corresponding to the point of tangency gives the economic w as 14.4 acre-inches for this region. This clearly is only an approximate solution as accurate cost factors for b are not available. However, this illustration serves to show that very accurate solutions may be obtained when the cost factors for b are known and when the y-w curve is fully established.

Case 3. Area Partly Dry-farmed and Partly Irrigated—In many cases the entire acreage in a district is under cultivation, some of it being developed by irrigation and the remainder by dry-farming. Here again the problem arises as to how much water shall be applied per acre on the irrigated part to give the maximum profits for the total area. This case differs from Case 2 in that the land not irrigated may be dry-farmed with profit. In this case $P = P_i + P_o$, where P_i equals the profit from the irrigated section and P_o the profit from the dry-farm area.

For the solution of this case we may take the equation $P = P_i + P_o$ from formulas (3) and (4). Then using the following notation:

i_0 = profit per ton of crop produced without irrigation.
y_0 = yield per acre in tons without irrigation.
i_0y_0 = profit per acre for the dry-farmed area.
t = total area of land in acres.
Q = total quantity of water in acre-inches.

$$P=\frac{Qiy}{w}+i_0y_0\,(t-Q/w)\quad(8)$$

Taking the derivative of P with respect to w, equating to zero

and dividing out the factor Q/w and solving for $\frac{d(iy)}{dw}$ gives

$$\frac{d(iy)}{dw} = \frac{iy}{w} - \frac{i_0 y_0}{w} \quad (9)$$

which is the slope of the profits-per-acre curve from which

$$\frac{idy}{dw} + \frac{ydi}{dw} = \frac{iy}{w} - \frac{i_0 y_0}{w} \quad (9_1)$$

As in case 2, substituting the values of i from equation (1) and di/dw in equation (9_1) cancelling, adding and dividing by a, we obtain

$$\frac{dy}{dw} = \frac{y - \dfrac{b + i_0 y_0}{a}}{w} \quad (10)$$

which is the slope of the y-w curve at the economical w and which differs from equation (5) only by an effective increase in the factor b.

The west part of Cache Valley, Utah, presents an interesting example of Case 3. This land may be dry-farmed at a profit. Recently an irrigation project has been formed to irrigate part of the land and the question arises as to how much land shall be irrigated or how much water shall be applied per acre. To answer this question we must know the profit per acre obtained by dry-farming and we must have the y-w curve for the crop grown on the irrigated land; we must also know the various cost factors outlined under b.

Consider for example that wheat is grown on the dry-farmed part and sugar-beets on the irrigated part. The average yield of wheat on the dry-farm in this district is approximately 26 bu. an acre. The land is worth approximately \$65 an acre. One-half of it is summer-fallowed each year. Thus, rent for two years must be charged against each crop. At 7 per cent this amounts to \$9.10 per acre. The labor cost includes that on the summer-fallowed part. The costs of producing winter wheat are given in *Bulletin* 943, published by the U. S. Department of Agriculture[5]. These costs were taken for 1919 and are about 50 per cent above the average. This fact has been taken into consideration in selecting the items given below which make up the cost factor classed as b.

ESTIMATED COSTS OF PRODUCING ONE ACRE OF WHEAT IN CACHE VALLEY, UTAH, CLASSIFIED AS b COSTS

Use of land	\$9.10
Man labor	4.25
Horse labor	3.35
Cost of seeding and seed	1.45
Binder twine	.30
Threshing	1.50
Use of machinery	1.90
Overhead	1.50
Total (b costs)	\$23.35

Considering the average price for wheat corresponding to these costs as \$1 a bushel and assuming an average yield of 26 bu. an acre, there would result an average profit of \$2.65 an acre, which is the value of $i_0 y_0$.

The cost of producing sugar-beets in this district is given by Moorhouse and Nuckols in *Bulletin* 963, published by the U. S. Department of Agriculture[6]. The following values are selected:

ESTIMATED COSTS OF PRODUCING ONE ACRE OF SUGAR-BEETS IN IDAHO AND UTAH, CLASSIFIED AS b COSTS

Use of land	\$11.70
Taxes and insurance	.95
Cost of machinery	5.80
Overhead and miscellaneous	5.80
Man labor	25.88
Horse labor	12.00
Contract labor	16.40
Seed	1.35
Manure	3.40
Total (b costs)	\$83.28

This gives the value of b as \$83.28. An average price for sugar-beets corresponding to these figures is \$5 per ton. The ratio $\frac{b + i_0 y_0}{a}$ is then $\frac{83.28 + 2.65}{5}$, which equals 17.2. This value of $\frac{b + i_0 y_0}{a}$ is indicated near the y axis in Fig. 6. Drawing a line through this point, i.e., 17.2 units above the origin, tangent to the y-w curve, shows the point of tangency as corresponding to a w of 21.5 acre-inches per acre, which is the economical w for this example.

[1]Adams, Frank, et al.: Investigations of the Economical Duty of Water for Alfalfa in Sacramento Valley, California. Univ. of Calif. Publications, Dept. Eng. Bul. 3.

[2]Bark, Don H.: Experiments on the Economical Use of Irrigation Water in Idaho. U. S. D. A. Dept. Bul 339.

[3]Harris, F. S.: The Duty of Water in Cache Valley, Utah. Utah Exp. Sta. Bul. 173.

[4]Connor, L. G.: Labor Costs and Seasonal Distribution of Labor on Irrigated Crops in Utah. Utah Exp. Sta. Bul. 165.

[5]Cooper, M. R., and Washburn, R. S.: Cost of producing Wheat. U. S. D. A. Dept. Bul. 943.

[6]Moorhouse, L. A., and Nuckols, S. B.: Cost of Producing Sugar-Beets in Utah and Idaho, 1918-19. U. S. D. A. Dept. Bul. 963.

Lessons from a Theater Fire

Stage Portion of Theater Destroyed, but Auditorium Not Damaged—Efficiency of Steel Curtains and Stage Vents

By Dr. E. G. Friedrich
Berlin, Germany

VALUABLE indications of some essential points in theater fire protection were given by a serious fire that destroyed the stage portion of the Wiesbaden Theater last spring. The fire broke out just after the close of a performance of the opera "Rienzi" and destroyed the interior of the stage portion completely, without, however, breaking through into the auditorium.

Very rapid spread of the flames and the development of intense heat characterized the fire. The stage roof, consisting of a zinc covering on wood sheathing on

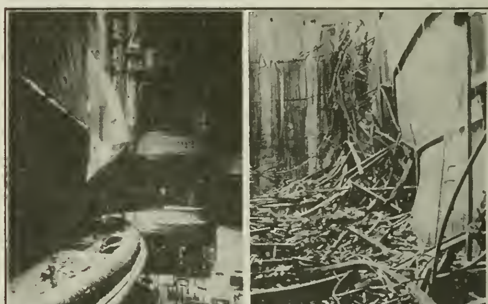


FIG. 1—BULGING OF LIGHT STEEL CURTAIN
Front and Rear Views

unprotected steel trusses, fell a few minutes after the fire department reached the scene. The smoke vents in the roof opened early, under the action of the internal pressure, and gave the fire free vent. Shortly after the fire started, the steel curtain between stage and auditorium, built of corrugated steel with angle-iron stiffening, became incandescent in its middle portion and began to bulge out toward the auditorium. It would have been unable to resist very long but for the relief of the pressure.

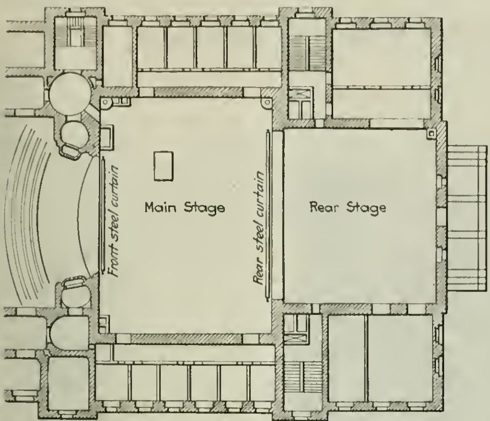


FIG. 2—PLAN OF STAGE SPACE

The roof vents in the stage were formed by swinging sections in the sides of a roof monitor, each swinging section being about 24 in. wide, pivoted on its horizontal center line, and weighted so as to open when the closing rope was released or burned through.

Because of the rapid destruction of the stage portion and the narrow margin by which the auditorium was saved (in view of the incipient failure of the curtain), two points have been under discussion since the fire: How the separation of stage and auditorium is to be made effective under all conditions, and how the stage space itself is to be protected.

Separation of Auditorium from Stage—It is a first principle of theater protection that a fire on the stage must be limited to the stage. This can be accomplished only by a really effective steel curtain provided with substantial stiffening and capable of resisting both intense heat and a certain amount of pressure. The Wiesbaden fire demonstrated that a curtain of corrugated steel with a few angles to stiffen it is wholly inadequate. Stronger construction is necessary. Rapid heating of the curtain should be prevented, so far as possible, and for this purpose it might be advisable to line it on the stage side with oak lagging, which would retard the transmission of the heat from the fire to the steel and serve effectively as a short-time fireproofing of the curtain.

Automatic-sprinkler protection of the curtain is also necessary, but it must be so arranged as to be itself not exposed to derangement by a fire on the stage or by mechanical actions. The Wiesbaden Theater had such a water curtain, but it was of a primitive kind, consisting of a perforated trough above the curtain on the stage side, supplied by pipes running along the stage wall and thus exposed to rapid destruction. The sprinkler piping should unquestionably be embedded in the wall or else placed on the auditorium side; both automatic and manual operation of the sprinkler system should be provided for.

Careful attention should be given also to the construction of the curtain guides. The guides must be of fireproof construction, preferably of concrete, and must be so detailed that there is no chance of the curtain canting or jamming while it is being lowered.

No openings between stage and auditorium other than the opening protected by the curtain should be permitted. Even small openings for ventilation pipes or the like may prove dangerous. All existing doors and openings in present theaters should be closed or equipped with fireproof vestibule construction.

Operation of the curtain should automatically light up the auditorium. Emergency lighting is not likely to prove sufficient in case of outbreak of fire during a performance.

Stage Protection—Provision of sprinkler protection for the stage space itself (apart from the curtain water spray) is eminently desirable. The Wiesbaden Theater had no such sprinkler protection, but its merits were excellently proved in a theater fire in Hamburg years ago.

Divergent views have been expressed since the fire concerning the roof construction and venting of the stage. On the one hand it is claimed that the roof construction should be as light and combustible as possible, and that the roof vents should be greatly increased in area over present practice and should be actuated automatically by a moderate rise in temperature, so that venting of any fire will occur at the earliest possible period and the protection of the auditorium will thereby be rendered more certain. Others hold that the roof should be of completely fireproof construction, that thermostatic smoke vents are unnecessary and objectionable; and that pressure-relief openings, in conjunction with a curtain of adequate strength, are sufficient and would enable the fire to be held in check so that the stage could be saved except in extreme cases.

Doubtless the true solution lies between these two extremes. That smoke vents are necessary can hardly be questioned. Present requirements of building ordinances, which demand a vent area of 12 per cent of the ground plan of the stage, are believed to assure a sufficient vent capacity, but it is questionable whether they should be operated automatically by temperature rise. The initial spread of a fire on a stage, because of the large amount of combustible material and of dust, is exceedingly rapid, and if at a very early stage the draft were increased by automatic opening of roof vents the fire would at once become uncontrollable and it would be doubtful whether actors and the stage force could save themselves. Manual operation should therefore be provided, as well as operation by internal pressure.

Fireproof roof construction is believed to be essential, for proper safety of the occupants of the stage. Nothing will be gained for the safety of the auditorium by facilitating the collapse of the stage roof in a fire.

Operation and Maintenance—Several auxiliary points of caution are brought out by the Wiesbaden fire. The origin of the fire is believed to have been due to alcohol torches which the action of the opera required to be thrown down from a tower on the stage. Through carelessness, presumably, one of these torches was not entirely extinguished. With present-day electrical facilities there should no longer be need for open fire in any stage effect. Combustible or explosive liquids, open fires, and smoking should be banned entirely from the modern stage.

Stage floor spaces must be kept open. Scenery and properties should not be allowed to encumber the stage.

Fire department supervision should not end with the close of a performance but should continue until all spectators have left the theater and a complete inspection of the premises has been carried through.

Los Angeles—The Wonder City of America

By T. A. Rickard
Contributing Editor, *Engineering and Mining Journal-Press*, San Francisco

LOS ANGELES is the wonder city of the country. Its growth has been phenomenal. Its building activity has never known a drop since the war and is increasing remarkably.

To those who have not been there, the tales from Los Angeles seem to be nothing but promoters' talk. But this is not so. Los Angeles, even five years ago, had the earmarks of a boom town, but it has matured at an astonishing rate. Today it is a great industrial city. Around it and in it are three important industries, agriculture, oil and the movies. With these as a basis, Los Angeles has been building industries for supplying food, clothing and housing for its citizens, so that more and more it is becoming self contained. It grows on its own needs.

It was because of the unusual record of Los Angeles and because the work of the civil engineer and contractor follows upon such broad developments as are in progress there that *Engineering News-Record* asked T. A. Rickard, formerly editor and publisher of *Mining and Scientific Press*, and now contributing editor of *Engineering and Mining Journal-Press*, to tell the economic story of Los Angeles.—*Editor.*

AIRPLANE VIEW OF LOS ANGELES HARBOR

LOS ANGELES was founded on September 4, 1781, under the romantic name of *Nuestra Señora Reina de Los Angeles*, Our Lady the Queen of the Angels—but that was long before Hollywood! The first settlement was based upon a grant of land given by the King of Spain to twelve soldiers, all veterans of European wars. The founding of the pueblo was honored by the presence of the military governor, Don Felipe de Neve, and a group of padres from the neighboring mission of San Gabriel. That mission, started ten years earlier by the famous Franciscan friar, Junipera Serra, was the priestly sponsor of Los Angeles, which thereby is linked with the very beginning of Spanish settlement in Alta California. The spot where the Spanish flag was hoisted and the pueblo established 142 years ago is on the northern edge of the old plaza, recently selected as the station for a new union railroad terminal. At that time the site of the present city was on the bank of a small stream, whose fringe of verdure threaded a sunburnt valley. It was an arid land, save in the short rainy season, when for a few weeks it rejoiced in habiliments of tender green and short-lived flowers; during the rest of the year the dust-clouds of the desert danced unhindered over the coastal plain.

The Spanish pioneers were picturesque but idle; the pueblo was of no consequence; it languished, it stagnated, until the early part of the 19th century, when the Mexican revolution provoked a series of internal wars among the Spanish Californians, who resented dictation from Mexico and fought among themselves for control. When Juan Alvarado became governor in 1837 only 150 foreigners were resident in California. The influx of immigrants began soon afterward, and grew to a mighty flood when the cry of "gold" in 1848 lured the adventurous in every land to the hills of California. That immigration synchronized with the finish of the Mexican war and the cession of California to the United States by the treaty of Guadalupe Hidalgo, which was signed on Feb. 2, 1848, nine days after Marshall had found the nuggets at Coloma. This discovery of gold made San Francisco the metropolis of California. Seven years earlier the precious metal had been mined in the San Fernando hills behind Los Angeles and profitable operations had attracted prospectors thither from Mexico. Even earlier finds are known to have been made in southern California during the Mexican régime, but they attracted little notice because the *haciendados* deprecated anything that might take the laborer from their fields and gardens. But although Los Angeles failed to become a gold-mining center, she takes tribute today from a mineral industry—oil—vastly more profitable than the placer diggings that drew the world's wondering eyes upon California.

While the people of northern California were rejoicing in their golden dreams, those in the south turned their attention to the humdrum business of raising cattle. For a decade Los Angeles took rank as the "Queen of the Cow Counties". That may sound unromantic as compared with *Nuestra Señora Reina de Los Angeles*, but it denotes the making of money. The large land-holdings that had survived from the Spanish dominion favored this industry; but, in the transition from Mexican to American control the titles to the old ranches were thrown into confusion by squatters; and on top of these misfortunes came a series of droughts culminating in that of 1864, which ruined the *rancheros*. The result was to change the economic life of Los Angeles, by introducing a diversified agriculture upon the small holdings into which the old estates were cut. At first grapes and wheat were the chief products. The citrus industry began in 1873; the oil industry in 1892; the moving-picture industry in 1908. In all of these Los Angeles today ranks supreme. Astonishing as has been the growth of this community during the life of our generation, its statistical record for the first four months of the current year has been even more remarkable.

The Harbor—The port of Los Angeles was known as San Pedro until 1909, when it was embraced by the city limits. There are some who have laughed at the pride of Los Angeles in her maritime approach, but he laughs best who laughs last, and in this case it is Señor Angeleno. The wharves are 20 miles from the center of the city, but the time is not far distant when the entire inter-

mediate space will be covered with homes and gardens, factories and warehouses. The harbor itself consists of an estuary protected by a breakwater. In 1922 Los Angeles imported more lumber than any other seaport in the world, namely, 1,440,000,000 board feet. This indicates an enormous activity in building operations; in which respect for three years Los Angeles has been exceeded only by New York and Chicago. It is expected that the building permits in Los Angeles for 1923 will be $200,000,000. In March, 1921, the building permits totaled $6,915,216; in March, 1922, $10,964,829; in March, 1923, $21,196,087.

The incoming traveler is given another hint of big business by noting a steamer, or tanker, that is being loaded with oil at a neighboring wharf. Los Angeles is today the biggest oil-producing center in the world, and much of her oil is being exported through the Panama Canal to the Atlantic and Gulf ports: during the first quarter of 1923 such shipment was no less than 1,143,000 tons. In April a single tanker carried 4,200,000 gal. of gasoline in bulk from Los Angeles to London.

In intercoastal trade the port of Los Angeles ranks second in the United States. During the last three months of 1922, according to the Shipping Board, the coastwise trade of Los Angeles was 2,401,464 tons, and the foreign shipping 251,963, a total of 3,171,629 tons in those three months. During the first quarter of 1923 Los Angeles did a business greater than all the other Pacific Coast ports and more than half all the intercoastal business of the United States; its "in" and "out" tonnage was 1,410,533, which included an incoming tonnage of 300,000. Foreign shipments have increased from 10½ to 23½ per cent during the past year. In 1921 the commerce through the port was 4,850,000 tons; in 1922 it was 10,800,000 tons. Evidently the arid eloquence of statistics is on the side of the Angeleno when anybody sneers at his claim to having a great seaport.

The Inhabitants—The streets are congested with motor traffic, the sidewalks are crowded with people, the benches in the parks are occupied all day, and the hotels are overflowing. This suggests a large and growing population. Statistics tell the story:

Year	Population	Year	Population
1781	44	1890	50,395
1800	315	1900	102,479
1850	1,610	1910	319,198
1870	5,614	1920	576,673
1880	11,183		

Evidently such a growth is too fast for accurate enumeration; any census is soon out of date. In May the population of Los Angeles was 800,000. I noticed a poster "Los Angeles—A Million—1925", and when I spoke of it to the statistician of the Chamber of Commerce, he exclaimed: "Oh, we'll be a million long before 1925". I asked: "How long?" "In 1924", he replied. Evidently they measure time not by the swing of the pendulum but by heart beats.

It is the boast of Los Angeles that it is 70 per cent Anglo-Saxon; it is peopled by men and women of the old stock, by the descendants of those who left the New England and Southern States to open up what was then the West and is now the Middle West. The census of 1920 gave Los Angeles a population of 576,673, of whom 454,542 were native-born. Of these 116,116 were born in California; the Middle West (12 States) contributed 181,835; the South contributed 52,329; New York gave 50,548, and Pennsylvania 19,457. Of the Mountain States the largest complement, 8,979, came from Colorado. Los Angeles has 50,000 Mexicans, who do most of the common labor. No other large city in the United States has so small a proportion of aliens.

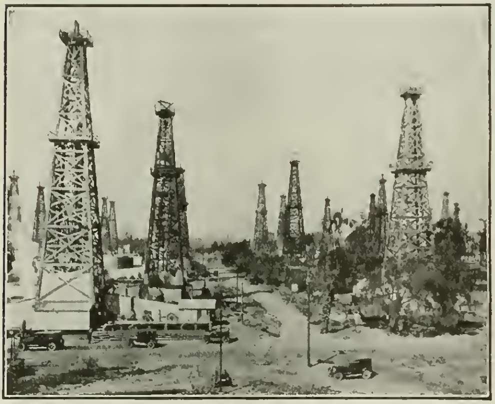
The growth of Los Angeles is the romance of the Middle West; it represents the migration of homeseekers from the prairies and mountains to the orange groves and rose gardens. Again let statistics tell the tale. New settlers are arriving at the rate of over 10,000 per month, say 130,000 per annum. These bring an average bank account of $700, making $91,000,000 in a year. To these deposits are added further sums as the new residents transfer investments from their former habitats to Los Angeles. It is estimated that 250,000 new settlers have come to the County of Los Angeles in the last 2½ years. Next is the tourist traffic. Fully 400,000 tourists reach Los Angeles by train annually, at least 50,000 by steamer, and 75,000 by automobile. Of the summer arrivals fully 20 per cent become residents.

Agricultural Development—Los Angeles, however, is not a community of tourists, valetudinarians, and idlers; it is a city of many industrial activities. Of these the oldest is the agricultural. On the surrounding plains where fifty years ago gaunt herds of cattle scraped a bare existence from the hard soil, where starving sheep wandered disconsolate amid clouds of dust, today is one of the pleasure gardens of the world. This arid land has been touched by the fairy wand of irrigation, which has first made use of the subterranean supply of water, tapped by wells and distributed by ditches, and later of the water brought on a large scale from distant fountains. The city covers an area of 370 square miles; the county, 4,076 square miles, of which not quite half is on the seaward side of the coast range, the country north of the mountains being of desert character. The county of Los Angeles is the most productive county in the United States, and it has enjoyed that distinction for more than a decade. In 1919 the total value of its agricultural output was $61,864,479. The second county in productivity was Fresno, in California, with $52,541,205, and the third, Aroostook, in Maine, with $51,861,252. In 1920 the orange crop was worth $18,965,800, which may be compared with the gold production of the State of California in that year, namely $17,398,200. The golden fruit of Los Angeles was worth more than all the golden ore of the leading gold-producing state. In 1922 the orange crop suffered from an unusual frost, but a high price mitigated the disaster, so that the total production of crops was worth $59,680,183 the principal items being:

Oranges	$17,841,542	Lettuce	$2,500,000
Lemons	3,748,000	Beans	2,284,800
Walnuts	3,412.800	Sugar beets	1,932,984
Alfalfa	3,388,000	Grapes	1,735,500
Strawberries	3,310,790	Potatoes	1,663,500

Oil Resources—Within four blocks of the center of the city oil is still being pumped from a number of old wells. This is the Salt Lake oil field, discovered by miners from Salt Lake City in 1892. Here Edward L. Doheny made his start as an oil-operator. In 1894 these wells produced 196,094 bbl. of oil; but that was a mere bagatelle. The industry has grown enormously during the last three years. In 1920 the oil fields of the Los

Angeles area, including the counties of Los Angeles and Orange, yielded 30,005,427 bbl.; in 1921, 35,587,492 bbl.; in 1922, 68,344,308 bbl., or just one-half of the total production of California, which was 138,236,490 bbl. The oil produced in the Los Angeles area during 1922 was worth $96,000,000. The three principal oil fields tributary to Los Angeles (Santa Fe Springs, Long Beach (Signal Hill), and Huntington Beach) have developed greatly. Between Jan. 1, 1922, and 1923, the number of wells at Santa Fe Springs increased from 3 to 145 and their yield from 3,000 to 203,000 bbl. per day. The increase at Long Beach was from 5 to 237 wells, production from 1,100 to 144,000 bbl. At Huntington Beach there were 71 wells at the beginning of 1922 producing 13,800 bbl. per day; sixteen months later this oil field had 248 wells yielding 113,915 bbl. per diem. On May 1, 1923, these three oil fields were producing 460,915 bbl. daily, or more than two-thirds of the output of the whole of California. In 1921 the average daily production of the entire State was only 314,657 bbl.



THE OIL FIELDS OF SANTA FE SPRINGS

The activities of the oil promoter sometimes conflict with those of the dealer in real-estate, but usually they supplement one another amicably. A realtor's sign says: "Mining rights included". That means that a man can buy a tract of land on which crops are growing and retain the ownership of any oil that may be stored in the sand several thousand feet underground; he can speculate both on the surficial agricultural products and on the subterranean mineral deposit.

Industrial Development—A community that is growing fast creates the need for new industries; it also becomes rich enough to start industries that will serve the surrounding region. The bank deposits of Los Angeles were $284,940,000 on June 30, 1917; they were $620,095,000 on June 30, 1922. In 1900 the products manufactured in Los Angeles were valued at $15,134,000; in 1922 their value was $900,000,000. Conditions are highly favorable to manufacturing on a big scale. The costs of power and water are low.

The climate permits outdoor work the year round. Conditions are such as to attract the best type of workman. Labor troubles are infrequent. Strikes are non-existent, because Los Angeles is an open-shop center. The labor-unions have nicknamed it the 'scab' city, and its citizens accept that opprobrious epithet as a compliment. It means liberty under the law. The last eruption of anarchy was in 1909, when the office of the *Los Angeles Times* was wrecked by bombs; the perpetrators of the crime are in prison. That affair outraged public opinion so thoroughly that the truculence of the unions was checked effectively.

In 1910 Los Angeles was the 37th industrial city in the United States; today it is seventh. It employs 130,000 artisans. The leadership of the community is in the hands of a group of men with the ability to take advantage of the remarkable natural resources of Los Angeles, and sufficiently big-minded to work together harmoniously for what they deem to be the common interest. For example, in 1920 the market for cotton collapsed just when the crops of the Imperial valley (in California and Mexico) and the Salt River valley (in Arizona) were ready for sale. The producers faced the loss of a market for a crop that had been grown during a period of high cost, involving most of their capital, which was the working capital of a territory new economically. If they did not receive financial aid at this critical juncture, at the end of 1920, the people in these two great valleys would become bankrupt, and with their bankruptcy would go the capital accumulated in twenty years. Thereupon the Los Angeles bankers joined in extending a loan of $5,000,000 to the banks in the two cotton-growing districts, this loan being secured by the cotton, which could not then be liquidated. Instead the Los Angeles bankers imported experienced men from other cotton regions (in Texas and the South) and developed contacts with cotton buyers; they opened a market for the cotton, and eventually moved the entire crop at a price that sufficed to repay the loan and yet leave something for the producers, who are now in process of recovering their prosperity. The result is that the people of the two cotton districts are bound by ties of friendship to Los Angeles, which is accepted as their metropolis.

Los Angeles is establishing good relations with the mining districts of the Southwest. The people of western Arizona, southern Nevada, southwestern Utah, and northwestern Mexico are being taught to look upon Los Angeles as their metropolis, as the source of capital, as the market for supplies, as the resort for a holiday. For those living in the Pacific Southwest, the harbor of Los Angeles is becoming recognized as the "front door", through which their products can be moved to market most economically. Los Angeles money is going forth into the central valleys of California and is helping to finance projects much farther afield, in Utah, Nevada, Arizona, New Mexico, and northern Mexico. Communication with the southern counties of California is facilitated by a fine system of paved roads, of which these 14 counties have 3,105 miles, besides 30,924 miles of secondary roads.

Climate—The climate of Los Angeles is one of its attractions. Meteorological records for 47 years show that Los Angeles has an annual average of only 11 days without sun, and only 15 days with as much as a quarter of an inch of rain; it can claim 273 days when the temperature is neither above 80 deg. F. nor below 40 deg. The rainfall averages only 15 inches per annum and is concentrated into a period of 40 days. The result of these favorable conditions is that Los Angeles enjoys a vigorous semi-tropical climate with all varieties of healthful weather.

The Movies—Hollywood is not a suburb of Los An-

geles; it is an integral part of the city, although its outer edge spreads among the hills, where the more notorious cinema actors have built their villas. Disreputable or not as some of them may be, they contribute to the wealth of Los Angeles. The weekly payroll of the local cinema industry is $500,000 and the capital invested in the business is said to exceed $20,000,000. Los Angeles produces 85 per cent of the motion pictures made in the United States. Fifty-three studios, employing 200 companies, with 15,000 regular employees and 20,000 extra helpers are producing films valued at $170,000,000 per annum. The actors represent only 10 per cent of those employed in this business. The cost of a seven-reel picture ranges from $100,000 to $250,000. Most of this output is financed in Los Angeles.

Public Utilities—Such a community—growing by leaps and bounds—calls for the rapid development of public utilities on a large scale. Los Angeles suffers from growing pains: the sewers periodically prove inadequate, it is impracticable to install telephones as fast as they are wanted. the extension of the street-car system lags far behind the requirements, the schools are overcrowded, but in one respect the city has made ample provision; it has a superb supply of good water.

First, let us look at the telephone system. Los Angeles has 22.7 telephones per 100 of population, as against 4.7 per 100 in London, and an average of 12.5 telephones per 100 in the whole United States.

Second, an abundant supply of good water is essential to a large community; in this respect the men of Los Angeles showed keen foresight. They have water enough to supply a city of 2½ million people. The building of the water conduit from the Owens river across 250 miles of rugged desolate country to Los Angeles is one of the romances of public utility. The engineer who designed it—William Mulholland—fulfilled his promise to do the work in five years at a cost of $23,000,000. In 1905 a report made for the Water Commissioners showed that nowhere in the basin south of the Tehachapi range and west of San Bernardino could an adequate supply of water be obtained for the city without interfering with the welfare of the adjacent agricultural territory. The former source of supply, the Los Angeles river, would have restricted the population to 300,000. Fred Eaton, formerly city engineer and mayor, was familiar with Inyo county and had seen the splendid stream of water that the Owens river carried from the watershed of the Sierra Nevada into the desert, where it was lost in a dead sea of saturated salt solution. To take this water would rob nobody. He bided his time, he bought lands for the purpose, he acquired options, he was prepared for a private enterprise if the city should hesitate to tackle the project. In 1907 the people of Los Angeles voted $23,000,000 of bonds to finance the project. The vote was in the ratio of ten to one.

Five generating plants along the aqueduct develop 110,000 hp. Another 110 hp. is generated from streams tributary to the aqueduct. The total hydro-electric power resources owned by Los Angeles in connection with its aqueduct amount to 220,000 net horsepower. The city is distributing 90,000 hp. from its aqueduct system, at a cost to itself of 0.4c. per kilowatt-hour, and 25,000 hp. more that it purchases from the California Edison Co. Domestic lighting costs 5.6c. per kilowatt-hour for the first 100 kw.-hr., and 4.1c. for the next 500 kw.-hr. For manufacturing purposes a rate of 1.06c. per kilowatt-hour for 100,000 kw.-hr., and of 0.86c. for 1,000,000 kw.-hr. is maintained.

Here, too, it is proper to mention the enterprise of the Southern California Edison Co., which is engaged in a project to develop 1,400,000 hp. on the south fork of the San Joaquin river at an expense of $300,000,000. This power is to be transmitted at the unprecedented pressure of 220,000 volts. In 1923 this company will expend $26,000,000, as against a budget of $50,000 in 1900, when its generating capacity was only 12,000 hp. as compared with 500,000 hp. today. This company has 48,108 stockholders.

Real Estate Promotion—The increase of population explains the tremendous activity in house-building and the hectic condition of the real-estate market. Los Angeles has had many such booms, all of which have run their course to an exuberance that brought its own natural corrective in a temporary collapse; nevertheless the dreams of the realtor of yesterday have become the actualities of the householder of today. At the present time the property assessment of Los Angeles county is $1,517,000,000, which is one-third that of all California. During the year ending March 5, 1923, there were erected 102,000 new buildings in Los Angeles.

As I strolled downtown from the University Club, I was asked by a pleasant voiced young woman to join an "excursion de luxe to Verdugo Woodlands", which was described as "the California Switzerland with its memories of Spain". To help the Iberian illusion, I was informed, on a handbill, that "a dainty Spanish luncheon will be served, while the breezes, whispering through the old rose vines will tell you of the historic happenings of a bygone century". The realty agent and the oil promoter adopt similar methods for beguiling the unwary. The visitor to Los Angeles is invited to a "free ride" in a handsome motor-bus to see some lovely lots in a new subdivision or to consider the purchase of attractive stock in an oil company. He hears a lecture on oil or oranges or the climate of Los Angeles from a person of the preacher type, a spellbinder to whom the promoters pay a fabulous salary, comparable with that of a 'movie' actor. The supposition that the average man grasps at something for nothing is based on good psychology, likewise the anticipation that he will be lured by the chance of making ten dollars by risking one.

Labor Conditions—Labor is being attracted to Los Angeles by the prevailing high wages. This may explain the shortage of workers at the mines of the Southwest. As I walked along the street I heard a warning: "Look out below". A man was throwing remnants of construction over a fence. The phrase he used told me that he was a miner, so I asked him where he had been working: At Jerome, in the U.V.X., he said. Even the high wages paid by James Douglas in such a rich copper mine as the United Verde Extension did not suffice to keep him in Arizona. Can you wonder? Who would not prefer to work in the sunlight, so near the seashore and the orange groves, rather than labor in the dirt and darkness underground? They come to their work in automobiles. Almost anywhere in the outskirts of the city one can see a string of cars lined up like a funeral, the cars belonging to those at work on a nearby building. Thanks to Henry Ford, the

workman can live anywhere within 15 miles of his job; when off work he can cruise about the adjoining country, and acquire the desire for better ways of living.

Yes, there are many automobiles in Los Angeles. One of the Angelenos carries the license of No. 1,000,000. That is a gasconade; it does not mean that a million licenses have been issued by the State Motor Vehicle Department, which distributes its licenses in serial groups for local distribution; however, in 1922 Los Angeles county had 275,000 out of the 840,000 motor vehicles in California. The city itself had 200,000 automobiles, or nearly a quarter of those in the State.

Her Citizens—While Los Angeles has been exploited by advertising on an extraordinary scale, it is also the product of the co-ordinated energies of good citizens. Its Chamber of Commerce today has 9,400 members, which is more than any other Chamber of Commerce in the world. In them there is "some genius of authentic love for their neighborhood, their city". They are men of the old stock; their names are easy to pronounce; they represent the diverse activities of the community. I venture to name some of them. Among the bankers: Henry M. Robinson, Joseph F. Sartori and Henry S. McKee; among the business men: Henry E. Halderman, John B. Miller, Lee Phillips, and the late Arthur Letts; among the engineers: William Mulholland, J. B. Lippincott, and Seeley W. Mudd; among the lawyers: Marshall Stimson, George A. Farrand, and Louis Hill; a publisher, Harry Chandler; a physician, John R. Haynes; an educator, Susan Dorsey, and two benefactors of great wealth, Henry E. Huntington and Norman Bridge. The gift of the Huntington library, picture gallery, and botanical garden at San Marino is an event in the cultural life not of Los Angeles alone but of California. Similarly the endowment of the California Institute of Technology at Pasadena by Dr. Norman Bridge and Arthur H. Fleming has established a center of scientific research for all California, under the leadership of Dr. Robert A. Milliken.

Man does not live by bread alone, neither on oil, nor even on oranges; the leaders of Los Angeles are awake to the fact that if their community is to hold its proper place it must provide for more than the material needs of its people, it must not count only on its tons of oranges or its barrels of oil, but on the great imponderables that make men worthy citizens of a democratic commonwealth.

Four Years Enough to Complete Hetch Hetchy

M. M. O'Shaughnessy, city engineer of San Francisco, recently made an official statement as follows: "It will take from thirty to thirty-two million dollars to build the Hetch Hetchy aqueduct from Moccasin Creek to Irvington. There are no physical obstacles in the way. If the money is provided this work can be done inside of four years and would make Hetch Hetchy water available for use not only in San Francisco, but in other bay cities." Moccasin Creek, the location of the first Hetch Hetchy system power house, is the point to which water can be delivered through works now practically complete. Irvington is about 100 miles toward San Francisco from Moccasin Creek and it is here that the aqueduct begins which is now being built for the use of the Spring Valley system until Hetch Hetchy water is available. Reference to the construction of this aqueduct from Irvington to the city appeared in *Engineering News-Record*, May 4, 1922, p. 751.

Leveling Morro do Castello in Rio de Janeiro

Fifty-Acre Hill in Brazilian City Being Cut Down and Used to Make an Extensive Fill on the Water Front

ONE of the largest city grading operations of recent years is in progress at Rio de Janeiro. The Morro do Castello, having a volume of some 5,000,000 cu.m., is being leveled and the excavated material used to add to the waterfront building area. A portion of the excavation and fill is being done by steam shovels and trains, but a larger portion is being accomplished by sluicing, using hydraulic giants to break down the material and dredge pumps to assist the sluices as the lower levels of the excavations are reached.

Covering an area of about 50 acres the Morro do Castello is a rocky elevation rising to a maximum height of nearly 200 ft. in the midst of the business section of Rio de Janeiro. On this hill and between its foot

FIG. 1—STEAM SHOVELS HANDLED SOME HUNDREDS OF THOUSANDS OF YARDS

and the waterfront was the original settlement of the city. Before the improvement it was crowned with old forts and church edifices dating back to the sixteenth century, around which huddled the homes of a mixed Latin population. Virtually it had become the city's slums, into which business did not crowd because of inaccessibility for commercial traffic. Also this high land lying between shut off the ocean winds from a large section of the city. To improve these living conditions but more especially because leveling the hill and using the excavated material to build out the shore line would add some 200 acres to its business area, the city decided to cut down the elevation, fill in beyond the old sea wall and build a new sea wall embracing the fill. The plan of this improvement is indicated in Fig. 2.

As indicated by the contours, Fig. 2, the hill has rather abrupt sides. By its removal the area gained for building will be about 185,000 sq.m. or about 46 acres. The area formed by the fill is 612,000 sq.m. or about 151 acres. The volume of material in the hill was estimated as 5,000,000 cu.m., approximately, 25 per

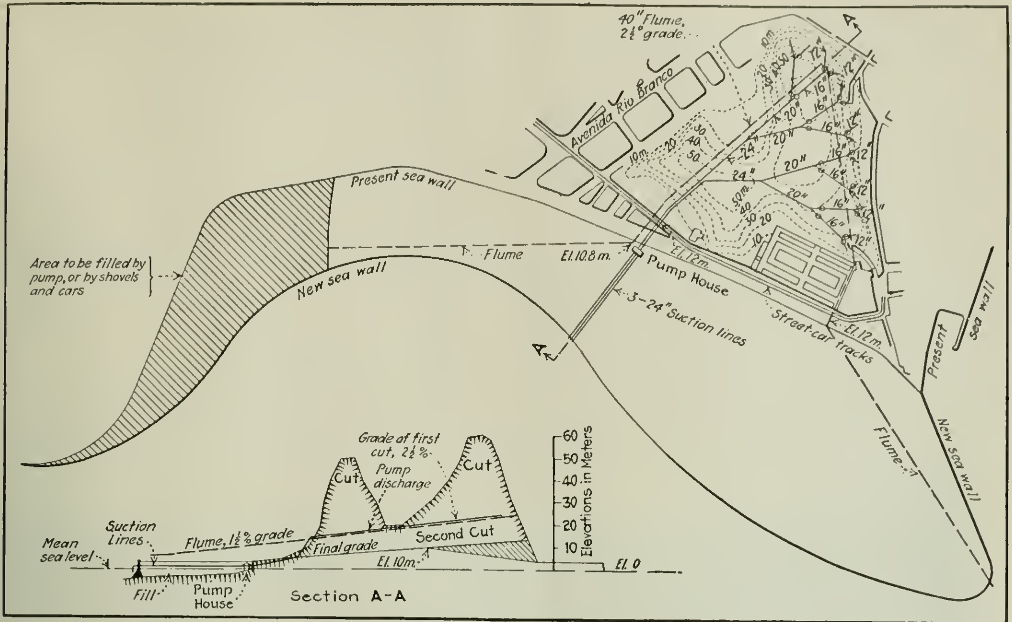


FIG. 2—PLAN OF 5,000,000-CU.M. LAND RECLAMATION OPERATIONS IN RIO DE JANEIRO

cent of which is rock. About 3,500,000 cu.m. have so far been removed from the excavation into the fill. As previously stated, part of the excavation and fill was by steam shovel and trains and a larger part by hydraulicking.

Steam Shovel Work—At the outset the city began work with light German shovels using locomotives and flat cars, motor trucks and mule carts, to transport the excavated material. Later, when American bankers undertook the financing of the work and Leonard Kennedy & Co., Inc., of New York City were made administrators of the operations for the city of Rio de Janeiro, American equipment was installed throughout, except for two German light shovels retained for cleaning-up operations. The enlarged outfit comprised, then, the two German shovels, two railroad-type coal-burning, American shovels, four 30-ton locomotives, forty 12-cu.yd. automatic air-dump cars and one 15-ton locomotive crane. This outfit was put in operation in July, 1922. A view of the steam-shovel excavation is shown by Fig. 1.

Excellent service is reported of all the equipment. The large railroad shovels load from 150 to 250 cu.m. an hour, depending on the materials and the train service. The material is hauled from 1 to 1½ km. and dumped behind a granite quay-wall, which is also a part of the project. The trains consist of eight cars each, and their operation is somewhat delayed as they cross a busy street at grade. Owing to the proximity of the work of the city, all blasting has to be done very carefully and is expensive. Besides the area marked as filled by shovels and cars, considerable other fill is being placed by them because they are available and by being kept busy are earning money. However the great bulk of the fill is being put in by hydraulic methods.

Hydraulicking Operations—As stated, about three-quarters of the hill is decomposed granite, weighing about 98 lb. a cubic foot and consisting of 62 per cent sand and rapidly settling particles and 38 per cent clay and slow settling materials. The binding material separates freely from the sand when water strikes it. A study of the situation indicated that, by gravity sluicing, about 2,250,000 cu.m. could be removed with flumes located 7 m. (23 ft.) above street-car tracks at crossings, the cut being started at El. 12 (m.) and running to El. 23 at the point of the hill farthest from the pumps. On Fig. 2 this is indicated as "first cut." Later the second cut could be removed by the same

FIG. 3—DREDGE PUMPS IN PIT BOOST MATERIAL INTO ELEVATED FLUME

flumes by hydraulicking to sumps and pumping into the flumes. Briefly this was the plan adopted, the general arrangement of pumps, pipe lines and flumes being as shown by Fig. 2. Of course there is no fixedness of location of the dredge pumps nor of flumes and pipe lines, but the drawing indicates the general plan followed.

Broadly the equipment divides into the pumping plant, the pipe lines and the monitors for breaking down the ground; the sluices and dredge discharge pipe lines; and the dredge pump units, of which two are semi-stationary and two are removable.

The pumping plant for the hydraulic giants, Fig. 2, consists of three units each with its separate suction line of 24-in. pipe. Each unit consists of three 16-in. centrifugal pumps in series, designed to deliver 7,500 gal. a minute against 475 ft. head. Each is direct-connected to a 1,200-hp. motor. The three units deliver into a cast-iron header from which the two 24-in. discharge pipes extend into the pit and divide into branches as indicated by Fig. 2. The pipe sizes decrease from 24 in. to 20, 16 and 12 in. The 12-in. pipe reduces to 9 in. at the giants, which range from 150 m. to 900 m. from the pumps.

At the sea ends the suction lines have 24-in. Newman continuous-service foot valves with galvanized steel screens. As the pumps are primed, by means of vacuum pumps the foot-valve flaps were removed and large check valves were used in the 20-in. discharge lines. Owing to the rapid tropical sea growth it is necessary once a week to raise and scrub with steel brushes the outside screens and once in two or three months to remove the entire foot valve and clean the inside screens. Rising-stem gate valves are used for controlling the discharge. In the hydraulicking pit it has been found a time saver to substitute a lever for the valve stem handwheel, it will close the valve against pressure much faster than will the wheel. The giants have 4-in. tips. Fig. 3 shows the pit with giants in operation.

The first cut in the upper part of the hill above El. 15 was gravity sluiced directly to the fill. Below this level dredge pumps in the pit lift the material into the sluices which deliver to a sump on the beach whence other dredge pumps force it through pipe lines to the fill. One of the pit sumps and pumping plants is shown by Fig. 3, and Fig. 4 shows the discharge pipe lines on the fill.

There are four dredge pumps, each 16 in., semi-steel direct-connected to a 500-hp. motor, with 30 per cent speed control, mounted on skis. Two of these are a semi-permanent location on the beach and two in temporary locations at the hydraulicking pit, Fig. 3. These pit outfits are moved up toward the base of the hill as the excavation progresses. All pumps are primed by means of water ejectors, there being a special dredge-type enclosed flap valve immediately connected to the pump on the discharge side. The pumps are designed for 8,000 gal. a minute against 120-ft. head. As indicating performance, at the time of writing, the beach pumps are averaging each 235 cu.m. of solids an hour. The average of the pumps in the pit is 202 cu.m. of solids per hour. One pit pump is discharging through a 212-m. line with a lift of 9 m. and the other through a 555-m. line with a lift of 11 m. The average coefficient of friction is 5.6. The percentage of solid handled ranges from 5 to 13 and averages about 10.

Between the pit and beach sumps open flume is employed. It is 40-in. semi-circular steel with about 45 per cent of the section lined with cast-iron plates. The most efficient grade has been found to be $3\frac{1}{2}$ per cent. The pipe lines from the beach pumps to the fill are 16 in. in outside diameter, with sleeve couplings. Two kinds of pipe have been installed, one a $\frac{3}{8}$-in. lap-welded steel and one a special-analysis hard steel. No comparison of wear is yet possible.

FIG. 4—LARGE PORTION OF 150-ACRE FILL PLACED HYDRAULICALLY

As previously stated Leonard Kennedy & Co., Inc., of 67 Wall St., New York, are the administrators for the City of Rio de Janeiro. The work was organized by A. D. Chisholm, with J. W. Armstrong as chief engineer, T. E. Siebenthal in charge of the steam-shovel operation and Nathan H. Jones in charge of the hydraulic work, with D. V. Nystrom as general foreman of the latter operation. The work is now in charge of Nathan H. Jones.

Disinfectant on Garbage Fills

The sanitary fills made in Portland, Ore., as a means of garbage disposal are sprayed with a deodorant consisting of 21 parts of pinoleum to 25 parts of water, which is used when the wind blows from the fills toward residential districts, and with a disinfectant made up as follows: To 1 gal. of carbolic acid is added 3 oz. of caustic soda and $\frac{3}{4}$ lb. of rosin. This compound is mixed with 100 gal. of water and is then sprayed on the fill.

Development of High Efficiency in Centrifugal Pumps

A Description of a Recent Program of Experimental Design Carried Out in the Hydraulic Laboratory of the University of Michigan

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Among the various ways in which centrifugal pumps may be classified one based on their so-called specific speed appears to the writer the most rational. The term specific speed applied to the centrifugal pump has somewhat the same meaning as its perhaps better known relation to the water turbine. Mathematically it is expressed as follows:

$$N_s = \frac{RPM\sqrt{GPM}}{H^{\frac{3}{4}}}$$

The value of the specific speed thus computed establishes the performance of a pump with regard to its three most important elements, speed, capacity and head. The efficiency of a centrifugal pump is often represented as a function of its specific speed.

Another important and very useful method of classification is with reference to the capacity. This is regarded by some as of such importance that the efficiency is expressed as a function of the capacity alone. The fact of the matter is that probably neither method alone will give altogether reliable results and a method based on a combination of the two would be more useful and accurate. This was discussed, at some length, by the writer in *Engineering News-Record*, June 30, 1921, p. 1114.

From an examination of the data published in various books and technical articles one is apt to reach the conclusion that pumps of low specific speed are inherently of low efficiency. One author calls attention to this, adding the remark that for this reason no effort is made to produce such pumps. This article has been prepared for the purpose of indicating approximately to what degree such opinions are justified.

A pump of low specific speed is seen to be one which discharges a relatively small quantity of water against a relatively high head at a moderate rotative speed. Such pumps are easily recognized by the large diameter impeller of narrow width.

This leads to another means of classification of centrifugal pumps with reference to the ratio of diameter of the impeller to its width. Such a method has proved extremely helpful as applied to water turbines and no doubt can be used fairly successfully for the centrifugal pump. Various reasons are assigned for the low efficiency usually found in pumps of low specific speed. From among them two are worthy of special mention, (1) disk friction and (2) internal leakage. By disk friction is meant the power consumed by the friction of the impeller rotated in water, which varies with the diameter as the fifth power. The pressure or head developed varies only as the second power. This indicates (a) that the disk friction increases at a much greater rate than the pressure and that the efficiency is thereby reduced; (b) that it is more efficient from the point of view of disk friction to develop a given pressure with a small diameter impeller at a high rotative speed than with a larger diameter impeller at a lower rotative speed, the peripheral speed being equal in each case. (2) Internal leakage: The high-pressure water is in most pumps prevented from leaking back into the suction of the impeller by means of a very close running fit between the impeller and the stationary walls of the casing. Some designers, in addition to a close fit, employ a so-called labyrinth packing so designed as to increase greatly the length of the path the water must take in its flow through the clearance. The amount of this internal leakage or short circuited water varies with the clearance and the pressure and while it may be but a small percentage of the total pump discharge in the case of pumps of large capacity it should be noticed that expressed in the same way it may represent a considerable part of the discharge of a small pump. This internal leakage means that the capacity of the pump will be reduced by that amount and, worse yet, that power is required to circulate this water, which further increases the power required to drive the pump.

From this it will be seen that we are, in general, limited in two ways in the design of centrifugal pumps for low specific speed.

In spite of the apparent certainty of low efficiency the writer contends: (1) That there is a real demand for pumps of this type, and (2) that if properly designed they may have very satisfactory values of efficiency.

When from the above considerations it appeared likely that the pressure would be too high and the quantity too small for good efficiency the required pressure was developed in two or more stages. This naturally results in an increase in the size and cost of the pump as now two or more runners are required. If a single-stage pump could be designed to do the work it would probably be much cheaper, lighter, occupy less space, and cost less for maintenance and repairs than would a multi-stage pump.

The usual pressure limits for small single-stage pumps (300-600 g.p.m.) seems to be about 150 ft. for best efficiency, although some higher values are found and in some cases some lower limits have been set by their designers.

During the early part of 1919 the writer was engaged in developing a new line of pumps for an eastern manufacturer. This company had formerly built very excellent pumps of European design which were not particularly well suited to American practice. The principal reason for this lay in the fact that owing to the construction of the pump the weight increased very rapidly when designed to receive the larger diameter runners required by current American practice in order to meet the available motor speeds.

The writer's past experience had led to the belief that it would be possible to build pumps for considerably higher heads per stage than were usual at that time and that if properly designed and constructed the efficiency need not be unacceptably low. In order to learn to what extent this might be true a 3-in. pump was designed for a capacity of 400-500 g.p.m. and heads around 200 ft. at a speed of 1,750 r.p.m. Nothing very definite was prescribed and the whole design was mainly

for purposes of study. There were no unusual features connected with this design except that the impeller was of greater diameter and narrower width than the writer had ever designed before. This naturally called for greater care and workmanship in the foundry and machine shop. The ratio of width of the impeller divided by its diameter was in this case about 1/76, which was very extreme indeed, a value which has not often if ever been exceeded.

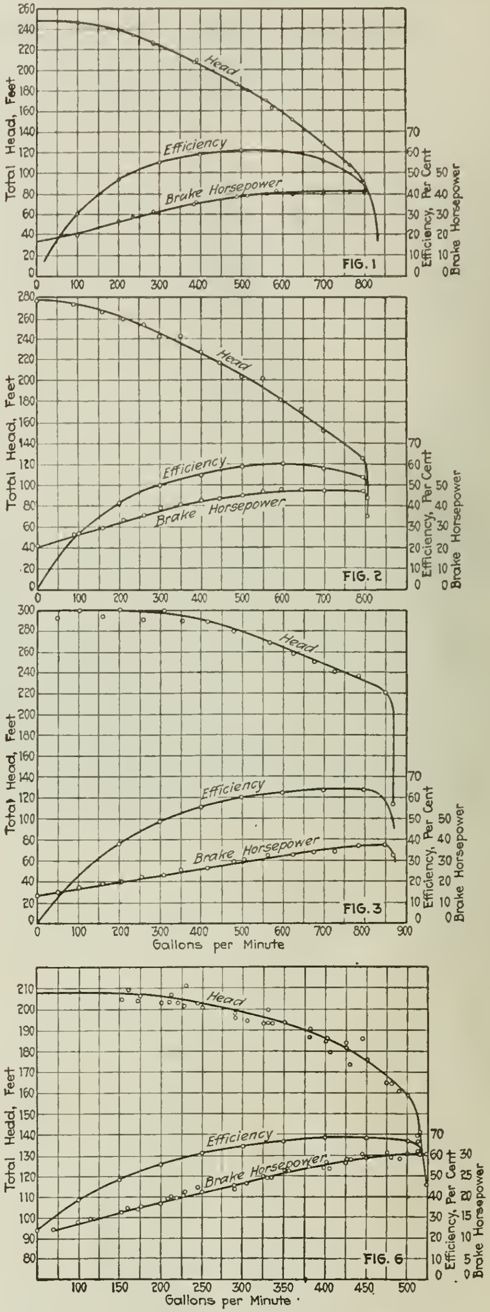
This pump was built in 1919 and tested the early part of 1920. The test results for a speed of 1,730 r.p.m. are shown in Fig. 1. The actual test results were a little different from those expected but nevertheless were very satisfactory indeed. A maximum efficiency of over 60 per cent was obtained at a discharge of about 520 g.p.m. against a total head of 180 ft. A comparison of the results secured by this design with the multi-stage pumps offered for those conditions by other manufacturers indicated that its performance was fully as good as had often been obtained by the use of two or more stages. Other very desirable characteristics were obtained as well. Fig. 1 indicates that the pump was adaptable for a very wide range of operating conditions with but slight change in efficiency. A very flat power curve was also obtained. The specific speed of this pump, as computed by the formula $N_s = \frac{N\sqrt{GPM}}{H^{\frac{3}{4}}}$ is approximately 800.

Prof. R. L. Daugherty in his book on centrifugal pumps shows that for a volute pump having a specific speed of 800 the probable efficiency would be about 52 per cent and that for a pump having an impeller with a ratio of width to diameter of 1 to 76 the probable efficiency would be about 35 per cent.

If we recall that the pump built and tested by me developed an efficiency of over 60 per cent under the conditions named above the figures are very significant and indicate rather unusual performance.

While the writer was still engaged in study and analysis of the test data secured from this pump he was called to the University of Michigan to take over the course in Hydraulic Machinery formerly given by Prof. S. J. Zowski then on leave of absence. The final results of the study made on the performance of this pump seemed so worthwhile that the experimental development of this type of pump was begun in the hydraulic laboratory of the University of Michigan. In April, 1921, the second pump of the series was tested. The results for a speed of 1,700 r.p.m. are given in Fig. 2. The tests on the original pump had indicated more or less clearly the best lines of procedure and these were embodied as far as possible in the second design. Although considerably different in design these two gave about the same characteristics. The diameter of the runner in Pump No. 2 was greater than No. 1 and hence somewhat higher pressures are obtained even at a lower rotative speed. This increase of both capacity and pressure was obtained with no loss of efficiency or of any of the desirable characteristics of the original design. Pump No. 2 was built from an entirely new set of patterns for both the shell and impeller.

As an interesting application of the possibilities of this new development it occurred to the writer to design a pump for such conditions of capacity and pressure as were prescribed for fire service. Accordingly the designs were prepared without delay for a pump to deliver 750 g.p.m. against a total head of 231 ft., equivalent to a pressure of 100 lb. per square inch. To reduce the expense as much as possible, as well as to permit the use of a portion of the existing patterns,



CHARACTERISTIC CURVES FOR 3-IN. EXPERIMENTAL PUMPS NOS. 1, 2, 3 AND 5

this pump was also designed as a 3-in. pump having a 4-in. suction. Obviously better results would have been obtained had the pump been built as a 5- to 6-in. size as was subsequently shown by later tests. This pump was tested in June, 1921. Fig. 3 gives the characteristic curves of the pump when tested at 1,750 r.p.m. Fig. 4 shows the equal efficiency curves for the same pump at speeds of 1,750, 1,450 and 1,150 revolutions per minute. Attention is called to the extremely flat efficiency curve in Fig. 3 as well as to the wide range in capacity and pressure with relatively high efficiency shown in Fig. 4.

The pump developed a maximum efficiency of 64 per cent at a capacity of 750 g.p.m. against a head of 240 ft. at 1,750 r.p.m. The results of this test exceeded all expectations by a considerable margin, and it is believed that, everything considered, it established a record not yet equalled in European or American practice. The underwriters specify that a pump offered for this service shall be an 8-in. two-stage design and that the efficiency shall not be less than 55 per cent, the expectation being that it will vary between 55 and 60 per cent. Later tests indicated that several per cent could have been added to the efficiency by an increase in the size of the pump. Inasmuch as an efficiency of 64 per cent was actually obtained under the conditions named, it is probable that had this pump been designed as a 6-in. instead of a 3-in. pump the efficiency would have been not far from 68 per cent. This would be fully as good if not better than that developed by the average multistage pump for these conditions.

It should be pointed out that these results were obtained with a simple volute pump without the use of any guide vanes or diffusors. This still further confirms my belief that guide vanes and diffusors are entirely unnecessary in pumps of careful design and equally good results can be obtained without them. The writer is well aware that others may still prefer to use them but maintains that it is possible by proper design to secure the same results without.

In the light of this the results obtained from this 3-in. pump are surprising to say the least. The average pump offered for the same service would weigh in the neighborhood of 2,000 lb., while the total weight of the pump whose results are shown in Fig. 3 was only 412 lb. This indicates that it has been possible to reduce the weight of the pump from about 80 per cent with little or no loss of efficiency. The cost of this pump would be somewhat in the same proportion although probably not as extreme a variation. The writer believes that this design has established, by a considerable margin, a new record for large capacity and high pressure with light weight. Strength was in no way sacrificed in this design and the pump would be amply safe under much higher pressure than it was called upon to meet.

Up to this point efficiency had been considered of secondary importance and no especial attempt had been made to secure high efficiency. The previous designs were primarily for the purpose of study and it was desired to see what values of efficiency might be obtained.

Space does not permit an account of the various tests, studies, etc., which were undertaken with these designs but it will be sufficient to say that after a careful study of all the test data there were strong indications that an improvement in the efficiency was possible. With this in mind a new impeller was designed for somewhat lower capacity and pressure in order to keep within the easy test range of the dynamometer. This design was undertaken in an effort to improve the efficiency without disturbing the other desirable characteristics previously obtained, such as the extremely flat efficiency curve. This impeller was tested the latter part of 1921. Fig. 5 shows that my prediction of increased efficiency was fully realized.

A comparison of Fig. 5 with Fig. 2 shows that an increase of about 7 per cent in efficiency was obtained by this new design. It was also considered likely that the new design would show even less variations in efficiency with varying capacity than had been obtained with the previous pumps. This too was borne out in the subsequent tests. A remarkable feature of this pump is the unusually wide range of capacity and head —more than half the total possible—for which the efficiency is 60 per cent or better. In other words this pump will develop within 35 per cent of its maximum efficiency at half its normal capacity or about 5 per cent more than is usual in such cases.

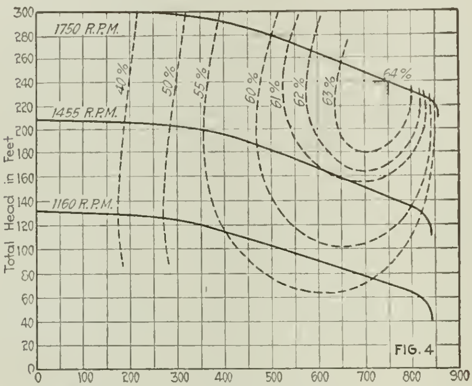
After a careful study of these tests it was thought that by proceeding in a slightly different direction it would be possible to still further increase the efficiency of this type of pump. Owing to the pressure of other matters the work on this pump was at a standstill until in August, 1922, the design of a special pump primarily for high efficiency was undertaken. This pump was designed for smaller capacity but about the same pressure as those in the past. The tests were made in November, 1922, with the results shown by Figs. 6 and 7.

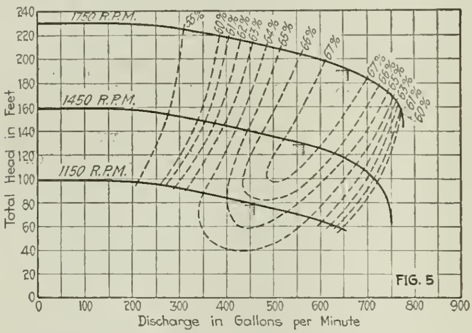
The increase in efficiency hoped for was obtained together with some improvement in the operating characteristics. The maximum efficiency was increased from 67 to 68.5 per cent or 1½ per cent in spite of the decrease in capacity from 650 to 425 g.p.m. This makes the results even more remarkable as the usual effect of a similar reduction in capacity is a decrease of 3 to 4 per cent in the efficiency.

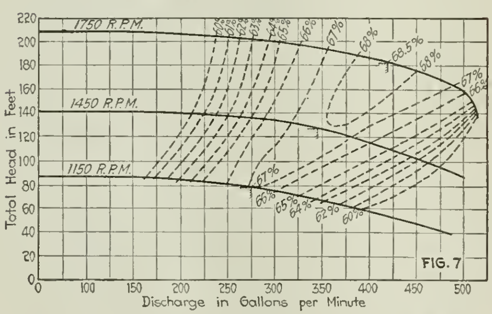
For the same capacity and pressure the efficiency was increased from 62.5 per cent in Fig. 5 to 68.5 in Fig. 7, a total of 6 per cent. Without regard to the high efficiency developed by this single-stage pump at heads around 200 ft. the curves of Fig. 7 are interesting for their broadness. The efficiency at half load is about 86 per cent of its maximum which is higher than usual by several per cent. The effect of this is very evident in the tests at lower speeds. For instance the development of 67 per cent efficiency with a discharge of only 275 g.p.m. under 80 ft. head at 1,150 r.p.m. is not exceeded by any pump which has come to the writer's attention. In efficiency, operating characteristics, etc., it is the equal of many of the 4- and 5-in. two-stage pumps offered for such service by manufacturers today. The total weight of this pump was 380 lb., which is perhaps half or less that of a two-stage pump offered for this service with no better efficiency.

The writer hesitated to publish the results of this work until such a time as he could be sure that these pumps had been in operation a sufficient length of time to warrant the belief that their initial satisfactory performance would be maintained in the future. To date nothing has occurred to indicate that they have any difficulties inherently connected with them, and they seem perfectly normal in every respect. Fig. 8 will

give the reader an idea of the general construction of these pumps. Ball bearings of the radial-thrust type furnished by the Gurney Ball Bearing Co. were used on all the pumps. Otherwise there were no particularly novel features affecting their general appearance. The operation of the ball bearings was highly satisfactory in every case. The tests were very carefully conducted and check runs were always taken to secure accuracy.







EQUAL EFFICIENCY CURVES FOR 3-IN. EXPERIMENTAL PUMPS NOS. 3 4 AND 5

The power was measured by means of an electric dynamometer, the pressure by calibrated test gages and the speed with a highly accurate form of tachometer. The results may be regarded as correct within a very small margin. The pumps are entirely of commercial design and are in no way to be considered as freaks. The workmanship and materials were first class in every respect.

The writer hopes that this brief account of the development of this type of pump may prove to be the means of stimulating further work along these lines. An exceedingly bright future is predicted for this type of pump if adapted to commercial requirements, as it seems to have all the good characteristics of multi-stage design with few or none of their well known disadvantages. It should be understood that many of the refinements of design used in the production of these rather high pressure pumps are entirely applicable to those for moderate pressures. The efficiency of centrifugal pumps is known to vary with the capacity, other things being equal. This variation is rather well known and has been represented by various curves showing this relation. For volute pumps having a capacity of 275 g.p.m. the probable efficiency would be about 60 per cent in the usual case. For pumps of about 4,000 g.p.m. efficiencies as high as 85 per cent have been obtained.

The pump shown in Fig. 7 is seen to develop about 7 per cent more efficiency than the usual design. It seems not at all improbable that by the use of these same methods of design the efficiency can be raised about that amount all along the line. This should result in maximum values of efficiency in the neighborhood of 90 per cent and one long-hoped-for dream of the pump designer—that of equaling the efficiency of the water turbine—would then have been realized.

Rehabilitation of the Kansas City Southern Ry.

Study Made for Systematic Improvement—Grade and Line Revision—Track Rebuilt—Bridges Strengthened or Filled

LIGHT original construction to meet financial conditions, with subsequent extensive rehabilitation and improvement to develop operating economy and traffic capacity, has been the history of many American railways. This condition, as illustrated by the Kansas City Southern Ry., is presented in the annual report of that company in a reprint of an address by L. F. Loree, chairman of the board and an engineer of wide railway experience. Some brief extracts from this address are given below. The original line was described in *Engineering News*, Feb. 17 and March 10, 1898, pages 116 and 162.

The Kansas City Southern Ry. was a conception of Arthur Stillwell, whose purpose it was to bring Kansas City into connection with the Gulf of Mexico by the shortest practicable route. Partly by new construction and partly by the purchase of small lines, the road was completed and opened for operation in 1897. The difficulties both of location and construction had been very considerable. The traffic was thin, 887,108 tons being hauled one mile per mile of road in 1905; the bridges were light, having been built for Cooper E-31 loading; the rail was light, 60- and 56-lb. per yard, and was badly surface-bent because laid on dirt ballast. Sidings, yard and terminal facilities were inadequate. The grades on no division were less than 1 per cent and increased in the mountains to 1.8 per cent.

The new owners who took over the road in 1905 proceeded at once to deal energetically with these conditions; first in overcoming the more outstanding defects, while careful and painstaking study was made of the problems of maintenance, operation and traffic. The services of an experienced engineer, supplemented by a large field force, were secured to study the possibility and cost of grade reductions. These studies extended over 1906 and 1907,

and the conclusions reached have been closely adhered to in the subsequent development.

In the modernization of the property, the roadbed both in cuts and on fills has been widened to a standard cross-section, and much attention has been given to surface and sub-drainage, especially in the gumbo soil of Missouri. The line has been relaid throughout with 85-lb. rail and with the improvement of the condition of the main line rail has gone a corresponding improvement in that of yards and sidings. Each year a substantial percentage of the cross ties used has been subjected to preservative treatment until now 51 per cent of the ties in main track are treated. About 90 per cent of the line has been raised 6 to 12 in. on gravel or chat ballast, while some material has already been applied to the remaining 10 per cent. The line and surface, and generally the maintenance of the track, compare favorably with other lines in the Southwestern territory.

A carefully maintained bridge program has been followed, looking to a reduction in the number and length of wooden trestle openings and to the strengthening of all bridges to permit heavier loading. Several trestles are now of the ballasted deck type and of creosoted timber. The new bridges have been built for the Cooper E-50 loading, and two are of large size, one over the Kaw, built in 1917, costing $225,000 and one over the Arkansas, now under construction, estimated to cost $270,000.

The passing sidings have been progressively extended, their total having been lengthened 34 per cent, until this work is now about two-thirds completed, and they will accommodate the longest trains moved by the heaviest power over the lowest grades. Water and coaling stations have been revised to suit the changed conditions of traffic, water treating plants have been installed where water conditions are bad, and five gravity coaling tipples have been built, as well as adequate facilities for storing and delivering oil fuel for locomotives.

The traffic offered the Kansas City Southern Ry. is low grade freight such as lumber, coal and grain, that must be moved at low rates. In order to obtain a profit from the business, a movement as nearly balanced north and south as possible is necessary. The margin of profit is sharply reduced with the traffic out of balance and might entirely disappear with a large amount of empty mileage. Further, it must be moved in heavy trainloads and with a minimum of lost motion or delay. It was with these difficulties of operation in mind that the late Horace G. Burt, in presenting his exhaustive field investigation, reported that a line might be practically realized of a maximum gradient of 0.5 per cent. More than $5,000,000 have been spent for grade reduction, and the property is now operated as five divisions of 0.5 per cent, one division of 1 per cent and one of 1.35 per cent maximum grade. These changes in grade have yet to be pursued to a finality.

Old Cast-Iron Structures on British Railways

REPLACEMENT of a cast-iron railway bridge 88 years old and of cast-iron columns of a trainshed 69 years old, on two English railways, is reported in the *Railway Gazette* (London). The bridge, built in 1835, has a span of 50 ft. It carries four tracks across the Regent's Canal in London, near the Euston terminal station of what is now the London, Midland & Scottish Ry., so that an enormous main-line traffic has crossed it. In view of the great increase in weight of English locomotives during the past few years the removal of the bridge is not surprising, especially as it had been strengthened several years ago.

This bridge had three shallow through trusses of the bowstring type, each truss consisting of two parallel flat arched ribs of I-section with vertical spandrel members and a horizontal top chord over the full width, as shown herewith. The two sets of spandrel members were connected at intervals by cross frames. Wrought-iron hangers carried cast-iron cross-girders or floorbeams. In 1892, however, intermediate steel floorbeams were placed, suspended from the chords and ribs by steel slings or stirrups, the attachments being so adjusted that these steel members carried all the live- and dead-load. Cast-iron plates formed the floor originally, but a plank deck with wood stringer for each rail was laid about twenty years ago.

CAST-IRON TRUSSES OF ENGLISH FOUR-TRACK RAILWAY BRIDGE

The third truss (right-hand view) is partly concealed by a modern plate girder span carrying a fifth track at the right.

The new five-track bridge will consist of six parallel plate girders with transverse floorbeams carrying brick jack-arches and a concrete waterproofed deck for ballasted tracks.

The trainshed roof of the Paddington terminal station of the Great Western Ry., at London, built in 1854, was supported by round cast-iron columns on cross-shaped bases resting on small brick pedestals of the same form. For the renewal of these columns, two steel bents were erected at each column in succession, carrying I-beams which were wedged up to carry the arch rib supported by the column. The old column was then taken down and the brick pedestal replaced by a more massive concrete pier, with anchor bolts for the steel column base, as the brick pedestals were hardly adequate for the loads. The new column was then set, a 4-in. downspout inserted, and the column adjusted to position, after which the space between downspout and column was grouted. These columns, also of cast iron, are of octagonal section 15½ in. in diameter at the head and 17½ in. at the base, with a length of 24½ ft. After final adjustment, the bents were released, to transfer the load to the column, the column bases were cased in concrete, drain connections were made and ornamental cast-iron caps and bases were placed. The columns along one platform have been renewed and the work is to be completed before winter.

Through the Reclamation Country

By F. E. Schmitt
Associate Editor, *Engineering News-Record*

A SERIES OF ARTICLES on Federal Land Reclamation is to start in *Engineering News-Record* in a few weeks. It will give a history of the twenty-one years of government irrigation, state the many problems of operation engineering, agricultural and financial analyze the various complaints that are being so emphasized by those who are seeking a reform of the current law and methods and seek to present some views as to a constructive policy in the future. Through it all will run the evident theme that irrigation, from planning, through construction to operation, is a continuing engineering problem.

As a part of the preparation of the series Mr. Schmitt is now traveling through the West, visiting irrigation projects, studying developments and interviewing builders, operators and settlers. He will write a series of letters of running comment on the situation as he sees it on the ground. These are not the final result of his trip but they will serve to acquaint our readers with the actualities of reclamation as revealed to an unprejudiced investigator. —*Editor.*

Washington, D. C.

ON THE WAY to visit some federal reclamation projects I find that local observers of government doings believe that quite a muddled situation has developed out of the current mixture of federal reclamation and politics. Three months ago the Secretary of the Interior killed off and buried, decently or otherwise, the 21-year-old Reclamation Service, which in long and faithful performance had come to be close to the hearts of engineers and incidentally had made several million acres of desert bloom more or less like a garden. He erected a Reclamation Bureau on its grave, and converted a politician into a statesman by making him Commissioner of the Bureau. The facts, the Secretary in effect explained, condemn the engineer-controlled Reclamation Service; hence the Bureau. But now, three months later, he appoints a "fact-finding commission." So at last we are to be instructed with facts. Will they show that the Service should have been kept alive?

To my question, "What is the new commission for?" one man I met here answered, "Smoke screen!" The next man, equally shrewd though of different type, gave the same answer, "Smoke screen." The coincidence is striking. People close to the government naturally see its seamy side. But is it significant that the official action of one of the ten highest government personages should be promptly and spontaneously impugned as political subterfuge? And this action concerns a matter of outstanding national importance; not merely the welfare of a hundred thousand people on the farms, not merely the soundness of an investment of more than a hundred million dollars of the people's money, but the future development of our remaining unused land, with all that it means in production and in home-making.

They say in Washington that the Secretary has been unpleasantly surprised by the widely expressed disapproval and distrust aroused by his A. P. Davis - D. W. Davis coup d'état; that he is now trying to divert attention from it and perhaps build up a basis for new claims or policies which will lead people to forget the case of the engineers and of the late lamented Reclamation Service. If this is correct, it is about the first time that the engineering profession has made its voice heard and has dented the hard shell of a government official outside its own ranks. The protests of engineers, it is true, were backed by those of many newspapers which know something about reclamation. Nevertheless, the engineering profession has cause for some slight rejoicing.

There are plenty of predictions that the new Congress will take up the reclamation subject aggressively, as of course it ought, in view of the importance and urgency of the matter. But quite apart from politics the situation is obviously a big national problem, in which the Davis-Davis incident is merely a symptom and not the trouble itself. Such local evidence as records of committee hearings of the past year or two shows that there is much complaining in the irrigated areas of the West; and the complaints seem to mean that a cost burden of $40 to $80 per acre for water-supply works alone, plus annual operating charges, plus cost of land leveling, is a heavy load on a farm that lies far from markets and has to compete with fertile land amply watered by nature. Some of the reclamation areas are reported to be seriously in trouble, while others, with very likely the same kind of people on them, are clear or are coming clear. There is room for a good deal of fact-finding. Besides, men informed on personalities tell me that part of the complaining has come from kickers—kickers by temperament or by profession—and does not represent the sentiment of the genuine hard-working farmers along the ditches.

There is one phase of the matter that has a family interest. Just ten years ago this journal printed a number of protests concerning the difficulties against which the reclamation farmer must labor, all of them amounting to the assertion that his first four or five years are the hardest and that he cannot begin to repay the reclamation cost so early. "Let up on him during his pioneer years" was the burden of the protests. The protestors of the past two years have said exactly the same things, although their particular projects have been producing for six to ten years now. Is the reclamation farmer still pioneering? If he is ever going to pull out of the hole why are the present protests largely duplicates of the old ones? The situation doubtless has changed; but it is easy to keep on with an old line of talk, even though new talking points have grown up. Just how the situation has changed, and what new hardships have developed to take the place of those of 1912 and 1913 also needs to be found out.

Panama Canal Tonnage Increases

The net tonnage of vessels transiting the Panama Canal during the fiscal year which ended on June 30, 1923, showed an increase of 63 per cent over the tonnage for the same period last year, this year's figures being slightly over 18,600,000 tons. Another interesting fact concerning this movement through the canal is that with very few exceptions the number of vessels each month is slightly greater than the number in the preceding month so that whereas the number for July, 1922, was 206, the number for June, 1923, was 417, which figures would indicate that the growth in canal traffic is increasing regularly. The toll collection from the 3,967 vessels which transited the canal during the past year was $17,500,000. Net profit on Canal tolls now amounts to about $500,000 monthly.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Dealers' Profits on Cement to Large Users

Sir—The issue of Sept. 6, 1923, is before me, and I note your editorial remarks concerning the analysis of federal income tax reports of several cement companies and the conclusion based thereon by H. Parker Wills as outlined on page 407.

As a buyer of cement, I see no just cause of complaint, either as to the price which the mills receive for their product, or the profit which their returns show they are receiving from the use of their capital. Theirs is a somewhat uncertain and irregular business, in that it is subject not only to seasonal fluctuations but also to all the chances and changes which both local and world conditions tend to bring about.

What the state and municipal authorities are trying to do, as I understand the situation, is to bring about a change in the marketing methods of cement companies which will result in the placing of the states, counties, and municipalities on the same basis as the local dealer. We object seriously to paying a tribute of from 25 to 60c. per barrel to the local "representative" of the mills, despite the fact that his only service to us is to write an order for the quantity we may need. We are perfectly able to write these orders for ourselves, have our own storage, and in all cases take the cement from the car with our own labor and trucks.

We have the cash to pay for the goods, and yet we must pay tribute to a dealer in every case, although in many cases, the dealer does not sell in a year as great a quantity of cement as we often use in a month in the busy season.

It is this, to us, unfair attitude of the cement mills which has caused the agitation for state-owned cement mills and which will keep up this or other equally ill-advised agitation until some relief is given the user of cement in large quantities. We will not forever go on paying a tribute for which there is no justification in sense or reason. And if at some time in the near future the cement makers find themselves in the same fix with the railroads they will have only themselves to blame.

Nearly two years ago, the writer, with the board of commissioners of this county, was invited to dine with the officials of one of the great cement companies of the middle west, the object of the getting together being to try to arrange for the use of their cement on our work. During the discussion of the matter we frankly stated that so long as we had to do business with them through a local dealer, and pay an unreasonable tribute to him, we would never be found among their customers, and we further stated that at the coming session of the state legislature we were planning to have action taken which would place counties and municipalities or any one else buying their product in car lots on the same basis as their regular dealers, so far as price was concerned. Their reply to this was that so far as their particular company was concerned they were willing to make such an arrangement but owing to the "Association" rules they could not act alone; the matter was in process of being threshed out at their meetings and they had no doubt that within a year we would be able to buy their product on a dealers' basis. We have used a great many cars of cement since that time, but have not been able to buy any of it without the local dealer "getting his," nor have we bought any from that particular mill until last month when we bought two cars through their dealers at and below the price we have been paying a dealer representing another company whose ideas of "profit" were more nearly in line than theirs had been heretofore. If to regain our trade, which they had lost, they could cut their "margin" in one case 76c. per barrel and in another 87c. per barrel, it would seem that there never had been any legitimate foundation for their prices.

The cement makers are "in bad" with the public, and, the public does not always stop at reasonable concessions from those who it feels have unjustly dealt with it. It is high time the cement makers took note of the storm signals and began to throw a little oil on the waters. It will prove as effective and much cheaper than a price cut after state-owned mills are in operation. They are entitled to all the profit which their returns show they are getting from their business, and what the public is demanding and will get sooner or later is not so much a reduction in price as it is a reduction in the "spread" between the mill and the job.

While the product of the cement mills was a new and comparatively unknown quantity, there was an excuse for maintaining a dealers' organization as well as an association of manufacturers, who by their combined effort could at comparatively small expense carry out the advertising campaigns necessary for putting before the possible consumer all the facts and arguments which might induce him to try their product. But at this time with every one familiar with the use of cement it would seem that their efforts and money could be better spent perfecting their product and bettering their marketing facilities and methods, than in supporting an "association" upon which the people look with disfavor—however innocent its purpose—and which is more and more attracting the unfavorable notice of the courts.

If Mr. Wills' analysis is based on truthful and fair returns from the companies considered, their profits are certainly conservative and no one should have any quarrel with them. But when we go to their mill door with the cash in hand to pay for our cement, we do not like to be referred to some dealer to whom we must pay tribute before our wants can be supplied.

O. T. REECE,
County Engineer, Neosho County, Kansas.

Erie, Kansas,
Sept. 10, 1923.

Reproduction-Cost-New Measure of Value

Sir—Recently I had occasion to reread your editorial comment in the issue of June 7, 1923, on the decision of the Supreme Court in the Missouri telephone case, and apparently your view is that the minority opinion of the court is the more sound, namely that legitimate prudent investment should be the rate base instead of cost of reproduction at the date of inquiry.

It seems to me that your editorial as well as other advocates of the prudent investment theory neglect two factors which are of prime importance.

1. While original investment is stated in terms of dollars, the real investment was labor and materials. The total amount of these constitute the capital invested and the investment should be measured by these rather than by the fluctuating dollar. If the investment is measured in these terms, the prudent investment becomes essentially equal to the reproduction cost. The difficulty lies in considering dollars as capital instead of merely a medium of exchange of capital or elements of ultimate value. A fair return on the real investment of capital should be provided, and this return should be in terms of the medium of exchange in vogue or applicable at the time the return is being contemplated. Reproduction cost is essentially this investment quoted in terms of the currency of the time of inquiry.

2. As a practical procedure, the term "prudent investment" offers no advantage over "fair value," for "what is prudent" or "what is imprudent" is quite as vague as "what is fair," each having to be determined by evidence and judgment.

Moreover, as a practical procedure, records of additions can be as readily kept in terms of material and labor as in terms of dollars. As a matter of fact, the record is necessarily kept in both forms, although more conveniently summarized or tabulated in terms of the common medium, dollars.

Justice as well as stability requires that the same economic laws be applicable to public utility property that are operative for private property, and this means that investments in public utilities should be as sound as investments in hotels, apartment houses, banks, mercantile houses, or realty.

While probably most engineers will agree that a better term than "fair value" might have been chosen as a basis of rates, yet the concept involved is doubtless sound. "Invested capital" or an equivalent term would have been more definite and advantageous in many ways. However, the "invested capital" should not be construed as meaning the dollars invested but rather the real capital invested.

Recognition of the soundness of the Supreme Court decision of May 21 in the case mentioned will do much to dispel the fogginess of appraisal procedure, a consummation devoutly to be wished by every engineer engaged in work of this character.

C. C. WILLIAMS,
Head of Department of Civil Engineering, University of Illinois.
Urbana, Ill.
Sept. 8, 1923.

[Comment on this letter appears on the editorial page of this issue.—EDITOR.]

Eccentric Heel Joint

Sir—Referring to the eccentric heel joint problem brought up by Camillo Weiss in your issue of Aug. 30 p. 339, and also by Walter H. Weiskopf in your issue of Sept. 13, p. 447, I should like to recommend again a simplified method, one that a man can carry under his hat without the use of a formula or the influence line, as suggested.

In 1915 I proposed a method. Prof. E. H. Rockwell pointed out an error in that method, an error that could readily be corrected without affecting the principle of the solution. At that time I endeavored to show in *Engineering News* how the error could be corrected, also to point out

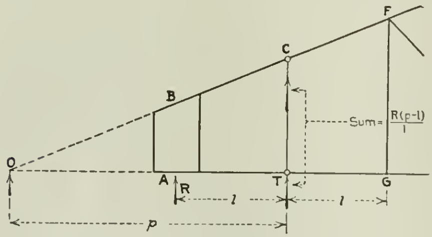


DIAGRAM TO SOLVE ECCENTRIC HEEL JOINT

the need of some correction in Professor Rockwell's solution. However, Professor Rockwell became ill and could not respond until a time when the matter was too "cold" for publication.

Stripped of theoretical niceties the method is simply this: Given, a truss heel joint, as in the figure herewith; assume equal degree of fixed-endedness at B and F and at A and G, so that points of inflection occur midway between these points. Continue the chord members to their intersection O.

Now consider the reaction R as a load on a beam of span OT or p. The reaction at O may be used either analytically or graphically to find the direct stress in the chords BF and AG, and the reaction at T may be used as a shear divided between these chords and producing bending moments at B, F, A, and G. This is all there is to remember, except that the last reaction should be divided between the chords in the inverse ratio of their stiffness or their moments of inertia.

It is scarcely necessary to introduce the different lengths of the chords, as affecting their proportion of shear carrying capacity, inasmuch as for roof trusses an approximation is all that is desirable, and, in any event, the horizontal distances are alike.

EDWARD GODFREY.
Pittsburgh, Pa., Sept. 20.

Personal Element in Water Bacteria Research

Sir—One feature of your editorial discussion of the recent action of the California State Board of Health (*Engineering News-Record*, Sept. 13, p. 417) was not emphasized. The plan of the board if carried out would insure more or less careful attention to water analysis on the part of many, perhaps several hundred, independent workers. The result of such increased opportunity for many investigators, even if amateurs at first and for a long time, can hardly be overlooked. There would be greater interest with more than a fair chance that from so many different viewpoints some actual gains would be made in the state of the art, even if only the simplest tasks were undertaken. Note the improvements in radio from almost numberless sources. The really difficult problems could be reserved for the expert.

Analyses require faithfulness and honesty as well as skill. Good judgment is important. There must be for each city or unit-installation some one intrusted as superintendent or manager with the responsibility incident to caring for the plant as a whole. To him any part might be understood after a reasonable opportunity to learn had been afforded; that is, the same qualities that had secured to him his position should be ample to enable him to take on the increment. No serious risk could be involved since the average case would invite some further knowledge of the daily supply. Whatever adds to the welfare of an isolated unit should be welcome in quite as deep a sense as those items which add to the activities of the state.. The California plan seems to have its advantages.

New York City,
Sept. 19, 1923.
H. F. DUNHAM,
Civil and Hydraulic Engineer.

One Cause of Earth Dam Failures

Sir—In the meritorious editorial in your issue of Sept. 6 relating to the recent failure of the Apishapa earth dam, it is affirmed that the difficult sequel of all such dam failures is to discover just what that something is that went wrong; you also questioned why there should be such diametric opposition as to the desirability of early filling of the reservoir behind dry fill earth dams as was evidenced by the contradictory views of the engineers reporting the disaster; and you declared that the essential development of the art of designing earth dams for varying local conditions and purposes should be furthered by determination of the actual causes of past failures.

I have seen six ruinous breaks, and several minor ones in earth embankments built for cofferdams, canal banks, and river dikes.

In most instances the primary cause of the break was the solid freezing of the embankment for several feet in depth below the top. The frozen part expanded and a definite crack was formed along the plane dividing the frozen from the unfrozen section as the frozen part shrank to its original size when free of frost. Under a slight head of a foot or two, water entering the horizontal crack gradually seeped along it till finally a leak was started.

In a new earth dam standing in the dry during the winter, similar cracks may be formed roughly paralleling the side slopes. When subjected to pressure later on, water entering the horizontal crack near the top can follow down the vertical cracks and into any pervious horizontal layer it may reach.

In Northern Michigan where the snow is generally three or four feet deep on the level throughout the long winter season, I have kept cofferdam embankments from freezing by piling loose brush on them, thus forming a brake for keeping the snow from blowing off the bank. Compacting the snow by walking along the dam was not permitted. Where the natural fall of snow is deep and is not disturbed, there will not be any frost in the ground, but under packed paths made in the snow the ground will be frozen four to eight feet in depth when night temperatures go to ten or more degrees below zero. Determination of depths has been made many times by excavations or by drilling holes.

Albany, N. Y.,
Sept. 24, 1923.
JOSEPH RIPLEY,
Consulting Engineer.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The Tehachapi Railway Co. Has been organized in California with a capital stock of $1,000,000 for the purpose of constructing 30 miles of railway in Kern County, Calif., between Ilmon and Bena.

American Bridge Co. Was the Lowest Bidder for the construction of 19 steel barges for the U. S. Government to be used in the construction of the new dams on the Ohio River. They are to be ready for use in the spring.

Reports That the Great Northern Ry. Co. plans to build 80 miles of new line from a point near Java on the southern border of Glacier National Park to Augusta, Mont., are stated to be without foundation by the chief engineer of the Great Northern Ry.

To Relieve Congestion Arising from the fact that the 4½-mile tunnel under the Severn River frequently is inadequate to carry the volume of traffic between England and South Wales, the Great Western Railway Co. has announced its intention to construct a bridge across the river at Beachley, a short distance above the tunnel.

Three of the Four Main Piers for the Bear Mountain-Hudson River bridge have been completed up to the bridge seat level and the fourth will be completed some time this month. The company will then be in a position to set the cast-steel tower bases and start the erection of the steel towers. Work on the approaches is well under way.

Bids Are Being Asked for the reconstruction of the substructure of the Georgia-Alabama bridge over the Chattahoochee River at Eufaula, Ala. The present wooden latticed-truss bridge was built about 1837 and the brick piers were built in 1855 to replace the original wooden ones. These piers are to be encased in concrete and the wooden trusses replaced by steel ones as soon as the necessary legislative enactment is obtained.

Reports from Mexico State that that country has announced plans for the creation of three free ports—one at Salina Cruz, one at Port Mexico, and one at Guaymas. A fourth will be added in the future at Rincon Antonio on the Isthmus of Tehauntepec. These free ports are based on the successful free ports of Europe and comprise areas where commercial operations not intended for consumption in the rest of the country are free from customs duties and regulations. They also provide reservoirs for storing material pending shipping orders. This announcement follows one from Belgium that 650 acres have been allocated tc this purpose at Zeebrugge.

Japan's Great Earthquake Described by American Engineer Eye-Witness

John W. Doty, President of Foundation Co., New York, Viewed Destruction of Yokohama, Sept. 1, from Deck of Ship at Pier Which Collapsed During Shock

The effect of the great earthquake which devastated cities in Japan, Sept. 1, as seen through the eyes of an American engineer, is told in the following diary of John W. Doty, president, The Foundation Co., New York. At the time of the shock Mr. Doty was in Yokohama harbor as a passenger aboard the Canadian Pacific steamship "Empress of Australia," which was just on the point of casting off from her pier for her return voyage when the disaster occurred.—EDITOR.

On SATURDAY, Sept. 1, at 11:45 a.m. all passengers were aboard the *Empress of Australia* in Yokohama harbor, the gangplank was removed, and the ship was ready to sail. The tug was alongside. Several hundred visitors were on the pier adjacent to the ship waving farewell. The ship lay with her bow toward the shore, her starboard side along the pier, about 1,200 ft. from shore. From the stern of the ship the pier projected out into the harbor another 600 to 700 ft., its total length being about 2.200 ft. Lying directly astern of us on the same side of the pier was the *Steel Navigator*, a ship of United States registry, and on the opposite side of the pier was the French liner the *Andre Lebon*. Both of these ships had gangways on the pier.

At 11:57 a.m. when every one anticipated that we were leaving the pier, a tremendous vibration of the vessel was felt and it was immediately apparent that a serious earthquake was taking place. Many people on the pier adjacent to the vessel fell to the deck of the pier and the two-story warehouse shook violently and seemed to sway laterally and vertically 12 or 14 in. throughout the first shock, which lasted from 40 to 60 sec. More than half of the pier from the bow of the ship to the shore collapsed and disappeared, leaving only the stringers on a few piles above the water level. From the stern of the ship the center of the pier for a distance of about 300 ft. collapsed and disappeared. The portion of the pier directly adjacent to the ship, on which stood the two-story Customs warehouse, remained standing. The collapse of the pier threw a great many people into the water. A portion of the breakwater encircling the harbor settled from 8 to 10 ft., some of it disappearing.

Buildings Collapse

Immediately our attention was called to the buildings which had collapsed along the water front. The Oriental Palace Hotel, the Grand Hotel, the Standard Oil Building, and other buildings along the Bund had fallen and it was apparent that most of the structures throughout the city had collapsed. As the buildings in the city collapsed a great cloud of dust arose from the wreckage and obscured a clear vision of the shore. The people on the portion of the pier which had not collapsed sought shelter by finding their way over the wrecked portion of the pier to the shore. Others sought shelter on the steamships *Steel Navigator* and *Andre Lebon*. As soon as our gangway openings could be unfastened ladders were sent down the side of the ship to take on board the few persons remaining on the pier. This was about 12:05 p.m. During this interval a number of other serious shocks occurred and, the dust cloud having lifted, it could be seen that the city was on fire in many localities. The tug left the side of the ship and the wind rose to a hurricane, blowing from the shore a few points off our port bow at a velocity of 60 to 70 miles an hour, making it impossible to turn the ship from the pier.

In the meantime the fires on shore united to make a complete chain of fire around the city and, fanned by the gale, swept towards the water front. At 12:30 p.m. the whole city was on fire and the heat coming over the ship was so great that the fire hose, which had been manned, were played over the decks of the ship. Two oil tanks on the ship's launch were thrown overboard. From this time the heat was intense and a large quantity of burning mate-

Automobile Association Plans to Broadcast Road Information

The national headquarters of the American Automobile Association in co-operation with the Radio Corporation of America will broadcast the latest information on road conditions every Wednesday night at 8 o'clock, Eastern Standard time, from Station WRC at Washington, D. C., which station has an effective consistent radius of 500 miles. While attention will be given to road and touring conditions based on data supplied by the National Touring Bureau, accident prevention, handling traffic, road building and maintenance will be discussed by recognized national authorities. Information of sufficient importance for use in this way may be sent to the American Automobile Association.

rial and cinders fell on the decks, and many of the small boats, lighters, junks, etc., all over the harbor, were set afire and, as their mooring lines burnt, drifted among the ships.

1 O'clock—The heat was so intense that the fire service was barely adequate to keep the exposed surface of the ship wet down. In addition to this, the force of the wind driving the heat and cinders and other debris into the faces of those operating the hose was at times blinding and it required relays of men at short intervals in order to keep the ship properly protected. Before this time it was quite evident that no one on shore could have survived the heat who had not escaped from the city prior to the joining together of the fires. Many had been forced by the heat into the water and could be seen floating around the bay in great numbers on timbers and other wreckage. The wind was so great that it was impossible to lower any life boats, and besides, every man aboard was fighting to his utmost to save the ship from fire. Those steamers which were able to get away from the piers and inner anchorages left for the outer bay. A small Japanese freighter drifted against the *Empress* but, fortunately, did no serious damage.

The *Steel Navigator*, which was lying directly astern of us and whose captain was ashore and subsequently found to have been killed, dropped one of her anchors immediately after the first shock of the earthquake and as the gale increased dropped her second anchor.

2:30 O'clock—It being apparent that, due to burning material carried by the wind and the intensity of the heat from the shore, the two-story Customs warehouse, which stood on the pier immediately adjacent to the ship, would take fire, and on account of the closeness of this warehouse, a matter of some 20 or 30 ft., the *Empress* tried to back away from this portion of the pier and in so doing the anchor chain of the *Steel Navigator* fouled her port propeller. This left the port propeller and engine useless, and in addition to this the chain was so engaged with the propeller that it acted as an anchor astern. By this time the Customs warehouse was afire and it was only the energy and courage of the officers and crew that saved our ship from taking fire until the shed had collapsed and the flames had somewhat subsided. At 4:30 o'clock the wind changed direction slightly and lessened in velocity. Innumerable burning small craft were drifting around and against the *Empress* and the danger of fire from this source continued very critical.

5 O'clock—The worst of the fire hazard was over and the wind had sufficiently subsided to permit several ship's boats to be lowered and sent to the shore for rescue work. The shore fires continued to rage all around the bay as far as one could see and many of the larger warehouses and buildings which had resisted the early ravages of the fire now burnt fiercely. The refugees commenced to arrive on the ship, many of them suffering from injuries and practically all of them from eye trouble caused by the heat and smoke. None of them had any but the clothes they stood in, and in most cases these were very few as they had used their clothes to wrap around their heads to protect them from the heat and smoke. At midnight the fires were still raging and could be seen all over the sky-line. Barges were burning in the harbor and many of the large fuel oil storage tanks were afire and exploding.

Oil in Harbor Burns

On Sunday morning most of the fires on shore were dying down but the surface of the harbor was covered with large pools of oil which had escaped from the exploding tanks. This oil was burning at various points, the largest fire, however, being directly against the shore in front of the Bund and about half a mile from the ship. This fire traveled along the shore until it reached the wrecked pier and commenced to follow the line of the pier out towards the ship. The flame of burning oil was at least 300 ft. in diameter and 150 to 200 ft. high. It became apparent, from the accumulation of oil around the ship and in many pools on the surface of the harbor, that with the approach of the fire from the shore the ship would have to move immediately. As the port propeller was out of commission and it was hazardous to try to operate the starboard engine for fear of also fouling it in the same anchor chain, the captain of the *Empress* requested the *Steel Navigator* to tow us back clear of the wharf, which was done. When we were some 200 ft. clear of the end of the pier anchor was dropped to avoid collision with nearby ships, and the engines were tested to ascertain whether or not they could be used. It was found that the port propeller could not be used but that the starboard propeller was clear.

As the ship lay in a pool of oil and the fire was still rapidly approaching along the line of the pier, and it was practically impossible to navigate through the number of ships lying at anchor in the harbor, the captain proceeded forward and by skillful manouvering directed the ship from the danger zone through the entrance of the inner harbor, and anchored nearby. Unquestionably the anchor fastened to the anchor chain which had fouled our port propeller had broken loose or lifted clear of the harbor bottom. Otherwise, this manouver would have been impossible. At 7 o'clock Sunday evening the oil had drifted out from the inner harbor and was again collecting around the ship. The tides and currents were in such a direction that it was dangerous for a crippled ship of the size of this one to attempt to move without assistance and an oil tanker in the harbor aided the *Empress* to turn about and reach water considerably beyond the oil pools. From that time the *Empress of Australia* was not in serious danger.

During all of Sunday the refugees continued to arrive on the *Empress* and to be received irrespective of condition, class, or nationality. There were probably 1,500 refugees on board. Many of these were seriously injured and practically without clothing, and it was impossible to move about the ship without encountering numerous cases requiring attention. It is remarkable the efficient service which the doctor and his staff rendered, not only to those slightly injured, but to many refugees with major injuries which required his personal attention. A number of volunteers ably assisted the doctor and his staff and did very efficient first aid work. The manner in which the officers and personnel of the ship received, cared for and fed the refugees is beyond commendation.

Reclamation Commission to Meet Oct. 15

First Session of Fact Finding Body Announced—Members Tell Work of Willingness to Act

A meeting of the fact-finding commission appointed recently to investigate conditions under which work in the Reclamation Service is prosecuted has been called by Secretary Work for Oct. 15. This will be the first gathering of the commission. Though seven nationally prominent men were first invited to become members of this commission, one, Elwood Mead, of California, is out of the country, and therefore will be unable to serve. The others who last week notified Secretary Work of their acceptance of his invitation to act are Julius H. Barnes, president of the U. S. Chamber of Commerce; Oscar E. Bradfute, president of the American Farm Bureau Federation; Thomas E. Campbell, former governor of Arizona; Dr. John A. Widtsoe, former president of the state university and the state agricultural college of Utah; and David W. Davis, former governor of Idaho and present commissioner of the Reclamation Service. James R. Garfield, who has but recently returned to this country, has been notified of the meeting Oct. 15, though he has not yet formally accepted Dr. Work's invitation to serve on the commission. Another member of the commission added during the week is Clyde C. Dawson, authority on irrigation law.

Secretary Work advised the members of the new commission that every facility at the disposal of the Department of the Interior would be placed absolutely at their service; that he wished every phase of the situation gone into thoroughly, and that he would appreciate a blunt and unvarnished report of conditions precisely as they may be found to exist, whether good or bad.

Public Will Get Facts

The Secretary explained further that when the report of this commission is completed he shall present it in toto to the President, Congress and the public.

The commission is asked to ascertain the whole amount of money expended by the Government and returned to it; the total sum owing but not due, and the amount due but unpaid; the relation between estimates and final costs; between expenditures and returns represented by structures, and to suggest the best approved methods of accounting, if not already practiced; the construction costs and methods employed to get water to the land; the methods of application of water in agriculture; original estimated costs of projects with actual costs; estimated time necessary for completion with actual time intervening; number of acres proposed to irrigate with actual number under irrigation; estimated costs per acre to water users before the work was begun and the actual cost when completed; whether the service lent itself to promotion or sought to determine possibilities and requirements of the locality; whether the government has obligated buyers of water to a higher acre cost than first proposed; if rates charged are impossible of payment from the land; if the government service is adequate; if the government has kept faith with the settlers by fulfilling its obligations for water supply; and if delinquencies have been unavoidable.

Grant Smith Dies

Was Head of One of Country's Largest Construction Companies—Activities of Organization Nation-Wide

Grant Smith, founder of the contracting firm of Grant Smith & Co. an organization which grew from a single small St. Paul firm to a group of associated companies operating all through the United States and Canada, died in St. Paul last week suddenly of heart trouble. He had just returned from a visit to his New York office the day before he died. He was 59 years of age at the time of his death.

Mr. Smith was born in Portage, Wis., in 1864. At an early age he entered contracting work and while still in his early twenties formed an association with E. V. and W. E. Hauser, both of St. Paul, the firm name becoming and remaining Grant Smith & Co. One of the first jobs taken by the firm was a subcontract on the construction of the Chicago Drainage Canal. The firm later took on numerous larger contracts, among the projects being revision of the shore line of the Great Northern Ry. into Seattle, and considerable municipal work for Seattle and Milwaukee. Activity of the organization in the Northwest became conspicuous between 1906 and 1910 when Grant Smith & Co. had a 70-mile contract on the construction of the Spokane, Portland and Seattle Ry., a Hill enterprise, and several contracts for the Canadian Northern and the Canadian Pacific Rys.

New York Firm Established

In 1911 Grant Smith & Co. & Locher was established in New York. This firm held contracts on the construction of the Catskill Aqueduct, the New York Barge Canal and two large rock contracts for the government in the Soo and Detroit Rivers. This company built that part of the aqueduct from 14th St. to 106th St., Manhattan. The name of this branch of the firm was changed in 1914 to Smith, Hauser & MacIsaac, a firm which has been active in river and harbor work in and near New York City since its inception. Smith, Hauser & MacIsaac also built during the war Camp Meade, the Curtis Bay Ordnance Depot at Baltimore, and the Ben Franklin Signal School.

During the war Grant Smith & Co. built the first wooden ships for the government in yards on the Pacific Coast at St. Johns, Ore., and at Grays Harbor, Wash. The original contract called for the construction of 50 of these vessels, most of which were built before the armistice cancelled contracts on half a dozen or so.

About twelve years ago Mr. Smith formed a Canadian branch known as Grant Smith & Co. & McDonnell. Headquarters were in Vancouver, and the activities of the company extended all through Canada, the company at the present time having charge of the construction of the extension into James Bay of the Timiskaming & Northern Ontario Ry.

Heavy Rains Destroy Trestle, Wrecking Burlington Train

The washout of a 110-ft. timber trestle spanning Cole Creek adjacent to its confluence with the Platte River near Casper, Wyoming, was responsible for the wreck of a Burlington train Sept. 28 in which about two score lives were lost. Heavy rains falling continuously during the 24 hours prior to the wreck had swollen the creek, which usually has a dry bed, into a raging torrent. A freight train had passed over the trestle but two hours before the wreck, and the roadmaster, on the train, had reported that there was no evidence of weakness in the trestle. A trackwalker had reported the structure safe an hour after the freight passed.

The locomotive and four cars were thrown into the water and the cars were either washed downstream or buried in the debris and sand. More than a score of passengers were rescued from the roof of a partly-submerged sleeping car by means of a rope suspended in midair from the car to the shore. About 80 passengers were said to have been on the train.

Civil Engineers to Have Earthquake Committee

The president of the American Society of Civil Engineers has been authorized by the Board of Direction to appoint a committee to collect information on the effect of earthquakes on structures. This is a result of the Japanese disaster. The appointment of the committee is the result of a letter by Col. John Millis, Corps of Engineers, U. S. A., to President Loweth calling attention to the great amount of information which would doubtless result from the Japanese earthquake and the necessity for collecting and collating that information for the benefit of future designers. A meeting of several of the members of the society was called with the representatives of the other national engineering societies, as a result of which a resolution was adopted recommending that the American Society of Civil Engineers undertake this study with such co-operation of the other national societies and the national societies of other nations as could be given.

President Loweth has not yet selected the personnel of the committee for this special study.

Birdseye Party Escapes Colorado Flood

Fear for the safety of the U. S. Geological Survey party headed by Col. C. H. Birdseye now making a trip down the Colorado River was set at rest by direct news received Oct. 2, from Peach Springs, Arizona. The party emerged from the flood-swept Grand Canyon, escaping by climbing through a crevice to high ground. From a safe eminence they saw the flood wall of water sweep the canyon. Noticeable rise in the Colorado's flow warned the party of impending danger in plenty of time to escape to high ground. There are ten members in the party.

Random Lines

Rubbing It In

A week or so ago a New York contractor went all the way out to Denver to close a contract he thought he was going to get for the construction of the Moffat tunnel. They treated him pretty rough in the high country. Not only did they award the contract to another fellow nearer home but on the way to his hotel a footpad held him up and took $200, a diamond ring and his watch away from him.

* * *

Building a La Mode

Sir—Some years ago I saw in your magazine—I have occasion to use a building a very wonderful train of automatic machinery assemble the similar train to assemble the parts of a building, and it occurs to me you might be able to put me on the right track, as to whom I should apply.

I have just been to the Aeolian Co. and they agree to make me a controller, similar to that on the player pianos. I intend to take an architect's plan, enlarge it to full size, by photostat, mark on it every pipe, heating and ventilation duct, electric conduit, etc., accurately, cut it in strips, suitable to pass through their controller, punch holes in it, similar to those now in use on the music rolls. Corresponding to these holes will be a series of pipes or rubber hose, these pipes will connect with the various machines, which do the particular thing required by the hole in the plan.

By pumping air, or by suction of vacuum, we can move or stop the rheostats, which shoot the juice, into the motors of our various machines.

What I want is to meet manufacturers of automatic machines, suitable for my purpose. I can see no reason why I cannot equip a factory, and turn out sections, which will clamp together, just as the sections of a bookcase do; except that my sections will only be of such size, as would fit in a box car, as I would have to ship them, to their destination complete.

Do you think it would be possible to arrange with your company to have an article published, describing this process? I desire to get the general opinion of the engineering profession, to pass on this, which I believe is a method whereby 75 per cent of the cost, and 90 per cent of the time, now consumed in building, can be saved. I have interviewed numberless architects, builders, and manufacturers of building material, and I have yet failed to meet a single man who did not commend my purpose: that there is disagreement as to the best method of attaining it, is of course to be expected. I would therefore like to put the problem squarely before the American public, and see whether or no they care sufficiently for their so-called liberties, to back up a 100 per cent American revolution, against the menace of oligarchy.

J. A. H.

This highly practical scheme, submitted in all seriousness, is herewith placed before the engineering profession for opinion.

Railroads to Co-operate With Port Authority

Belt Line on the New Jersey Side of New York Harbor to Be Set Up by Trunk Railroads

The immediate outcome of the concurrent hearings before the Port of New York Authority and the Interstate Commerce Commission held during the week of Sept. 17 is that the carriers' operating committee and the engineering staff of the Port Authority are now working together to determine what improvements in operation of the marginal railroads in New Jersey can be effected at once through physical and operating changes along the lines proposed by either or both parties. As soon as this first step in the improvement of port facilities is well under way, similar co-operative studies will be made to determine the exact location of the middle belt line west of Bergen Hills in New Jersey, which line the carriers now agree should be completed as promptly as possible.

Marginal Railroad

The marginal railroad in question, known as Belt Line No. 13 of the Port Authority's comprehensive plan, is made up of sections of track of the various railroads along the west side of the Hudson River at New York and extends from Fort Lee on the north, to Constable Hook near Staten Island on the south. The sections of track which make it up are now operated by the various railroads more or less independently, but during the war they were operated as a belt line and the Port Authority, as the first step in putting its so-called Comprehensive Plan for the development of the Port of New York into effect, called upon the railroads to set up this belt line again and arrange for its unified operation. Opposition to this plan, on the part of the railroads, resulted in two hearings before the Port Authority and the Interstate Commerce Commission sitting concurrently, at which times the railroads were called upon to show cause why this belt line should not now be put into effect. The interval between the two hearings was provided in order that the railroads might have time to prepare their arguments after hearing the case as presented by the Port Authority. But instead of coming forward at the September hearing with arguments against the proposed belt line, the railroads came forward with a resolution signed by fourteen officials of the principal railways affected, in which they stated that they were of the opinion that no consolidation of existing tracks into a belt line nor their unified operation was necessary at this time, and that the existing facilities were ample to handle the current traffic and any normal increase, but that facilities at interchange points should be provided in order to insure economical and expeditious handling of traffic. These facilities included increasing the capacity of the West Shore R.R. yard at Kings Bluff, certain interchange tracks and crossovers, interlocking devices and automatic signals, an estimated cost of about $500,000. In addition to this, the presidents of the three railroads principally affected agreed to appoint a supervisory operating agent to direct the movement to, from, and over their joint lines. The railroad companies also presented a second resolution to the effect that all interested railroads join in having a study made for the construction of a belt line on the west side of Bergen Hills and east of the Hackensack River for the interchange of freight.

The proposal of the railroad companies in so far as physical changes are concerned agrees substantially with the Port Authority's plan, under which it estimates that the operation of belt line No. 13 as a belt line will result in an annual saving of about $1,100,000. The operating arrangement proposed is not complete unification as proposed by the Port Authority, but is expected to give practically the same results without the legal complications necessary to effect unification and it can be modified at any time that the Interstate Commerce Commission feels that shippers are not getting the full service they would get under unified operation.

The portion of the middle belt line No. 1 which the railroads propose to set up is practically all in existence, with the exception of four miles of extensive trackwork at the north end. Its primary function is to divert through business and interchange business away from the congested yard around the water front. The railroad companies consider it much more essential than belt line No. 13 and have been considering ways and means of building it for a number of years. The recent hearing made it possible for them to bring forward the proposition in order to discuss the details and method of construction with the Port Authority. In regard to financing the necessary improvements, the counsel for the Port Authority said that the Port Authority stands ready to use the power vested in it as a Port Authority to acquire any additional land, equipment, facilities, or anything else that may be needed for the operation of this or any other part of the Comprehensive Plan, and are prepared to borrow the money necessary to effectuate the same upon the rates of interest the tax exempt securities will bear in the market; that it stands ready at any time that such action becomes desirable to become the operating agency of either belt line No. 13 or any other part of the Comprehensive Plan.

Greene Starts Investigation of N. Y. Barge Canal Bureau

Investigation of the New York State Department of Public Works under the superintendence of Edward S. Walsh, present commissioner of canals and waterways under the reorganized Department of Public Works, was begun Oct. 2 by Supreme Court Justice Joseph A. Kellogg acting as a special commissioner. The hearing into the administration of the canal bureau was directed by Governor Smith at the instance of Col. Frederick Stuart Greene, present superintendent of the State Department of Public Works, following charges made by Col. Greene that $70,000 paid for supplies bought from the General Mill & Contractors' Supply Co., of Albany, was $25,000 in excess of alleged market quotations. During the first day's inquiry Col. Greene submitted numerous receipted vouchers for supplies, each one of which he maintained was far in excess of a reasonable market quotation.

Ramapo Water Project of City of Bayonne Upset

The New Jersey Court of Errors and Appeals has ruled that the City of Bayonne cannot take water from the Ramapo River for its supply because it failed to get the consent of the North Jersey District Water Supply Commission before applying to the State Board of Conservation and Development for a water right permit. In addition, the court holds the permit from the Conservation Board to be of no force because of certain technical defects in the proceedings. The Bayonne application was filed in 1921, and the permit was granted on March 23, 1922 (see *Engineering News-Record*, March 30, 1922, p. 511). The permit allowed Bayonne to divert 50 m.g.d. from the Ramapo River and continued various requirements as to supplying water to other communities and developing a larger supply, if demanded.

Some of the opponents of the Bayonne project held that notwithstanding the provisions to safeguard other communities inserted in the permit by the Conservation Board the grant violated that water policy of the State as embodied in legislation creating the North Jersey Water Supply District and providing that no municipality in the district should be allowed to acquire rights in any new source of water supply without the approval of the District Commission.

Bayonne maintained (1) that certain home rule legislation enacted after the district was created freed it from the jurisdiction of the District Board and (2) that since it now gets water from the Passaic River (by contract) and since the Ramapo is a "branch" of the Passaic therefore the Ramapo would not be a new source of supply. The State Supreme Court upheld contention (1) but the Court of Errors and Appeals reversed that decision and disallowed (2) as well. As to the second point, the highest court held that a "branch" is a part of a parent stream while a tributary has a drainage area of its own until it discharges into some other stream or body of water, after which the waters of the tributary become a part of the stream so joined. Consequently, the Ramapo River would be a new source of supply for Bayonne.

The suit in question was brought by the Borough of Oakland and other municipalities in the Ramapo drainage area. Since the city authorities of Bayonne voted to take steps to get a water supply from the Ramapo, there has been a city election which resulted in a majority of the City Commission or Council adverse to the Ramapo project.

To Raise Endowment for Stevens Institute

The Stevens Institute of Technology million dollar endowment campaign was given impetus at a meeting held Sept. 27 at the Engineers' Club under the direction of John W. Lieb, vice-president of the New York Edison Co., who is in charge of the campaign in Manhattan, New York City. Plans for raising the New York quota for the fund were perfected following an address by Alfred R. Whitney, Jr., of the Whitney Co., who is a member of the national executive committee for the fund.

A. P. Davis Made Chief Engineer of East Bay District

Arthur P. Davis, late director U. S. Reclamation Service, has been appointed chief engineer, and Gen. George W. Goethals, of New York City, and William Mulholland, of Los Angeles, consulting engineers, of the East Bay Municipal Utility District, comprising municipalities across the bay from San San Francisco. The first objective of the district is to purchase the existing privately owned water-works serving that territory, and the next is to construct additional supply works. As sources of supply there have been suggested for choice the Sacramento, McCloud, Yuba, American, and Eel Rivers; also partnership with San Francisco in the Hetch Hetchy supply.

At a meeting of the directors of the district on Sept. 20, it was voted to have Mr. Davis report on whether a lack of water or its improper distribution contributed to the great fire in Berkeley on Sept. 17.

Bids Rejected for Perth Amboy Raritan River Bridge

The New Jersey State Highway Commission has rejected all the bids for the new bridge over the Raritan River at Perth Amboy as being too high. The lowest bid was about $600,000 in excess of the highway department's estimate; it was the bid of the Frederick Snare Corp. of New York for a total of $3,934,000. The same corporation submitted a bid of $3,890,000 for the bridge without trolley tracks or power conveyors and of $3,872,000, omitting asphalt block pavement. Other bids submitted on a similar basis were The Stillman, Delahanty Ferris Co. of Jersey City, $4,444,696 and $4,329,696; and Patrick McGovern, Inc., New York, $4,933,011 and $4,793,011. It is expected that the bids will be re-advertised some time in December and it is possible that the designing engineer, Clarence W. Hudson, will suggest some changes to be made in the design in order to bring the cost more nearly to the amount of the original estimate.

Voters Approve Philadelphia Transit Plans

Approval was given on Sept. 18, at the time of the primary elections in Philadelphia, to a transit referendum bill transferring previously appropriated funds from the purposes for which they had been voted, to construction of subway lines in accordance with the plans recently approved by City Council. The referendum was carried by a majority of 151,500 votes. It releases about $48,000,000.

The funds had formerly been "earmarked" for certain lines, but they were not sufficient in any case to complete the lines contemplated. The transfer approved last week makes the money available for Step No. 1 in the comprehensive transit plans recently developed by a Councilmanic Transit Commission, as described in *Engineering News-Record*, Aug. 2, 1923, p. 196.

As the funds thus made available will not be sufficient to complete the work of Step. No. 1, additional funds are expected to be included in a new loan bill to be voted on in November.

Calendar

Annual Meetings

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga., Nov. 12-16.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Meeting, Washington, D. C., Nov. 13-15.

AMERICAN ROADBUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 14-18.

American Water Works Association, New York Section, will hold its first meeting for 1923-4 at Watertown, N. Y., Saturday, Oct. 6.

The Engineers' Society of St. Paul will celebrate on Oct. 8 the fortieth anniversary of its founding. Charles F. Loweth, president of the American Society of Civil Engineers and a charter member of the St. Paul society, will give the principal address. The first meeting of the fall season, Sept. 10, was addressed by Col. Frederick Mears, chief engineer of the St. Paul Union Depot Co., on "Alaska Railways," of which he was formerly chief engineer. On the same day the society resumed its noonday luncheons, being addressed by B. M. Cowan and W. F. Brown, chief engineer and assistant chief, respectively, of the new Ford plant at St. Paul.

Personal Notes

JAMES H. FUERTES has been retained by the Board of Water Commissioners of Denver, Colo., to act in an advisory capacity and to assist the engineers of the board in preparing plans and specifications for the city water improvement under the $6,500,000 water bond issue authorized in the last city election.

C. A. BAUGHMAN, who spent the summer with the Iowa State Highway Commission investigating the comparative value of concrete pavements of various kinds in order to aid in preparing specifications for hard-surface roads, has now returned to his work as professor of highway engineering in Alabama Polytechnic Institute, Auburn, Ala.

SAMUEL REA, president of the Pennsylvania R. R., celebrated on Sept. 21 the 52nd anniversary of his connection with the railroad, his services having started in the position of chainman. He has been president of the lines since 1912.

CLYDE A. WALB, whose term as vice-chairman of the Indiana board for the registration of professional engineers and land surveyors will end about the first of next year, has resigned.

HON. FRANK OLIVER, of Edmonton, Alta., formerly Canadian Minister of the Interior, has been appointed a member of the Dominion Board of Railway Commissioners, succeeding the late Dr. James G. Rutherford.

GEORGE GUY, former engineer of the public utilities commission of Winnipeg, has been made managing director of the Tudhope-Anderson Co. of Onillia, Ont.

H. G. BAYLES, Morgantown, W. Va., has been chosen city manager, succeeding Arthur A. Hall, resigned, who returns to his former employment as professor of electrical engineering at West Virginia University, Morgantown.

THE MCKELVEY CONSTRUCTION CO., St. Louis, Mo., has opened a branch office at 320 St. Charles St., New Orleans, La., with B. H. Alvey in charge. Recently this company opened a branch in Detroit.

C. L. HUGGINS, city engineer of Berkeley, Calif., has tendered his resignation, effective Oct. 1.

R. P. KITE, of the Dorr Co., engineers, has been transferred from the New York office to the Chicago branch, where he will work with J. V. Slade.

L. E. ANDREWS has been appointed division construction engineer with the New Jersey State Highway Commission, in charge of the Northern Division, with headquarters in Newark. Mr. Andrews was formerly survey engineer in the Southern Division, and previous to that was assistant district engineer with the Pennsylvania State Highway Department; engineer officer on road construction in France and resident engineer with the Illinois State Highway Department.

C. A. BURN, of Caldwell, N. J., will have direct supervision of highway construction in New Jersey for the Public Service Production Co., of Newark. Mr. Burn was formerly Northern Division construction engineer with the New Jersey State Highway Commission.

V. BERNARD SIEMS, who has been assistant water engineer at Baltimore, Md., has been appointed water engineer. Re-appointments, also, are: STEUART PURCELL, chief engineer; BERNARD L. CROZIER, highways engineer; and BANCROFT HILL, harbor engineer.

COL. WILLIAM KELLY, the chief engineer of the Federal Power Commission, is making a detailed inspection trip throughout the Rocky Mountain region. He expects to visit a considerable number of projects. During Col. Kelly's absence, Major H. S. Bennion will act as chief engineer for the commission.

ED. O. MCMAHON, formerly assistant engineer with Howard McCurdy, Los Angeles, Calif., is now located at Santa Ana, Calif., in charge of field work for Hoy & McMahon, civil engineers.

L. J. FELLOWS, formerly assistant engineer for the Longbell Lumber Co. on street paving at Longview, Wash., is now engineer in charge of construction of a power plant at Longview, for Charles C. Moore & Co., engineers.

COL. CHARLES KELLER, of the Corps of Engineers, has been retired from active duty in the Army after more than thirty-seven years of service. The action was taken at the request of Col. Keller. It means that Col. Keller has definitely cast his lot with the hydro-electric industry. Col. Keller was made manager of the El Dorado project being developed by the Western States Gas & Electric Co. in the Sierras near Placerville, Calif. He was granted a leave of absence in April, when he resigned as engineer commissioner of the District of Columbia.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Time Saved for Buyer of Supplies by Organized Sales Methods

Assignment and Follow-Up of Prospects Prevents Needless Calls and Disputes About Commissions

By Albert H. Rhett
Summit, N. J.

INTERVIEWS with salesmen of construction equipment and materials are often regarded by contractors, engineers and architects responsible for purchasing or recommending the purchase of machinery and supplies, as a necessary, but onerous and time-consuming part of their duties. The selling of building supplies and contractor's plant presents some of the most difficult problems in the whole field of merchandising, yet seldom does the user of equipment consider this problem of selling from the point of view of the manufacturer. The peculiar feature about selling in the construction industry is that in almost every case *two* individuals with somewhat divergent interests have to be "sold." It is difficult enough to sell one thing to an individual who needs it, but more than twice as hard to sell the same thing to two individuals who do not, very often, want the same thing.

These two people are the engineer or architect and the contractor. Their divergence of interest arises from the fact that the engineer or architect, being responsible for results, desires the best he can get, while the contractor, at least on the usual lump-sum form of contract, desires—and this is said with apologies where due—the cheapest. The question of personal friendship or favoritism also enters doubly. The sales problem, therefore, is to synchronize these interests into orders on as many building and construction operations as possible.

One Manufacturer's Methods

It is proposed to show below the method used in the case of a manufacturer in New York City producing a varied line of specialties sold throughout the country. The method has two phases pertaining to local and national distribution, of which the local phase will be considered first. In the greater metropolitan district there are nearly a thousand architects; from 3,000 to 4,000 projects have to be followed for various materials each year. Competition is keen; prospects most difficult to see; and only the most direct and efficient sales methods will produce satisfactory results. The multi-phase nature of the sales effort to be made affects every detail of the sales management problem —assignment of work to the salesmen, method of follow up, even method of compensation.

All construction projects begin in the office of the engineer or architect and as it is desirable, if not always necessary, to have specifications that will cover the supplies or equipment to be distributed, the sales effort must begin at this point. Each project is bid on by many contractors from various localities and one contractor may have contracts from the offices of several engineers or architects. In this fact arises the first difficulty, the method of assignment of work to the salesmen.

It would be desirable to have but one salesman of the same manufacturer call at the office of each engineer and each contractor and an attempt to do this has been made by having specially trained salaried men do the preliminary work in the engineer's office and commission salesmen do the actual selling in the contractor's office. The inevitable result, however, is loss of continuity, duplication of effort and credit disputes. A territorial method of assignment is also, obviously, out of the question, because the engineer or architect may be located in one district, the contractor in another, the job in another, the owner in another—and all may have to be followed up.

Plan of Assignment

In the instance under consideration the plan of assignment used was based on the theory that the sales effort must begin with the engineer or architect at the specification stage and the man beginning it is the man to follow it through to its consummation. Consequently, the offices of all engineers and architects in the district were arbitrarily divided among the various salesmen. Each man was allowed to call only on the offices assigned to him, and was held responsible for results or lack of results obtained on all projects emanating from these offices.

This plan produced the desirable result of having but one man call on each engineer or architect but was open to the objection that various salesmen did call on the same contractor on various projects. It was thought that this objection was more than offset by the fact that but one salesman had to familiarize himself with each project and he alone handled all the negotiations with the various parties concerned on each operation.

It might be anticipated that with several men calling at a contractor's office, poaching and commission or credit disputes would inevitably result, but this was obviated by a simple card record system which also provided an almost automatic follow-up index.

Card Record System

Advance information of all proposed operations was received from one of the agencies providing this service.

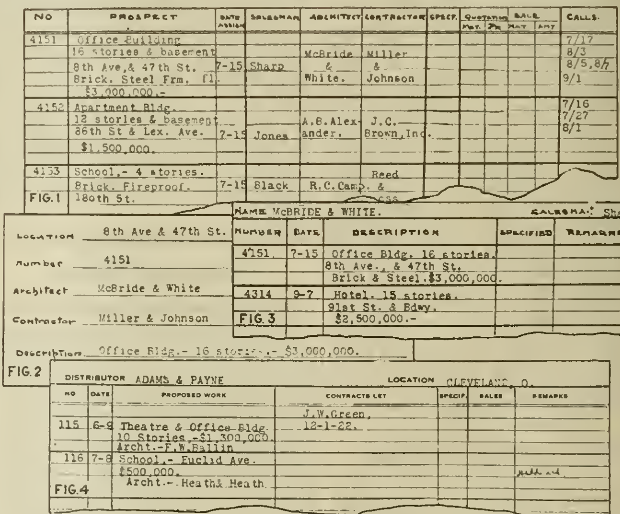


FIG. 1, PROSPECT RECORD; FIG. 2, JOB LOCATION CARD; FIG. 3, ARCHITECT'S OFFICE CARD; FIG. 4, LOCAL DEALER'S CARD

Each project was serially numbered, entered on the card (Fig. 1) and referred to the salesman to whom the office of the architect or engineer concerned had been previously assigned and on whom he was expected to call promptly in regard to this specific job. All salesmen made daily reports, referring to each job by serial number. The dates of calls were entered in the right hand column; quotations or sales also were recorded. All orders, however received, were traced to the operation on which they were used and if the record showed that the salesman to whom the operation had originally been referred had properly followed it, his credit was immediately established. On the other hand, if the record showed neglect, he received no credit.

The follow-up was effected by surveying the call column periodically and notifying the salesman involved if any

job failed to show a call date within a reasonable period. It will be observed that each job, when entered on the Prospect Record (Fig. 1), was simply given a serial number and it was necessary to index these numbers with two supplemental index cards, (1) a location card for each job (Fig. 2) filed according to location and giving the serial number, and (2) a card for each architect's office (Fig. 3) filed according to name of architect and giving description and serial numbers of current work in that office.

Reasons for Indexing

There are several reasons for this indexing. If a salesman picked up a job on the outside he was required to register it and get a serial number for it. With the location or architect's name known it could be seen at once from the respective cards whether or not it had been previously assigned or worked, and conflicts and duplication of effort thus are avoided. Conflicts and duplication were also likely to arise from the assignment to the wrong man of the "follow up" on telephone requests for quotations or information on any operation. If the inquirer could give the location of the job or architect's name the serial number could be ascertained from either index card and this reference number on the main card gave the full history of the job and the man working it. It was also desirable to have a complete record of all work in each architect's office. The keeping of this simple three-card system insured the following of every possible prospect, increased the volume of sales and absolutely eliminated credit disputes among the salesmen.

Another factor that had an important bearing on the situation was the method of remuneration of the salesmen. It was found that the salaried men worked the architect's offices very nicely but were not always "there" when it came to the final struggle of closing in the contractor's office. On the other hand, the commission men were always looking for the quick break in the contractor's office and would not do the time-consuming, but essential, work in the offices of the engineers or architects. The salary plus commission method of payment was found to give the most satisfactory results.

National Distribution

When the question of national distribution is considered matters become still more complicated. Of course if district offices are used the same system could be applied in each office, but only the larger cities can support a district office and there is considerable expense to be carried in the way of office, storage and trucking facilities. There is, however, in almost every town of any size a building supply dealer with these facilities and as the market for the commodities manufactured in this instance was general, this method of distribution was used.

The objection, however, is the same as that encountered in the use of commission men on the local work. The building supply dealer sells the contractor and is usually neither inclined nor equipped to do much work with the architect or engineer. This necessary part of the work had to be otherwise accomplished by dividing the dealers into groups or districts and having a salaried man from the home office cover all the architects and engineers in each district periodically, working with the dealer and selling through him.

This work was given point and intensity through the use of a card record (Fig. 4) somewhat similar to that used locally. This form of card was kept for each dealer. Advance information of the most important projects in each district was obtained from an available source and entered on this card and on two additional copies. One copy went to the dealer with the request that he fill in the information and return. Sometimes he did this and sometimes he did not, but it acted as a prod or reminder. The second copy went to the salesman who covered that district, so that he went to each locality with advance information, at least on the major projects, and did not have to rely on the dealer for information. He reported by number the result of his work on each job and this was entered on the original card. This record was of further use in showing to which dealer should be referred requests for information received through the mail and also in straightening out disputes between dealers which most often arose through the complication of the architect being in one location and the contractor or job in another.

August Paving Brick Shipments

Paving brick shipments for the month of August were higher than for any previous month in 1923, according to statistics just issued by the National Paving Brick Manufacturers Association. Reports from 67 per cent of the industry's tonnage showed that shipments were more than 9,000,000 greater for August than for July, 36,446,000 brick being shipped in August and 27,092,000 in July.

Production for August was 33,457,000 brick as against 30,529,000 for July. Stock on hand the last day of August was 74,399,000 as against 78,835,000 the last day of July. This reduction of 4,000,000 in stock on hand was due to the heavy August shipments.

There was a falling off in unfilled orders amounting to 12,000,000 brick, a natural trend toward the end of the summer paving season.

Ohio led all other states in consumption, 5,781,000 brick going for city streets and 5,784,000 for country highways. Illinois was second with Pennsylvania, Nebraska and Texas following closely.

Form Cinder Concrete Association

The National Cinder Concrete Products Association was formed in Philadelphia recently by manufacturers of the Straub patented cinder concrete building block. The purpose of the Association is to increase the use of cinder concrete products and to engage in research work for the improvement of methods of manufacture.

Francis J. Straub, of New Kensington, Pa., was elected president. The other officers are: first vice-president, Raymond M. Weeks, Philadelphia; second vice-president, Henry Boettcher, Lancaster, Pa.; secretary, J. Edwin Rutter, (Cameron and Reily Sts.), Harrisburg, Pa.; treasurer G. Edgar Allen, New York.

Only corporations and individuals holding licenses from Crozier-Straub, Inc., New York, are eligible for membership.

Business Notes

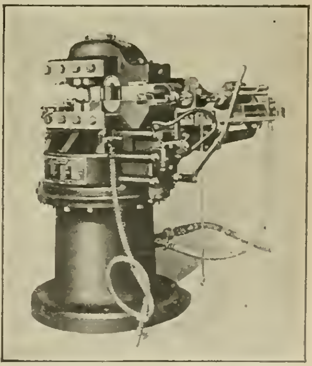
L. W. Kemp, superintendent of the Southwest division asphalt sales department Texas Co. at Houston, Texas, has been appointed manager of the Texas Rock Asphalt Co., San Antonio. Mr. Kemp is a graduate of the University of Texas. He is succeeded by Col. A. D. Stivers, formerly the Texas Co.'s representative in Dallas.

Henry Seibel, president of the Seibel Air Spring Co., San Francisco, manufacturer of shock-absorbing seats for industrial and farming equipment and motor trucks, was the guest of honor at a dinner tendered him by friends on the occasion of his seventieth birthday, Aug. 29, at the Hotel Whitcomb, San Francisco. Col. Charles A. Simmons, manager of the local Chamber of Commerce was toastmaster.

Equipment and Materials

New Shank and Bit Punch

For punching holes when shanking and bitting hollow drill steel ranging in diameter from ¾ to 1¼ in., the Ingersoll-Rand Co., New York, has developed a new type of machine known as the "IRLP" shank and bit punch. It is made in two models, one constituting a part of the company's sharpener and the other a separate unit. The attached-to-sharpener pattern can be attached to the No. 4, 5 and 50 sharpener. The pedestal pattern is a self-contained machine with pneumatic clamp, mounted on its own substantial cast-iron pedestal base.



DRILL SHARPENER WITH SHANK AND BIT PUNCH ATTACHMENT AT RIGHT

The entire punch is under single-lever control. By holding this hand lever forward compressed air is admitted to a hammer cylinder and by a series of rapid blows the hammer cylinder with punching pin attached is moved forward, thus punching a hole in the drill steel shank or bit which is held in position by a clamping device. To remove the pin from the drill steel it is only necessary to release the hand lever. Springs attached to this lever return it to its normal position, whereby air is admitted to the opposite end of the

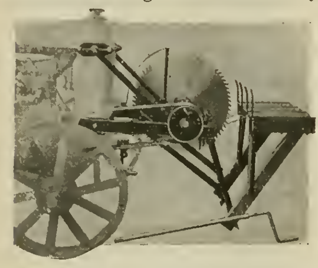
hammer cylinder and the pin is withdrawn by a series of hammer blows. The centering device assures holes which are centrally located and, according to the manufacturer, eliminates the chief cause for breaking water tubes.

The clamping of the steel for the attached-to-sharpener pattern is done by the sharpener crosshead; with the IR-50 sharpener the clamping pressure is 14½ tons at the 100 lb. air pressure. In the pedestal type the clamping jaws are operated through a toggle arrangement and the clamping pressure is much greater than will ever be required.

The attached-to-sharpener pattern weighs 227 lb. No extra floor space is needed for this type. The pedestal type weighs 610 lb. and requires a floor space of 2½ x 4½ ft.

Saw Frame Attachment for Tractor

For attachment to a Fordson tractor, the Stover Manufacturing & Engine Co., Freeport, Ill., has placed on the market a saw frame. Except for the sawing table, the frame is of all-steel construction. Angle steel braces carry-



ing the table extend low enough to rest on the ground, making a stiff support. The distance from the center of the saw mandrel to the ground is 30 in. The drive is by belt from the tractor engine and the frame has an adjusting bolt each side to take up slack in belt.

The frame is carried on four castings attached to the upper and lower ends of the radiator by four bolts that run in front of and in back of the radiator, as shown in the accompanying illustration. The frame, therefore, may be attached without disturbing any bolts or nuts on the tractor and also without drilling any special holes. The circular saw has a diameter of 30 in. The shipping weight of the frame, knocked down, is 250 lb.

Publications from the Construction Industry

Centrifugal Pumps—Erie Pump & Engine Co., Medina, N. Y., describes in a 23-p. illustrated bulletin its double-suction, horizontally split shell centrifugal pumps for water-works and industrial service, including the handling of ammonia water, brine and hot water. The pumps are built in a variety of sizes with discharge diameters from 2 to 20 in. and capacities of 150 to 14,000 gal. per minute. For handling brine an all-iron type of design is employed, while for service with chemicals pump casings are furnished in acid-resisting bronze.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 187 to 200, are the following:

Loft, New York, N. Y., Rathmuk Realty Co., $2,500,000.

Apartment, New York, N. Y., A. Campagna, $5,000,000.

Recent Unit-Bids Throughout the Country

Unit prices of various materials and operations, applying on several of the more important contracts recently awarded, are compared in the accompanying table. Materials and operations, though very similar in nature, show diversity of unit costs according to geographical location. For instance, 3 mi. of concrete paving cost $28,333 per mi. in Tulsa, Okla., as against 1 mi. of concrete highway in the state of Washington at $42,583. Excavation of 2,780,000 cu.yd. of navigation channel at Lake Charles, La., cost 13.8c. per cu.yd., compared with 8,700 cu.yd. of channel excavation at Anamosa, Ia., at 48c. per cu-yd. Seventeen miles of gravel surfacing at Lake Village, Ark., cost $6,470.59 per mi., against 9 mi. of Louisiana state highway at $5,269.45 per mi. and 11.6 mi. in the state of Washington, at $4,994.22 per mi.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 187 to 200, are the following:

Power Plant, Florence, Ala., to Alabama Power Co., Birmingham, Ala. $3,472,487.

Bank and Office, Pasadena, Calif., to Scofield Eng. Co., Los Angeles, $1,000,000.

High School, New York City, to Willetts Constr. Co., $2,057,000.

Bank, Seattle, Wash., to Puget Sound Bridge & Dredging Co., $1,250,000.

Temple, Springfield, Mass., to A. E. Stephens Co., $1,000,000.

Next week—"Brick and Cement Imports Not Large but Increasing."

A tabulation of fifty large contracts awarded this year is being prepared for early publication in this section.

Freight Loadings at New High Mark

More cars were loaded with revenue freight during the week which ended on Sept. 1 than during any week heretofore in history. The total for the week, 1,092,567 cars. This exceeded by 22,635 cars the previous record, which was established during the week ended Aug. 25 this year, when 1,069,932 cars were loaded.

UNIT PRICES OF MATERIALS AND OPERATIONS ON RECENT CONTRACTS LET

Cables for Delaware River Bridge, Philadelphia	
Pounds	Per Lb.
13,500,000 wire cables	$0.18
50,000 suspender ropes	1.60
180,000 steel castings	0.15
30,000 structural steel shims	0.20
30,000 c.i. separators	0.10
Excavation	
Cu.Yd.	Per Cu.Yd
2,780,000 navigation channel, Lake Charles, La.	$0.138
270,000 navigation channel, Lake Charles, La.	1.695
106,660 earth, Anamosa, Ia.	0.22
8,700 channel change, Anamosa, Ia.	0 48
Grading	Per Mile
8,474 mi. road, 18 ft. wide, Garnett, Kan.	$1,879.73
Surfacing	
17 mi. gravel, Lake Village, Ark.	$6,470 59 per mi
9 mi. gravel, Louisiana	5,269.45 per mi.
11.6 mi. crushed stone or gravel, Washington	4,994.22 per mi.
63,000 cu.yd. gravel, Napoleon, N. D.	0.4683 per cu.yd.
Tile in Anamosa, Ia.	Per Ft
30,690 ft. 6 in.	$0.122
540 ft. 8 in.	0.178
1,325 ft. 12 in.	0.34
Paving in Eight Centers	
25,000 sq.yd. removing old macadam and replacing with new bituminous macadam, Providence, R. I.	$1.38 per sq.yd.
12,800 sq.yd. bituminous, Houston, Tex.	3.575 per sq.yd.
11,050 lin.ft. rein.-con., Waynesburg, Pa.	10.93 per ft.
5 mi. bitulithic, 20 ft. wide, Alabama City, Ala.	7,671.20 per mi.
1 mi. monolithic brick, Canton, O.	60,943.00 per mi.
1 mi. Trinidad asphalt, 30 ft., Canton, O.	49,000.00 per mi.
3 mi. concrete, Tulsa, Okla.	28,333.33 per mi.
0.83 mi. vibrolithic, South Dakota	32,077.11 per mi.
1 mi. concrete, Washington	42,583.00 per mi.
Dredging Willapa Harbor, Wash.	
8,035 cu.yd. ledge rock	$9.30 per cu.yd.
2,400 cu.yd. other material	1.50 per cu.yd.
Waterworks, Detroit, Mich	
Pipe:	
100 tons, class C, 42-in., c.i.	$55.00 per ton
1,504 tons, class C, 8-in., c.i.	56 70 per ton
105,600 ft 8-in. centrifugal	0.878 per ft.

Value of September Contracts 24 Per Cent Heavier Than For Same Month Last Year

Total of 708 Awards During September, Average Value $244,452, Compared With 820 in August, Averaging $172,681

The total value of contracts awarded on large engineering construction projects, in the four September issues of *Engineering News-Record*, reached $173,072,000 as compared with $141,599,000 in the five issues of August. This represents an average weekly value of $43,268,000 for September, against $28,319,800 during the preceding month.

The weekly average of $43,268,000 for the month of September represents an increase in money value of nearly 26 per cent above the weekly average for the corresponding period in 1922. September, 1922, contracts totaled $138,648,000.

Minimum costs observed in Construction News on each class of construction are as follows: Water-works, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings, $150,000.

Of the $173,072,000, a total of $6,132,000 represented Canadian awards, which fell off heavily from August.

Streets and roads gained 6 per cent in total money value during the month, while buildings increased 33 per cent and excavations, 50 per cent. September totals for bridge construction and miscellaneous work, tripled those for the month preceding. Water-works, sewers, industrial construction and Federal Government work fell off somewhat during September.

Among the large projects awarded during September were the following: The Moffat tunnel project in Colorado, $6,075,000; sewage treatment works, Chicago, Ill., $5,602,636; a nineteen story office building in Dallas, Tex., $5,000,000; bridge over the Carquinez Straits, $4,500,000; a 260 ft. dam at Danville, Ky., $4,000,000; and a hospital at Cleveland, O., $3,300,000.

The actual physical volume of construction represented by September contracts is 6 per cent greater than September, 1922; 50 per cent heavier than for the corresponding period in 1921 and twice the volume of September, 1920, lettings.

Engineering News-Record Construction Cost Index Number

October, 1923	220.30
September, 1923	221.50
October, 1922	188.60
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number declined 1.2 points since last month, owing to drop in lumber. Prices of other basic building materials remained unchanged during the month. The average rate for common labor is still 54c. Thus, general construction cost is 17 per cent higher than one year ago and 20 per cent under the peak; it is 120 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly		
September, 1923	(*4 issues of E. N.-R.*)	137
August, 1923	(*5 issues of E. N.-R.*)	111
September, 1922	(*4 issues of E. N. R.*)	129
1913		100
Yearly		
1922 (entire year)		130
1921 (entire year)		88
1920 (entire year)		91
1913		100

Engineering News-Record's Construction Volume Index Number is 137 for the month of September, and 130 for the whole of 1922, as against 100 for 1913. This means that the actual volume of construction in 1922 (not the mere money-value of the contracts let that year) is 30 per cent above the volume of construction for 1913. Our monthly volume number, 137 for September, 1923, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING SEPTEMBER, 1923

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total United States	Canada	Total
Waterworks	....	$211,000	$40,000	$1,970,000	$327,000	$281,000	$2,829,000	$52,000	$2,881,000
Sewers	$40,000	686,000	765,000	7,000,000	1,351,000	526,000	10,368,000	....	10,368,000
Bridges	1,107,000	767,000	3,324,000	1,504,000	589,000	4,884,000	12,175,000	434,000	12,609,000
Excavations, drainage and irrigation	....	1,198,000	1,183,000	469,000	253,000	10,000	3,113,000	247,000	3,360,000
Streets and roads	1,740,000	9,962,000	6,033,000	6,165,000	8,501,000	4,500,000	36,901,000	911,000	37,812,000
Industrial works	2,045,000	1,360,000	643,000	3,890,000	1,485,000	761,000	10,184,000	1,062,000	11,246,000
Buildings	1,413,000	23,209,000	4,509,000	10,530,000	11,114,000	15,579,000	66,354,000	1,930,000	68,284,000
Federal Government	207,000	587,000	114,000	195,000	408,000	773,000	2,284,000	....	2,284,000
Miscellaneous	33,000	2,913,000	4,146,000	7,393,000	8,027,000	220,000	22,732,000	1,496,000	24,228,000
September, 1923	$6,585,000	$40,893,000	$20,757,000	$39,116,000	$32,055,000	$27,534,000	$166,940,000	$6,132,000	$173,072,000
August, 1923	4,308,000	30,933,000	11,974,000	34,425,000	24,962,000	21,555,000	128,157,000	13,442,000	141,599,000
July, 1923	8,897,000	34,633,000	24,065,000	42,044,000	25,666,000	19,718,000	155,023,000	8,436,000	163,459,000
Total 3 months	$19,790,000	$106,459,000	$56,796,000	$115,585,000	$82,683,000	$68,807,000	$450,120,000	$28,010,000	$478,130,000

Labor Rates and Conditions Throughout the Country

Fewer wage changes and a slight decrease in employment mark the industrial situation at the beginning of the autumn season.

Twenty-three wage changes were noted by the National Industrial Conference Board for the month ending Sept. 15, against seventy-seven during the preceding month. Of the twenty-three, twenty-two were increases and one a decrease.

Latest reports of the U. S. Department of Labor show a decrease in employment of only 0.45 per cent in one month.

Tremendous building programs continue in nearly all of the principal centers throughout the country. State and county highway construction is particularly active with a shortage of labor reported in some sections.

The average rate paid common laborers, pick and shovel men in construction operations, remains at 54c., the same as for July, August and September as against 53c. per hr. during June, according to *Engineering News-Record* figures. Local building conditions are as follows:

Baltimore—Scarcity of structural iron workers. Conditions nearing normal among hod carriers and common laborers; normal in other crafts.

Boston—Bricklayers scarce; other trades plentiful. Minimum carpenters' rate, $1, maximum, $1.10, against $1.05 per hr., last month.

Dallas—Excessive demand for bricklayers and carpenters; other crafts plentiful.

Denver—All building trades 100 per cent employed.

Detroit—Good supply of men for all trades available; no shortages noted.

Los Angeles—Construction active.

CURRENT BUILDING TRADES WAGE RATES PER HOUR

(Higher rates indicated by +, decreases by —)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.90	$0.70	$0.50	.	$0.75	$0.30@.35
Baltimore	1.50	1.00	90@1.12½	.87½	$0.65	80@1.00	30@.50
Birmingham	1.00	1.00	50@1.00	.30@.40	. . .	1.25	.30@.40
Boston	1.25	+1.00@1.10	1.25@1.35	.82½	1.05	1.12½	.55@.70
Cincinnati	1.25	1.05	1.05	.82½	1.05	1.05	.45
Chicago	1.25	1.15	1.00@1.25	.88¾	1.10	1.25	.82½
Cleveland	1.40	1.25	1.25	.87½	1.00	1.10	87½
Dallas	1.50	1.00	1.00	40	87½	1.00	.30@.50
Denver	1.37½@1.50	1.12½	1.12½@1.18¾	.75@.81¼	1.00	1.15⅝	.35@.55
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.37½	1.00	1.00@1.25	— 87½	1.00	1.07½	.35@.60
Los Angeles	1.25	.87½@1.00	.87½@1.00	.62½	.....	1.00	.50
Minneapolis	1.12½	.87½	.87½	.71½	.....	.87½	.50@.55
Montreal	—90@1.00	.65	.50	.35	.50	.65	+30@.35
New Orleans	+1.25	.90	+1.00	.65	.80	1.00	35@.40
New York	1.50	1.25	1.25@1.50	1.00	1.00	1.25	.50@.75
Philadelphia	+1.50	1.12½	+1.02½	.70@1.00	1.00	1.10@1.12½	—45@.50
Pittsburgh	1.40	1.20	1.12½	1.00	1.12½	1.25	+.70
St. Louis	1.50@1.75	1.50	1.25@1.37½	1.25	1.25	1.25@1.50	—.45@100
San Francisco	1.25	1.00	1.00	81¼	1.00	1.12½	50@.55
Seattle	+1.25	1.00	+1.00@1.12½	93¾	+1.00@1.12½	1.12½	+.56¼@.62½

Minneapolis—Labor conditions easy. Slump in building construction.

Montreal—Scarcity of structural iron workers; plenty of other building trades mechanics. Common labor rate down 5c. per hr. since last month.

New Orleans—Labor adequate to all demands.

New York—Wage conferences expected to begin during current month. Bonus agreements with many trades expire at end of the year. Bricklayers beginning to be plentiful; many accepting flat rate of $12 per day with no bonus. Scarcity of plasterers; those working six and a half days per week, with one hour overtime per day, receive $122.50 per week.

Pittsburgh—Bricklayers scarce. Continued demand for common laborers.

St. Louis—Bricklayers now receiving $1.50 will demand $1.75, Nov. 1. Carpenters' rate $1.50 per hr., effective Oct. 1.

San Francisco—While new work is not in sight to any appreciable degree, there is very little unemployment among members of the local building trades councils. The disastrous fire at Berkeley which destroyed over 600 dwellings will undoubtedly tend to keep down unemployment among building trades mechanics.

Seattle—Bricklayers advanced to $1.25 from $1.12½ per hr. Maximum rate for hoisting engineers and pile drivers, $1.12½, against $1 per hr. Minimum for common laborers, 56¼c., compared with 50c. per hr. last month.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Market weak, with prices tending downward. Iron still being piled up, despite high production cost due principally to labor. Quotations under $23 per ton for No. 2 foundry iron have been made at Birmingham.

Railway Supplies—Minimum on light rails, $43 at Pittsburgh mill, against $45 per ton, one month ago. St. Louis quotations at maximum of $43. Oak and cypress ties up 5c. in St. Louis. Standard spikes and track bolts higher in San Francisco and St. Louis. Light rail and track fastenings' markets dull, particularly in Chicago district.

Pipe—No changes in wrought steel, wrought iron or cast-iron pipe during month. Clay drain tile (New York) same price as year ago. Slight decline in sewer pipe in Baltimore. Four-inch sewer pipe advanced in New Orleans due to scarcity of that gauge.

Road and Paving Materials—Few changes in road oil and asphalt prices since last month. Baltimore reports drop of $3 in package asphalt and $1 per ton in bulk. Wood block firmer in Boston and New Orleans, due to increased costs of lumber, creosote oil and labor; slightly lower in Minneapolis and Atlanta.

Sand, Gravel and Crushed Stone—Gravel down 5c. per ton in Atlanta. Both sand and gravel lower in Baltimore. Sand and gravel being stocked for winter demands. Crushed stone, ¾-in., down 10c. in St. Louis and 25c. per cu.yd. in Minneapolis, during month.

Lime—Hydrated finishing, down 50c. in Philadelphia and $2 per ton in Dallas; up 50c. in Atlanta. Hydrated common, advanced 50c. in Atlanta and 60c. in Baltimore; declined 50c. per ton in Philadelphia. Lump finishing, dropped 20c. in Boston and rose 5c. per bbl. in Atlanta. Common lump down 69c. in Philadelphia and 60c. per bbl. in Dallas, due to increased output of Southern lime.

Cement—Stability of cement market unbroken in forty-six centers, reporting regularly to *Engineering News-Record*, excepting slight advances in Philadelphia and at Fordwick, Va., mill.

Structural Steel—New buying of plates and structurals extremely quiet. Numerous small orders, however, received for new plate tonnages. Bulk of plate tonnage for car and tank construction. New structural business firm at $2.50 base, but mostly confined to small tonnages. Plates quoted as low as $2.40 per 100 lb., Pittsburgh, with very small tonnages at $2.50. Bars at $2.40 base; buying more active for fourth quarter requirements.

Brick and Hollow Tile—Common brick down 25c. in Detroit, $1 in Atlanta and $2 per M. in Boston, during month; no advance reported. Slight decline in hollow tile in New York; no advances in twenty-one cities reporting.

Lumber—Increase in yellow pine orders and inquiries for fall trade. Fir timbers advanced $3 in San Francisco and yellow pine, declined $2 per M. ft. in New York, during month. No changes in hemlock and spruce. Pine down 50c. to $1 in Atlanta. Fir declined $1 per M. ft. in Minneapolis. Pine timbers advanced $1 in Philadelphia and $3 in Boston. Fir timbers rose $1 in Seattle and $1.25 to $2 per M. ft. in Minneapolis, due to Japanese demand.

Explosives—Slight decline in 40 per cent gelatin dynamite reported in St. Louis. Both 40 and 60 per cent advanced in Los Angeles.

Scrap—Iron and steel scrap prices weaker, particularly in Chicago district.

Linseed Oil—Raw oil declined 1c. per gal. f.o.b. New York, in month; dropped 2c. in Atlanta and 7c. per gal. in San Francisco.

Price advances since last month are indicated by heavy type; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Oct. 4	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	*$27.05*	$30.55
Northern Basic	*25@26*	32.27
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	*25.50*	34.27
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	*30.00*	36.27
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	*23.00*	27.50
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	*26.25*	36.64
Virginia No. 2 (silicon 2.25 @ 2.75)	*30.17*	37.17
Basic	*26.00*	34.00
Gray Forge	*25.00*	33.00
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	*26.00*	32.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	*29.01*	31.50
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	*26.77*	35.00
Basic	26.77	32.50
Bessemer	*27.77*	33.00

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$15.00	$11.50	16@**16.50**
Stove plate	12.00	12.00	**16@16.50**
No. 1 machinery cast	17.00	16.50	*19.50*@20
Machine shop turnings	8.00	4.00	**12.50@13.50**
Cast borings	9.00	5.50	**14.00**
Railroad malleable cast	15.00	12.50	20@**21**
Re-rolling rails	13.00	13.00	**21.50**@**22**
Re-laying rails	...	30.00	**28.50**@*30.50*
Heavy melting steel	12.00	16.00	.....

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Oct. 4	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$43.00	...	$43.00	$43.00
Standard openhearth rails	43.00	43.00	*$40.00*	43.00	43.00
Light rails, 8 to 10 lb	*43*@45	45.00	2.00*	43.00	43.00
Light rails, 12 to 14 lb	*43*@45	45.00	2.00*	43.00	43.00
Light rails, 25 to 45 lb	*43*@45	45.00	2.00*	43.00	43.00
Rerolled Rails	38@40	...	.....		

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.50	$1.65
Chicago, Hardwood and Red Oak	1.25	1.40
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco......Green Douglas Fir	.84	1.14
San Francisco, Empty Cell Creosoted Douglas Fir	1.70	2.25
St. Louis, White Oak	1.30	**1.60**
St. Louis (creosoted) (zinc treated)	1.70	2.05
St. Louis, Red Oak, plain	1.20	**1.50**
St. Louis, Sap pine-cypress	1.05	**1.35**

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Oct. 4	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, $\frac{9}{16}$-in. and larger	$3.15	$2.75@2.85	$3.00	$4.00	**$5.00**	$3.75
Track bolts	4.00	3.75@4.50	4.00	**5.05**	**6.20**	4.70
Standard section angle bars	2.75	2.40	2.75	4.00	4.00	3.10

PIPE

WROUGHT PIPE—The following mill discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 1½	60	49½	1 to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	48%	50%	49%
2½ to 6 in. lap welded	44%	47%	46%

	Galvanized New York	Galvanized Chicago	Galvanized St. Louis
1 to 3 in. butt welded	34%	37%	36%
2½ to 6 in. lap welded	30%	34%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 15%. Cast iron, standard sizes, 17½% off

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York Oct. 4	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	$53.00	$68.60	$60.30	$64.20	$61.60	$66.00
6 in. and over	49.00	63.60	55.30	60.20	57.60	62.00

Gas pipe and Class "A," $5 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Oct. 4	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$45.00	$50.00	$62.50	.....	$73.00
4	55.00	55.00	50.00	75.00	$76.50	83.00
5	80.00	80.00	.	100.00	97.75	108.00
6	105.00	105.00	85.00	175.00	127.50	133.00
8	170.00	170.00	195.00	187.50	212.50	199.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3		$0.105	....	.	$0.15	$0.12	.....
4	.	.105	$0.11	$0.1175	.15	.15	$0.15
5	.	.1575	.1375	. .	.23	.18	.18
6	$0.24	.1575	.165	.1645	.23	.21	.21
8	.38	.245	.26	.26	.35	.30	.325
10	.57	.3675	.338	.364	.53	.42	.476
12	.72	.4725	.442	.468	.68	.54	.612
15	1.13†	.63	.65	.78†	.90	.90	.884
18	1.65†	.875	.85	1.092†	1.25	1.32	1.153
20	1.98†	1.05	1.125		1.50	....	....
22	2.64†	1.40	1.375	1.456†	2.00	....	1.564
24	2.97†	1.575	1.625	*1.56*†	2.25	2.16	2.04
27	4.81†	2.795	..	2.95†	4.69†	3.00	3.34
30	5.33†	3.096		3.65†	5.94†	3.60	4.06
33	6.93†	4.14		4.45†	6.88†	.....	4.99
36	7.91†	4.715		4.80†	7.50†	.. ..	5.42

	3	5	8	12	24	36
Boston	$0.129	$0.199	$0.315	$0.603	$1.99†	$5.95†
Minneapolis	.....	....	.40	.72	2.55	5.66†
Denver	.135*	.18*	.27	.47	1.70	....
Seattle	.13	.....	.36	.72	2.60†	.....
Los Angeles	.13	.165	.275	.475	1.65	.....
New Orleans	**.145***	.168*	.28	.476	1.182	.....
Cincinnati	.12	.18	.28	.54	1.80	4.10†
Atlanta	.105*	.16*	.27	.455	1.75	...
Montreal, *delivered*	.68‡	.45†	.70	1.35	4.50†	
Detroit	.117	.1755	.273	.5265	2.34†	6.15†
Baltimore	*.117*	*.175*	*.273*	*.5265*	*1.755*	*3.9575*
Kansas City, Mo.	.15*	.21*	.33½	.56		
Philadelphia	.12	.18	.28	.54	1.80	5.22

*4-in., 6-in., 9-in., respectively. †Double Strength ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

	Oct. 4	One Year Ago
New York, 45% asphalt (at terminal)	$0.053	$0.055
New York, 65% asphalt (at terminal)	.052	.055
New York, binder (at terminal)	.06	.0625
New York, flux (at terminal)	.06	.06
New York, liquid asphalt (at terminal)	.048	.065
St. Louis, 50@60% asphalt	.0565	. .
St. Louis, 40@50% asphalt	.0535	
Chicago, 40–50% asphalt	.0525	.0525
Chicago, 60–70% asphalt	.055	.055
Dallas, 45% asphalt	.0495	.10
Dallas, 55% asphalt	.0455	.13
Dallas, binder	.061	.15
San Francisco, binder, per ton	9.50*	13.00*

* F.o.b. Oelum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Texas*)...	$23 00*	$15 00†
Boston (*Mexican*)........	21 50	17 50
Chicago (*Stanolind*)....	22 25	16 00
San Francisco, *f.o.b. refinery*, Oleum, Cal...	17.00	11 00
Dallas (*Texas*)	27 10	21 10
Seattle, "*D*" *grade, California, f o b Richmond.*	24 75	20 50
Denver (*California*).....	24 00	.
Minneapolis *f.o.b. Twin Cities* (*Stanolind*)...	25 45	19 10
St. Louis (*Mexican*)....	29 50	24 50
Baltimore (*Standard Oil*).......	*18.00*	*14.00*
Montreal (*Imperial*).........	28 00	21.00
Atlanta (*Mexican*).........	26 00	23 50
Detroit (*Mexican*).....	22 47	18 40
Cincinnati (*Kentucky Rock*).	17 50	13.50
Maurer, N. J. (*Bermudez*)..	28.00	26.00
Maurer, N. J. (*Mexican*)......	21.50	18 50
Philadelphia (*Mexican*)......	20.00	15.00
Kansas City (*Texas*)	22.30	22 30
Los Angeles "*D*" *grade, California, f.o.b. El Segundo Refinery*	17 00	11 00

*F.o.b. Bayonne, N. J.
†F.o.b. Marcus Hook, Pa.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade 1)........	5-in. granite, 30 blocks per sq.yd.	**$138.00** per M.
Chicago..............	About 4x8x4 dressed.....	3 50 per sq.yd.
	About 4x8x4 common.	3.10 per sq.yd.
San Francisco..............	Basalt block 4x7x8. . .	70 00 per M.
Boston......................	5-in. granite 28 blocks per sq yd	*128 00* per M.
Atlanta......................	Granite....	2 66 per sq.yd.
Detroit......................	5-in. G anite	106 00 per M
Baltimore....................	Granite..............	2.85 per sq.yd.
Montreal.....................	Granite.......	104.75 per M.
New Orleans..................	Granite, 4 x 8 x 4...	3.25 per sq.yd.
Cincinnati...................	Granite.............	138.00 per M.
St. Louis....................	4x8x4 dressed......	3 15 per sq.yd.
	4x8x4 common.........	2 95 per sq.yd.
Kansas City..................	Granite.............	3.55 per sq.yd.
Philadelphia.................	Granite..	3.75 per sq.yd.
Minneapolis..................	Sandstone	2.74 per sq.yd.

FLAGGING—

New York.....................	Bronx, 4 ft wide.........	$0.22 per sq.ft.
	Manhattan, 4 ft. wide	.22 per sq.ft.
	Queens, 5 ft. wide.....	.24 per sq.ft.
	6x24-in. cross-walk....	1.10 per lin.ft.
Chicago......................	18 in. wide...........	.. . per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 80c.; 5 x 20 in., Queens, 85c. *St. Louis*: Class "A" straight, delivered, 5 x 16 in., $1.45 per lin.ft. *Chicago*: 5 x 8 in., $1.65; 6 x 8 in., $1.95 per lin.ft. delivered.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq Yd.
New York (*delivered*)............	3	16	$2 58
New York (*delivered*)............	3½	16	2 29
Boston...........................	3½	18	**2 60**
Chicago..........................	4	16	3.00@3.25
Chicago..........................	3½	16	2 50
St. Louis........................	3½	16	2 55
St. Louis........................	4	16	2 90
Seattle..........................	4	16	Off market
Minneapolis......................	3½	16	*2.70*
Atlanta..........................	3½	16	*1.90*
New Orleans......................	3	16	**2 50**
New Orleans......................	3½	16	**2.81**
New Orleans......................	4	16	**3.15**
Dallas...........................	4	18	3.90
Baltimore........................	3½	16	None used
Montreal.........................	4	16	4.50
Detroit..........................	3	16	2.84
Detroit..........................	4	16	3.00
Cincinnati.......................	3½	16	2.38
Kansas City......................	4	16	2.75
Philadelphia	4	16	None used

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In.		Gravel ¾ In.		Sand	
	Oct. 4	One Year Ago	Oct. 4	One Year Ago	Oct. 4	One Year Ago
New York................	$1 75	$1.75	$1.75	$1.75	$1.25	$1.00
Denver..................	1.90	1.75	1.90	1.75	1.00	0 75*
Chicago.................	2.00	2.00	2.00	2.00	2.00	2 00
St. Louis,..............	2.30	1.40†	2 35	1.45†	2 10	1 20†
Seattle.................	1.25	1.00	1.25	1.00	1.25	1 00
Dallas..................	2.38	2 25	2.38	2.25	1 89	2 25
Minneapolis.............	1.85*	1.75	1.85*	1.75	1.25	1.00
Cincinnati..............	1.50†	1.40	1.50†	1.40	1.30†	1 15
San Francisco...........	2 15	2.25	2.15	2 25	1.50	1 50
Boston..................	1 40†		1.40†	.	1.10†	
New Orleans.............	2 85	2 85	2.85	2.85	1 25	1 35
Los Angeles.............	2 50	1 50†	2 50	1 50†	1.75	1 35†
Atlanta.................	*1 85*†	2 00†	*1.85*†	2 00†	1.24†	1 35†
Detroit.................	1 62	2.00	1.62	2 00	2 02½	2 00
Baltimore...............	*1.40*	1 40	*1 60*	1.60	*0 70*†	0.70*†
Montreal................	1.25†	1 25†	1 50†	1.50†	1 25†	1.25†
Birmingham (Crushed slag used instead of gravel)					1.30†	1.20†
Philadelphia............	2 00†	1.70	2 00†	1.75	1.50†	1.65
Kansas City.............	1.75	2.00	1 60	2.00	0 66*†	0 66*†

New York—Grits, $1.75 per cu. yd.; ready mixed, $2.00
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit.
† Per ton.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Oct. 4	1½ In. One Year Ago	¾ In. Oct. 4	¾ In. One Year Ago
New York..........	$1 65	$1.65	$1 75	$1 75
Chicago............	2 00	1.60	2.00	1 60
St. Louis	*1 75*	2.10	*1.90*	2 20
Dallas	*2 38*	1.65	*2.38*	1 65
San Francisco........	2.15	2.25	2.15	2 25
Boston, ...	1.60*	..	1.60*	.
Minneapolis...	*1.85*	2.00	*2.00*	2 25
Kansas City	1.50	2.00	1.50	2.50
Denver........	3.50	3.50	3.50	3.50
Seattle	3 00	3.00	3 00	3 00
Atlanta..........	2.00*	1 90*	2.00*	1 90*
Cincinnati.	1 65*	1.55	1 65*	1.55
Los Angeles *delivered*.	2.75	1.75*	3 00	1 85*
Detroit..............	1.75	1.90*	1.75	1.90*
Baltimore...........	2.50	1.70*	2.55	1.60*
Montreal...	1.80*	1.50*	1 90*	1.90*
Philadelphia	2 00*	1.75*	2.00*	1.60*
Pittsburgh.	2 85	2 85	2.85	2 85
Cleveland .	3.25*	3.00*	3.25*	3.00*

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District.....	$1.30	$1.40	$2.00	$1.30
Steubenville District...	1.40	1.40	2.00	1.40
Ironton District...	1.40	1 40	2.00	1.40
Easton, Catasauqua, Pa..	0.85	0.90	2.50	
Birmingham, Ala..........	1.05	1.15	2 05	0.80
Buffalo, N. Y., and Erie, Pa.....	1.25	1.25	2.25	1.25
Cleveland, Ohio....	1.45	1.45	1 45	1.25
Eastern Pa. and Northern N. J	1.20	1.20	2.50	1.2(
Western Pennsylvania	1.25	1.25	2.00	1.2!
Longdale and Glen Wilton, Va	1.25	1 25	2.50	1 0(
Toledo, Ohio	1 50	1.50	1 50	1 5(

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York..........	$18 20	$13.10	$3 75*	$3.00@3.25*
Chicago............	20.00	20.00	1.50†	1.50†
St. Louis..........	23 20	20 00	1 87½†	1 87½†
Boston.............	22 50	16.00	*4.10**	2.60*
Dallas.............	*20.00*	..	.	*1 75*†
Cincinnati.........	16 80	14.30	....	
San Francisco......	22.00	....	....	2 10†
Minneapolis........	25.50	21.00 (white)	1.70†	1.50†
Denver.............	24.00	.. ...	....	2 70†
Detroit............	21.00	20.00	.. .	20.00‡
Seattle, *paper sacks* .	24.00	.....	2.80†	. .
Los Angeles.........	.....	18.50	....	*2.00*†
Baltimore..........	24.25	**17.85**	2.55	
Montreal...........	21 00	21 00		10.00‡
Atlanta............	**23 00**	**14.50**	**2.30†**	1.50†
New Orleans........	.....	.....	2.40†	1.85†
Philadelphia	*23.00*	*16.00*	....	*1 25*†
Kansas City	28.00	24 00	3.12*	2 96*
Birmingham	14 25	13.50	1.90†	1 65†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.80, Sheboygan $1.70. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Oct. 4	One Year Ago
Minneapolis (Rosendale)..............	$2.80	$2.80
Kansas City (Ft. Scott)..............	1.75	1.25
Cincinnati (Utica)...................	1.72	1.72
Boston (Rosendale).....	2.80	..
St. Louis (Carney).......	2 35	1.87
Birmingham (Magnolia) pozzolan cement..	2.10	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags.* Cash discount not deducted.

	Oct. 4	One Month Ago	One Year Ago
New York, del. by truck	$2 70@2 80	$2.70@2.80	$2.60@2 75
New York, alongside dock to dealers	2 30	2.30	2 55
Jersey City....	2 48	2.48	2 73
Boston.......	2 78	2.90	...
Chicago......	2.20	2.20	2 20
Pittsburgh........	2 24	2.24	2 24
Cleveland.........	2.46	2.46	2 46
Detroit...........	2 48	2.48	2 48
Indianapolis..	2.41	2.41	2 41
Toledo..........	2.48	2.48	2 53
Milwaukee.....	2 37	2.37	2.32
Duluth.........	2 25	2.25	2.14
Peoria......	2.41	2.41	2.41
Cedar Rapids .	2.48	2.48	2.48
Davenport.	2.43	2.43	2.43
St. Louis...	2.45	2 45	2 35
San Francisco.............	2.63	2.63	2 71
New Orleans...............	2.90	2.90	3.30
Minneapolis...............	2.50	2.50	2.39
Denver....................	2.84	2.84	2 85
Seattle...................	2.90	2.90	2.90
Dallas	2.25	2.25	2.25
Atlanta...................	3.00	3.00	2.54
Cincinnati................	2.54	2.54	2.59
Los Angeles...............	3.16	3.16	3.30
Baltimore.................	2.65	2.65	2.90
Birmingham	2 70	2.70	2.40
Kansas City...........	2.45	2.90	2.85
Montreal	2.25	2.25	2.78
Philadelphia	**2.96**	2.75	2.41
St Paul	2 50	2.50	2.39

NOTE—Bags 10c. each. 40c. per bbl.; 20c. each in Canada, 80c. per bbl

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind........	$1.95	Hudson, N. Y...............	$2 20
Universal, Pa...	2.00	Leeds, Ala.................	2 20
Steelton, Minn.......	2.06	Hannibal, Mo...............	2 10
Fordwick, Va...	**2 20**	Lehigh Valley District........	2 10
Mitchell, Ind..........	2.10	Wyandotte, Mich............	2 30
Iola, Kan.........	2.10	Alpena, Mich.	2 10
Mason City, Ia	2.10	Richard City, Tenn.........	2 20
La Salle, Ill....	2.10	Kingsport, Tenn............	2.20

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago Mill	Warehouse: New York	St. Louis	Dallas	San Francisco
032	22	$0 95	$1 02	$1.24	$1.04	$1 12	$1 21
049	28	1 20	1 30	1 58	1.32	1 38	1 52
068	35	1 47	1 59	1 94	1.62	1 67	1 87
093	45	1 89	2 04	2.50	2.08	2 00	2 42
126	57	2 34	2.53	3.09	2.59	2 55	2 99
153	68	2.79	3.02	3.60	3.08	3.15	.....
180	78	3 20	3.47	5.22	3.54	3.47	.....
245	103	4 22	4.57	4.60	4.66	4.58	.....
287	119	4 88	5.28	6 44	5.39	5.26	6 00
336	138	5 66	6.13	7.39	6.25	6.11	.....
395	160	6.56	7 10	8.67	7.25	7.12	.....
PAVING							
036P	17	$0.72	$0 78	$0.95	$0 79	$0.76	.....
053P	24	1.02	1.10	1.35	1.12	1.07	.....
072P	31	1.29	1.40	1 71	1.42	1.39	.....
097P	40	1.66	1 80	2.20	1.83	1.90	.....
049R	24	....	1.10	....	1.12	1.07	.....
067R	31	....	1.40	....	1.42	1 39	.....
089R	40	....	1.80	....	1.83	1 90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27Dia.	2.3	$22 00	$21.25	$20 72	$20 00	$25.50
26 "	2.5	22.00	22 50	22 39	19.11	27 58
25 "	3.0	22 00	25 25	24.93		30 71
24 "	3 4	24 00	27 25	27.10	24 09	33 16
22 "	4.33	27.00	31 75	32.27	.....	35 10

*Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
¾ and larger..	$2.40	$2 65	$3 54	$3.20	$3.35	$3 80	$3 65
⅝	2.45	2 75	3 59	3 25	3.50	3.85	3 75
½	2.50	2.85	3 64	3 30	3 55	3 90	3 85
⅜	2 65	2 90	3 69	3.45	3.75	4.05	4.05
¼..........	2 90	2 95	4 04	3.70	4 35	4.30	4.65

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
¾ and larger	$2 30	$3.05	$3.50	⅜........	$2 55	$3.30	$3.75
⅝ in.......	2 35	3.10	3.55	¼........	2 80	3 50	4 00
½........	2.40	3.15	3 60	....	.....	.....	....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Oct: 4	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)......	$23.65	$23.65	18@$20.20	$46.50	$54 00
New York (at dock)...	20.00	20.00	15@17	......	
Chicago	11 00	11 00	11.00	34 00	42 00
St. Louis, salmon......	16@18	16@18	14 00	38@40	40@42.50
Denver, salmon.......	12.00	12.00	12.00	......	......
Dallas.............	13.10	13.10	10 90	33.00	......
San Francisco	15 00	15.00	15 00	......	......
Los Angeles (del.).....	15.50	15 50	15 00	(not used)	
Boston (del.).........	21 00	23.00	.....	48.25	56.00
Minneapolis (del.).....	17@19	17@19	18@19	......	......
Kansas City..........	14 50	14 50	14 50	......	......
Seattle.............	15.00	13.00	14 00	55 00	......
Cincinnati...........	17@20	17@20	17.00	45.00	50.00
Montreal	16 50	16 50	16 00	100.00‡	68 00
Detroit (del.)........	18.25	18.50	16 50	38 50	41.50
Baltimore (del.).......	21.00	21.00	20.00	40.00	45.00
Atlanta	11 00	12 00	12 00	40.00	45 00
New Orleans..........	18.75	18 75	15 75	......	......
Birmingham..........	13@15	13 50@16	12.50	......	......
Philadelphia	22.00	22 00	19@24	38.00	46.00
Pittsburgh (del.)......	16.00	16.00	16.00	......	......
Cleveland	16.00	16.00	16.00	......	......

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Oct. 4 on Trucks*	New York: One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12...	$0 1179	$0.1230	$0 0724	$0.135	$0 089	$0 108	....
6x12x12...	.1769	.1844	.0996	......	.122	.156	....
8x12x12...	.2211	.2305	.1358	.23	.162	.244	$0.1968
10x12x12...	....	.....	.1695	....	.186	......	.2442
12x12x12...	....	.....	.1937	....	.232	......	.3175

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston..........................	$0.13	$0.24	......
Minneapolis (f.o b. cars)........	.0736	.12125	$0.214
Minneapolis (delivered).........	.0816	.13375	.234
Cincinnati....................	.0815	.153	....
Kansas City....................	.085	.135	....
Denver........................	.065	.123	.188
Seattle (delivered).............	.11	.25	.36
Los Angeles factory.............	.1042	.1880	....
New Orleans...................	.12	.23	....
Detroit (delivered).............	.1145	.2147	.27
Montreal......................	.115	.225	.30
Baltimore.....................	.125	.27	......
Atlanta.......................	.102	.175	......
Dallas........................	.115	....	......
Birmingham....................	.11	.18	......
Pittsburgh (delivered)..........	.068	.128	.179
Cleveland	.09	.172	......

San Francisco and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh Mill	Birmingham Mill	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in .	$2 50	$2 75	$3 64	$4 20	$3 45	$3 40	$3.60
Channels, 3 to 15 in..	2 50	2 75	3 64	4 20	3 45	3.40	3 60
Angles, 3 to 16 in., ¼ in. thick .	2 50	2 75	3 64	4 20	3 45	3.40	3.60
Tees, 3 in. and larger...	2.50	2 75	3 64	4 20	3.45	3 40	3.60
Plates, ¼ in. thick and heavier.	2.50	2 75	3.64	4.30	3.45	3.40	3.60

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York Oct. 4	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
¾ in. and larger	$3.00@3.25	$4 40	$3.85	$3 75	$4.15	$5.00	$4 90
CONE HEAD BOILER							
¾ in. and larger	$3.10@3.35	$4.50	$3.95	$3.85	$4.35	$5.10	$5.00
⅝ and 11/16........	3 25@3.50	4.66	4.11	4 00	4.70@4.95	5.25	5.15
½ and 9/16.... ...	3.50@3.75	4.90	4 35	4 25	4 95@5.10	5.50	5.40

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.........	$3.00	$3 80	$4.25	$4.25	$3.34	$4.95
Cut	....	4 45	5.80	5.75	3.64	5.00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco: Galv.	San Francisco: Black	Seattle Black
⅝..	$9.85	$7.65	$8.00
½..	7.80	6.30	7.75
⅜..	7.75	6.15	7.70

Pittsburgh base in lots of 200 kegs or more, $3.50

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.50 per roll in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.75 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., *$5.55* per square.

ROOFING MATERIALS—Prices f.o.b. New York, in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton....................	$67.50
Tar pitch (in 400-lb. bbl.), per 100 lb.	1.62½
Asphalt roofing (in barrels), per ton, f.o.b. plant*..................	38.75
Asphalt felt (light), per ton, f.o.b. plant*..........................	75.00
Asphalt felt (heavy), per ton, f.o.b. plant*.........................	75.00

* Delivered in Metropolitan Dist., $3.00 additional.

WINDOW GLASS—Double strength, box list, united inches, 34, "AA" grade, at discount of 84@ *85* per cent from standard lists, f.o.b. New York; "A" grade less 86@ *87* per cent and "B" grade, *88@ 89* per cent.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10...............	$3.00	$4.45	$4.15	$5.25	$4.59
No. 12...............	3.10	4.50	4.20	5.30	4.64
No. 14...............	3.20	4.55	4.25	5.35	4.69
No. 16...............	3.40	4.65	4.35	5.40	4.79
Black					
*Nos. 18 and 20.......	3.60@3.70	5.00	5.05	5.60	4 95
*Nos. 22 and 24......	3.65@3.75	5.05	5.05	5.65	5.00
*No. 26..............	3.70@3.80	5.10	5.10	5.70	5 05
*No. 28..............	3.75@3.85	5.20	5.20	5.70	5 15
Galvanized					
No. 10...............	4 00	5.35	5.35	5.50	5.15
No. 12...............	4 10	5.45	5.45	5 60	5 25
No. 14...............	4 10	5.45	5 45	5.75	5 25
Nos. 17 to 21.........	4 40	5.75	5.74	5 90	5.55
Nos. 22 and 24	4.55	5.90	5.90	6.05	5 70
*Nos. 25 and 26......	4.70	6.05	6 05	6 20	5.85
*No. 28.............	5.00	6.35	6.35	6.50	6.15

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Oct. 4	New York: One Year Ago	Chicago: Oct. 6	Chicago: One Year Ago
Raw in barrels (5 bbl. lots).....	$0.95	$0 91	$1 11	$0.97

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry Oct. 4	Dry 1 Yr. Ago	In Oil Oct. 4	In Oil 1 Yr. Ago
Red	14.00	12.75	15 50	14 25
White	14.00	12.75	14 00	12 75

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$40.00	$41.00	$42 00	$45 00
3x6 and 8	40.00	41.00	42 00	45.00
4x4-6 and 8	40.00	41.00	42 00	45.00
3x10 and 12	40 00	41.00	42 00	45.00
3x14	42 00	42.00	44.00	46.00
4x10 and 12	40 00	41.00	42 00	45 00
4x14	42 00	42.00	44 00	46.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$42.00	$44 00	$46 00
6x14	47.00	49.00	51.00
8x10	42.00	44.00	46.00
8x14	47.00	49.00	51 00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York* 20 Ft. and Under	New York* 22-24 Ft	Chicago 20 Ft. and Under	Chicago 22-24 Ft.
3x4 to 8x8	*$48.00*	*$49.00*	$45 50	$47.50
3x10 to 10x10	*52.00*	*53.00*	51.50	53.50
3x12 to 12x12	*56.00*	*57.00*	58.50	60.50
3x14 to 14x14	*63.00*	*66.00*	64.50	66.50
3x16 to 16x16	*68.00*	*69.00*	72.50	74.50
3x18 to 18x18	*82.00*	*83.00*	82.50	84.50
4x20 to 20x20	*92.00*	*93.00*	.....	.....

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under.

Other Cities

	8x8-In. x 20 Ft. and Under P.	Fir	Hemlock	Spruce	12x12-In. 20 Ft. and Under P.	Fir
Boston	$65.00	......	$60.00	$60.00	$85.00	.....
Seattle	.....	$28.00	......	......	......	$29.00
New Orleans	28.00	......	......	......	31.00	.....
Baltimore	33.50	53.00	53.00	60.00	*38.00*	53.00
Cincinnati	40.00	75.00	75.00	90.00	44.00	80.00
Montreal	50.00	......	......	......	70.00	90.00
Los Angeles	.....	50.00	......	......	......	51.00
Denver	.....	43.25	......	......	......	54.00
Minneapolis	42.00	43.75	41.50	......	44.00	45.75
Atlanta	*35.00*	......	......	......	*39.00*	......
Dallas	47.50	......	......	......	52.25	......
Kansas City	43.25	......	......	......	56.25	......
Birmingham	30@35	......	......	......	40@45	.....
Philadelphia	64.00	62.00	62.00	77.00	75.00	73.00
Detroit	45.75	50.25	......	......	58.75	50.25
St. Louis	44.00	......	......	......	56.00	......

	1-In. Rough, 10 In. x 16 Ft. and Under P.	Fir	Hemlock	2-In. T. and Gr. 10 In. x 16 Ft. P.	Fir
Boston	$50.00	*$50.00*	$50.00	$58.00	......
Seattle	......	24.00	.....	......	$26.00
New Orleans	72.00	......	.....	31.00	......
Baltimore	60.00	44.00	44.00	34.00	50.00
Cincinnati	76.00	81.00	76.00	35.00	90.00
Montreal	......	50.00	37.00	45.00	45.00
Los Angeles	......	45.00	.. ..	......	......
Denver	......	34.25	34.25	......	34.25
Minneapolis	42.00	*39.75*	39.50	38.25	*36.25*
Atlanta	*19.50*	......	.....	*29.00*	......
Dallas	47.50	......	.....	50.83	......
Kansas City	47.50	......	.....	36.00	......
Birmingham	26@30	......	.....	38@40	.....
Philadelphia	33.50@34	60.00	46.00	53.00	68.00
Detroit	49.50	37.00	.....	42.50	40.50
St. Louis	40.00	......	.....	29.00	......

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M.ft. to contractors.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers price to contractors on large projects.
St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M.ft. additional.
Seattle—Price to contractors, delivered.
Dallas—Wholesale to contractors, $10 per M.ft. additional.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

MISCELLANEOUS

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Oct. 4	One Month Ago	One Year Ago
$2.65	$2.65	$2.35

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	20%
Patent flattened strand, special steel wire rope	20%
Patent flattened strand, iron rope	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington Discount: 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arizona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft., ⅝-in., 6; ¾-in., 4⅓; 1-in., 3⅓; 1⅛-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	*$0.16½*	New Orleans	*$0.18½*
New York	*.18*	Los Angeles	.20
Chicago	.18	Seattle	.18
Minneapolis	*.18½*	St. Louis	.19½
San Francisco	*.16*	Montreal	.22
Atlanta	*.19*	Detroit	.20
Denver	*.17½*	Baltimore	.18
Cincinnati	*.19*	Kansas City	.21½
Dallas	.21	Birmingham	.20½
Philadelphia	.19		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Boston	.24	.26
Kansas City	.2225	.2475
Seattle	.165	19
Chicago	.22	.25
Minneapolis	.1917	.2123
St. Louis	*.2225*	.2475
Denver	.2025	.2275
Dallas	.225	.305
Los Angeles	.1975	.2225
Atlanta	.23	.2575
Baltimore	.22	.23
Cincinnati	.225	.25
Montreal	.195	.235
Birmingham, *delivered*	.16	.17
New Orleans	.195	.22
San Francisco	.1625	.1925
Philadelphia	.215	.240

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f. o. b. New York:

Sulphate of aluminum, in bags, per 100 lb.	$1.40@1.50
Sulphate of copper, in bbl., per 100 lb.	*5.00@5.15*
Soda ash, 58%, in bags, per 100 lb.	1.51
Chlorine, liquid, cylinders, 100 lb., per lb.	.09
Hypochlorite of lime (bleaching powder) in drums, per 100 lb.	2.00@2.10

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.29
Birmingham	.58	Kansas City	.735
Boston	.365	New Orleans	.67
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.34†
Cincinnati	.29	Philadelphia	.32
Cleveland	.215	St. Louis	.43
Denver	1.27*	St. Paul	.60

* Minimum carload, 40,000 lb.
† Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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Why Not a Cement Committee?

THERE is no doubt that there is a growing feeling among engineers that we do not know enough about the real nature of portland cement. It is an obscure material, of complicated composition and with curious reactions, affected acutely by processes of manufacture. It is in recognition of this feeling that the cement manufacturers, as announced by one of their number at the last meeting of the American Society for Testing Materials, have initiated a study into the nature of their product. More should be done. It seems an excellent time for the American Society of Civil Engineers to revive its committee on cement, which long ago initiated the movement for cement specifications. It is true that the subject of cement is taken care of by the Testing Materials committee, but whether that committee intends it or not it seems to be bound too close to the existing specification which it sponsored to get a true perspective on present cement needs. A new committee of the Civil Engineers, starting on the subject afresh, should achieve some useful results to supplement what the manufacturers do.

Water-Waste Prevention in Chicago Started

JUST how much credit the Western Society of Engineers can take to itself for the latest move in Chicago toward water-waste prevention is problematical. The campaign of the society's public affairs committee for waste curtailment was kindly receiver when the present administration went into office and much direct praise has come from the mayor. Anyway, a start has been made. The finance committee of the City Council has recommended the transfer of $187,000 from funds set aside for a new pumping station for the installation of meters in large apartment and industrial buildings. Opposition to the metering is likely when the City Council is asked to ratify the action of its finance committee but in general the committee recommendations usually prevail. Heretofore, it has been the stumbling block. Getting its approval is therefore tantamount to accomplishment. Other controversial engineering subjects in Chicago are being threshed out in the society's committees. May they have as successful issue.

Responsible Contractors

ASSURANCE of responsibility is a prerequisite to any considerable modification of specifications which place drastic restrictions on contractors. In every recent conference which contractors have held with engineers to consider contract forms this requisite has been made plain by the engineers. As a result the committee on ethics of the Associated General Contractors has set about the task of defining responsibility. It suggests as the factors involved, financial strength, experience, equipment, performance record and personal reference. The committee probably recognizes as fully as anyone that when every factor named has been determined, the query whether a contractor is responsible has not been answered. Much less has the irresponsibility of the contractor been established. The mental attributes which establish responsibility are not told by money or plant or testimonials but all these taken with a record of past performance are as certain and reliable an indication as the exigencies of canvassing a score of bidders permit the engineer to secure.

Exchange of Engineers

EXCHANGE of college professors between America and Europe was instituted before the war and proved helpful in many ways. A similar though less extensive intercourse between engineers on the two sides of the Atlantic was suggested some months ago by H. C. H. Shenton, president of the Institution of Sanitary Engineers. A friendly letter on this subject, by Mr. Shenton, elsewhere in this issue, tells of the kindly reception given to George W. Fuller when he appeared at a meeting of the Institution to give in London early in September an address on American sanitary engineering practice. It is to be hoped that there may be early and repeated opportunity for American engineers and engineering societies to extend like courtesies to British engineers. We do not mean to imply that such exchanges have been wholly lacking in the past but for the most part they have been incidental. More definite planning for this sort of thing is desirable. How it can best be effected is a subject for consideration by the leaders in some of our engineering societies.

Let Road Legislation Rest

STATE highway management appears to have been selected again for legislative attack. Candidates for governor in the coming elections are talking freely of how they will handle highways. The plans range from "canning" some politically intractable road official to changing the organization and policies of a whole highway department. With the people also in a hectoring mood because of high taxes, highway officials obviously need have no fear of a dull winter. Quite as obviously the situation promises no help to sound highway development. Indeed, except in the matter of improved or increased financing, a complete rest from immediate further highway legislation would seem wise. In 1922-3 the legislatures of all but four states were in session. The count of their highway activities is impressive. In nine states the lawmakers changed highway administrations; in nineteen they changed methods of financing construction or maintenance or both; in fourteen they changed motor fees and the distribution of this income, and in thirty-two they increased old or created new gasoline taxes. Add to these changes

the acts having to do with appropriations and with traffic regulation and our "road laws" of last winter number about 170 and each one requires some regearing of the highway business machine. It has taken engineers about all the year since the legislatures adjourned to adjust the business to the changes and to get going on the altered basis. Again it should be said, it would appear to be time to take a rest from highway legislation and to develop the business of improving highways.

Public Servants

CONCERN over the large number of persons now on our federal, state and city payrolls is expressed in a circular sent out by the National Industrial Conference Board of New York City. The Board says it has found that exclusive of pensioners there are 2,700,000 "public servants" on the payrolls of the country drawing about $3,500,000,000 annually. Such figures are interesting and to a degree impressive, but they mean little without data to show what services these employees are rendering that are not useful to the people of the United States and what part of the cost of these services would be paid to private agencies of one kind or another if our federal, state and city governments did not have these men and women on their payrolls. The significant thing is not the number of public servants and their total drafts on our various public treasuries, but how much of the work they do and the wages they draw are useful; and at what reduction in numbers and in cost the useful work could be done (1) publicly and (2) privately. Is not the work done by the National Industrial Conference Board itself in collecting these and other statistics an economic charge on the people of the whole country? Are not the Board's employees, as well as those of privately-owned utilities, and of contractors engaged in city and state construction work, public servants—good servants if their work is useful and rendered measure for measure, bad otherwise?

Low Maintenance an Asset

ALL OTHER things being equal in the question of steel versus concrete bridges, does the concrete structure offer to a city any advantages that would not apply to a corporation, such as a railroad, because of the fact that the city is subject to political pressure in the allotment of maintenance funds, while the corporation is free from such influence? The theory that there is such an advantage has been advanced by a city which found it difficult to get the council to appropriate funds for painting steel bridges. To be more explicit, the city in question has jurisdiction over eight comparatively small steel bridges. The painting of these structures was repeatedly urged by the city engineer, but was put off by the city fathers from year to year until, after ten or twelve years, it became so urgent that even the politicians could ignore it no longer. At this delayed date, however, the necessary work included a thorough scraping of the structures and three coats of paint. The city has spent $27,000 this year on these eight steel bridges and faces the expenditure of some $16,000 more to complete the work properly—a total amount considerably in excess of what would have been required by maintenance on a regular and systematic basis. Concrete bridges in the same city, on the other hand, have required and have received practically no maintenance and have therefore made a very favorable impression. In selecting the most suitable type of structure for a given set of conditions the engineer must give due weight to just such psychological considerations as that advanced in this case. Even in a well regulated city political parties may change, and what seems a stable policy today may be overthrown tomorrow. It may very well be that "fool proof" structures can best be entrusted to the uncertainties of political management.

Motorists Finance Roads

AMERICANS are spending about a billion dollars a year in highway improvement. To do this they are putting over the biggest accomplishment in special taxation ever recorded for public works—the motor license and the gasoline tax. The general property tax dollar is not building roads. Less than six cents of this dollar goes to highways. The general property tax is also not being increased by our growing road improvement program. Instead it was reduced last year in a number of states—generally by boosting motor car license fees or by imposing a gasoline tax. The motor vehicle is paying for good roads and not general property. This fact needs to be made plain by state road officials and by the associated motor vehicle interests. In this matter they have identical interests even though they may disagree on every other particular of the relation of the highway and the motor vehicle. It is on the plea of reducing the general property tax that the "practical" politician is urging local management of road funds and decentralized technical control of road work. To return to either of these practices in entirety would reverse all the policies which are now developing highways as state and interstate systems—which are creating the through routes essential to the motor truck and bus carrier and the automobile tourist. As their customers and members are financing the roads, this development is the particular concern of the associations of manufacturers and users of motor vehicles. They should actively uphold the hands of the federal and state departments in advancing centralized control and engineering direction of highway improvement.

From Laboratory to Field

FOR four or five years a few experts have been trying to impress on the concrete users of this country that there is a more economical and a more consistent method of proportioning concrete than the generation-old system of integral quantities. The idea, though, has been slow of acceptance and the old 1:2:4 concrete continues to be placed in by far the larger number of actual jobs. It is a hopeful sign of progress when a large railroad, such as the Big Four, undertakes the use of one of the more scientific methods of proportioning on so large a job as the Sidney Bridge described in this issue. Mr. Huntley's article was written before the full returns from the tests are available. It also will require for complete understanding a knowledge of Professor Abrams' bulletins describing his method of proportioning concrete. Nevertheless, it is sufficiently complete at the present time to make clear that the engineers of the railroad are quite satisfied with the system which they adopted, and that they are assured that the concrete produced is not only more uniform in strength, but was produced at less cost than would

have been possible under the older and somewhat simpler methods of proportioning.

It should be recalled that the other big experiment in scientific proportioning was the concrete on the Queenstown-Chippawa Canal, where the methods devised by R. B. Young of the Ontario Hydroelectric Power Commission were used. These methods and their application to the Chippawa work have been extensively described in *Engineering News-Record*. The work on that project is practically complete, and it may be interesting to note that there, too, the engineers are convinced of the efficiency of the design method of proportioning. There is quite a difference in the Abrams and the Young details, as the students of the two methods well know, but the methods are aimed at the same results, and apparently those results are equally well achieved by either method. What it is important for other engineers and contractors to realize is that these methods have now gotten beyond the laboratory stage and are now being used on extensive operations where money is important, where time is important, and where the strength of concrete is most important of all.

Departmental Reorganization a Live Issue

IN DECEMBER a new Congress meets in Washington with a different personnel from the one that adjourned last spring and under considerably different conditions. The election last November brought forward a number of new men who will come together for the first time to try to do business with a new President, at a time when political pots are boiling as they have not boiled in many years. In this confusion of politics it may seem that the obvious necessities of government will be subordinated to the expediencies of bloc or party, but, on the other hand, the fact that so many new elements have entered into the legislative mechanism may lead to a striking out into paths which the more hidebound of the veterans in Congress have hitherto been reluctant to tread. For that reason, it behooves the engineers of the country to lay their plans now for the presentation to Congress of the necessity for departmental reorganization at Washington

There is no need here to recite the long history of the campaign to render more efficient the work of the government by the proper alignment of the various functions of government. It will be remembered, however, that at the initiation of President Harding a committee, known as the Brown Committee, presented to the last Congress a scheme for departmental reorganization which involved the re-assignment of various bureaus in a more orderly arrangement, but which was most important because it collected all government engineering under one head, the Department of the Interior, with a subordinate to the Secretary of the Interior who should have engineering qualifications and who would be in complete charge of the engineering activities of the department, which means the engineering activities of the federal government.

The necessity for some such arrangement is quite obvious; it has, in fact, been quite obvious for many years, but the recent performance of the Secretary of the Interior in summarily removing Arthur P. Davis from the direction of the Reclamation Service brought forcibly to realization the dangerous possibilities of the present political control of the scientific branches of the government. So long as a man like Herbert Hoover is a cabinet officer or, to get outside the engineering profession, so long as a man such as James R. Garfield was a cabinet officer, there was small chance that the strictly engineering activities of a government department would be made subordinate to the needs of some chance politician out of a job. But when a political accident happens to come to power and when the exigencies of political control become so forceful as they apparently are in the Far West today, the danger of the present organization of the government department becomes apparent.

Some system of organization must be provided whereby the head of an engineering department will be by law required to be an engineer, as a general in the army must be a soldier by profession, and as the head of the Bureau of Mines must be a qualified engineer or geologist. No political superior should be empowered to juggle the law so as to take from that engineering head the responsibilities that should be his. It should be possible, of course, to remove individuals; it should not be possible to substitute so-called business men or administrators for trained engineers.

The Brown departmental reorganization may not be the best method whereby this end can be achieved, but it has the merit of the adoption by an expert committee after long study and at least stands a better chance of passing in Congress than some unauthorized scheme gotten up on the spur of the moment. Engineering societies would do well to study the main features of the Brown plan and to advise, through their local chapters, their respective congressmen of the necessities of the situation. The coming Congress will no doubt take up the Reclamation Service scandal as a specific matter, and there is a strong probability that the proper engineering control of this engineering body will be forced on a reluctant Secretary of the Interior. The attention of each congressman should be called to this possibility, but the general situation in Washington should not be overlooked. If one Secretary of the Interior can remove an engineer who has for forty years been in the service and take out of engineering control an efficient engineering bureau of twenty-one years' standing, there is nothing to prevent some other secretary from putting a country lawyer at the head of the Geological Survey or an Oklahoma gunman at the head of the Bureau of Standards. This possibility must be removed by guaranteeing at the head of the government engineering bureaus some single individual whose qualifications by law are such that whatever his personal disabilities may be, he would appreciate the necessity for the engineering direction of engineering work.

The engineers of the country might well ask Congress for some such legislation, not with any selfish purpose but with full knowledge that the government service will suffer under a political control. Group action of the engineers through their major societies and through the Federated American Engineering Societies will be useful but the most useful service can be performed by each local society or chapter with its single congressman. There is not a member of Congress who does not number among his constituents some organized groups of engineers whose opinions he is bound to consider. By making this an aggregation of local issues it can be made a paramount national issue. Persuade your Congressman and Congress itself will be persuaded.

Strength Specifications Used for Large Concrete Bridge

Abrams Method of Proportioning Concrete Used on the C.C.C. & St. L. Ry. Bridge Over the Great Miami River at Sidney, Ohio—Both Premixed and Separate Aggregates Used

By J. B. Huntley
Engineer of Bridges and Structures, C. C. C. & St. L. Ry., Cincinnati, Ohio

The adoption of a concrete arch, ballasted deck bridge for the new double-track crossing of the Great Miami River at Sidney, Ohio, by the C. C. C. & St. L. Ry. is indicative of the present tendency in railroad bridge design, particularly when, as in this case, the bridge is within the limits of a city. This new bridge is on a relocated portion of the railroad where existing structures do not limit the design and where rock foundations make it possible, without excessive cost, to use fairly long span arches. Some features of the design are notable and are given below but the principal interest in this bridge is centered in the construction methods, particularly the method of proportioning concrete.

FIG. 1—VIEW SHOWING LOCATION OF CONSTRUCTION PLANT

Design—The structure, as finally designed, consists of three 140-ft. spans over the river channel and the highway, and one 100-ft. approach span on each end to take the embankment slopes, making the overall length of the structure 780 ft. The height from base of rail to bed of stream is 95 ft. The track will be carried on a ballasted deck which is supported on spandrel arches having a span of 9 ft. 9 in., the top of the parapets being 3 ft. above the rail. The piers are 17 ft. thick at the springing line, with a moderate batter, but piers 1 and 4 are widened near the base to provide for the unbalanced load between the 140-ft. and 100-ft. spans. The footing courses are carried about 2 ft into the rock, which is a peculiar form of limestone, unstratified, very hard and at least 35 ft. thick, as shown by the deepest test hole. The piers are extended for buttresses, and above the haunches of the arch are hollow. Expansion joints in the floor and parapets are provided at the ends of each span.

The structure was designed for E70 loading, using equivalent uniform loads. This uniform load, considering half of the span loaded, was 10,400 and 10,900 lb. per foot of track for the 140 and 100-ft. spans respectively, and considering the entire span loaded, 8,500 and 8,600 lb. per ft. of track. Specifications impact was used, the impact percentage of the live-load being about 55 per cent for the 140-ft. spans and 68 per cent for the 100-ft. spans.

The 140-ft. arches are three-centered, having a rise of 50 ft.; the thickness is 5 ft. 6 in. at crown and 13 ft. 9 in. at haunches. The 100-ft. spans are semi-circular, and have thicknesses of 4 ft. 6 in. at crown and 10 ft. 9 in. at haunches. There is no tension developed at any section under live and dead-load, but temperature reinforcement was provided at the intrados and extrados, consisting of 1¼-in. square bars 12 in. on centers in the 140-ft. spans and 1-in. square bars in the 100-ft. spans.

Stresses due to a rise of 50 deg. and fall of 30 deg. in temperature, combined with live and dead-load and the effect of rib shortening, were found to be quite large. The intensity of stress at some of the critical sections of the 140-ft. spans is shown in the subjoined table.

DEAD-LOAD AND LIVE-LOAD STRESSES — 140-FT. SPAN

Section	Live-Load on Entire Span Total	+ D.L.	L.L. +I	Per Cent of LL+I of Total	Live-Load on Half Span z Total	D.L.	L.L. +I	Per Cent of LL+I of Total
Crown..	375	290	85	23	340	290	50	15
¼ point....	340	250	80	24	455	290	165	36
Haunch...	200	170	30	15	270	170	100	37

TEMPERATURE STRESSES COMBINED WITH DEAD-LOAD, AND LIVE-LOAD ON HALF SPAN — 140-FT. SPAN

Section	For Rise of 50° in Temp. Concrete	Steel	For Fall of 30° in Temp. Concrete	Steel
Crown..	+675	0	+760	— 5,500
15 ft. from skew back...	+700	—5200	..	.
At skew back..	.	...	+200	—10,500

The maximum pier reaction is 25,000,000 lb., giving an average pressure on the foundation of 10 tons per square foot. The maximum toe pressure at piers 2 and 4 under unbalanced loading will be 19 tons per square foot.

Waterproofing and Drainage—Experience with several structures of this type built about 15 years ago has shown that to avoid deterioration thorough waterproofing and ample drainage are necessary, and considerable study has been given to this detail. The deck will be sharply pitched to drains between the spandrel arches and waterproofed with a membrane, which will be protected with concrete. The fill between the ballast and deck will be of coarse material to permit free passage of water to the drain heads. The expansion joints over the piers and abutments will be flashed and counterflashed with copper, and the tops of the drains fitted with cast-

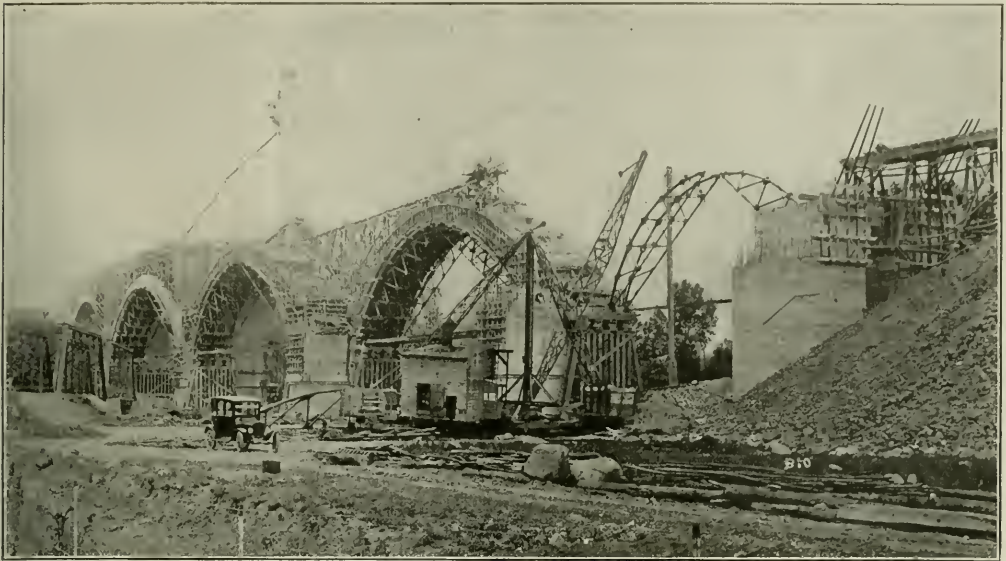

FIG. 2—CONSTRUCTION WORK AT BRIDGE SHOWING ARRANGEMENT OF PLANT AND ARCH CENTERING

iron flanges to flash and counterflash the membrane at this point. The deck drains lead through the pier walls, discharging into a channel on top of the main arches which will carry the water through the piers to the outlet. The lower portion of the chamber in the pier will be waterproofed to prevent seepage in case the outlet drain is clogged.

The structure will contain about 27,900 cu.yd. of concrete and 900,000 lb. of reinforcement.

Construction Plant—The arrangement of the contractor's plant for handling the material is interesting, and is shown in some detail in the accompanying sketch. The concrete materials are received on a track from the B. & O. R.R. about 1,000 ft. west of the bridge and on high ground, are unloaded by a locomotive crane and stored in piles over a timber tunnel through which tram cars run. The concrete aggregate is delivered through hoppers to the cars in measured quantities, and the bags of cement are placed on top. The cars run down an incline to the bridge, where the cement is added, and each car, containing one batch, is dumped into a hopper from which the mixer is charged. At first the cement was emptied on top of the aggregate in the car before leaving the tunnel, but it was found that there was some loss during the trip down the incline, especially in windy weather. The cars are operated in two trains, of 4 cars each, on a cable, and from the storage piles to the charging of the mixer practically all of the work is done by gravity. All laborers except those at the forms are under shelter, and continuous mixing and placing of the concrete is limited only by the formwork.

The mixed concrete discharges directly into the hoist of a 150-ft. steel tower and is distributed by chutes to most of the forms. In the abutments it was necessary to rehandle it by bucket and derrick, and for placing the concrete in the end spans and superstructure the chutes discharge into a car operating along an elevated trestle, which empties into distributing chutes. The inclination of the tower chutes was kept within the limits of 1 to 3 and 1 to 2. Each batch of concrete was mixed at least 50 sec. and for longer periods when it had to be rehandled by cars or buckets.

The excavation for the foundation was made by a 7-ton locomotive derrick on the west side and a 20-ton traveling stiff-leg derrick on the east side. These derricks were also used for rehandling the concrete from the chute to the forms which could not be reached by the tower, setting arch centers, etc.

Steel Centering, Camber and Deflections—Steel centering was used for all spans. Each set of centers consists of four ribs, which are three-hinged arches with bottom ties. They are made wide enough to pour one half of each arch, 16½ ft., and are rolled sideways, with the lagging intact, for the second half of the ring. Each half of each ring is poured in voussoirs of such size and in such order as to cause no undue reversal of stress in the arch centers. The centering is supported on double timber bents resting on top of the footing courses.

The trusses were cambered about one inch, and to allow for the take-up in the bents and blocking the shoes were set about 1 in. high. After the rings were poured elevations were taken on the 140-ft. spans and it was found that at the crown there was a settlement of about 2 in. and at the shoes about 1 in., verifying the original assumptions. After the centers were lowered (on the spans poured to date) elevations were taken on the arch ring to determine what settlement had occurred under dead-load, but none was apparent. The computed deflection at the crown of the 140-ft. span was found to be only 0.001 ft., and this was probably neutralized by the lengthening of the arch ring under rise in temperature. In fact there is some evidence that the rings had actually lifted themselves from the centers, as the wedges under the shoes were easily

backed out, although the computed load on the centering was about 1,700 tons. This condition would probably be reversed for arches poured in fall and winter.

Permanent points are being placed at intervals on one 100-ft. and one 140-ft. span, and it is the intention to take frequent elevations to determine the deflection as the work progresses and as the superstructure is added, and for some time after the completion of the bridge, under various ranges of temperature.

The centers were not lowered until 25 days after pouring of the arch ring, and 15 days after the last pouring on the adjacent spans. Due to the deflection of the centers under load, it was necessary to use some care in adjusting the centers for the second half of the ring in order to avoid a lip at the joint. After the centers were moved over, the inner truss was so near the completed ring that the crown was restrained and it was possible to jack up its bearings and introduce some initial deflection. This left the outer truss about one inch high at the crown, to deflect under load. To conceal a possible lip, a 4x6-in. channel was formed in the intrados where the two halves jointed.

After the concrete is poured an effort is made to keep it damp for at least two weeks. The tops of the arch rings are sprinkled several times daily, and as the deck is completed, the drain holes are plugged and it is flooded.

Proportioning the Concrete—Practically all concrete work of the company in past years had been poured under the ordinary specification, using the standard 1:3:6 or 1:2:4 mix, with probably average supervision but without especial care being given to the grading of the aggregate or the consistency of the mix, and some of this concrete has not been entirely satisfactory. It was felt that the importance of this particular structure required some unusual effort to assure the proper mixing and placing of the concrete, and, owing to the large volume, it offered an excellent opportunity to experiment with the method proposed by Prof. Duff A. Abrams, of the Structural Materials Research Laboratories, Lewis Institute, for the design of concrete mixtures. This method had been developed and confirmed in laboratory experiments but had not been used in the field to any great extent and there was some doubt as to the possibility of approaching the laboratory results, but it seemed that at least the mere moral effect of making the tests promised better concrete, and it would determine the practicability of adopting this method on future work, where there was sufficient yardage to justify it, and that possibly some evidence as to correctness or inconsistencies of present specifications and methods could be obtained.

It was decided to use mixes to produce concrete of the following strengths:

	Lb. per sq.in.
Footings	2000
Piers and abutments	2500
Arch rings	3000
Spandrel arches	2500

In the footings, piers and abutments, a premixed aggregate (concrete gravel) was used, of size 0 to 1½ in. The fineness modulus varied from 5.3 to 6.7, with an average of about 5.9. This wide range was probably due to separation of the sand and pebbles in unloading, and as the stockpile was large and the hoppers drew from the center of it the fineness modulus was uncertain, differing from day to day, and it was almost impossible to adjust the mix for the frequent variation in the aggregate. After some experimenting, it was found that, to avoid clogging the chutes, an average consistency as represented by a slump of 6 to 7 in. was required. The batches were 23.3 cu.ft. and the yield, or the ratio of the volume of finished concrete to the volume of loose damp aggregate, was assumed as 90 per cent to find the nominal mix, the true mix necessary to produce the required strengths being known after the consistency of the mix and characteristics of the aggregate had been determined. Including waste there were poured about 10,440 cu.yd. of gravel concrete, requiring about 11,700 cu.yd. of aggregate, which gives a yield of 89.0 per cent.

For the arch rings and spandrel walls separate aggregates are being used, the sand ranging from 0 to ¼ in. and crushed boulders and pebbles from ⅜ in. to 1½ in. The fineness modulus of the fine and coarse aggregates remains quite uniform, averaging 3.2 and 7.8 respectively. For the arch rings the batches consist of 11 cu.ft. of sand and 17 cu.ft. of stone, and the mixture has a fineness modulus of 5.95. For the superstructure there is used 12 cu.ft. of sand and 16 cu.ft. of stone in each batch, the mixture having a fineness modulus of 5.8. The sand and stone when mixed should produce about 23.8 cu.ft. of gravel or 85 per cent by volume. The 23.8 cu.ft. of gravel should produce about 21.4 cu.ft. of concrete (90 per cent) or, the ultimate yield would be $28 \times 0.85 \times 0.90 = 21.4$ or about 76.5 per cent. To pour 4,800 cu.yd. of concrete required about 6,400 cu.yd. of separate aggregates, which gives a yield of 75 per cent. Tests were made on several batches and it was found that 28 cu.ft. of sand and stone would produce about 22.5 cu.ft. of concrete (80 per cent) in the bucket at the mixer, but there would probably be further shrinkage by the time it is placed in the forms.

The accurate determination of the yield is important, as by this factor alone can the nominal or working mix be found after the true mix, for the required strength, is known. It has been determined in the laboratories, but with comparatively small volumes and under somewhat different conditions than those which exist in actual construction. The amount of moisture initially contained in the aggregate materially affects the yield and this must be allowed for.

It was found that the concrete made of separate aggregates could be easily handled in the chutes and forms with a slump of 3 to 4 in. In fact many batches were poured in which the slump was 1½ to 2 in., the average being about 3¼ in. This produces a concrete much drier than it was thought could be handled through the chutes, and much drier than the gravel concrete previously poured with the same equipment. This seemed difficult to explain as the gravel, sand and pebbles were from the same pit, but it is undoubtedly due to the fact that the fineness modulus of the sand and pebbles remained nearly constant and that the mixture was such as to produce a very "workable" concrete, while the gravel varied greatly and was often of such a nature that it required an excess amount of water to make it workable. This same fact was observed in another structure containing about 6,500 cu.yd. of concrete, built under a different inspector. Here the concrete was largely placed by buckets, but to get a good face on finished work required that the gravel

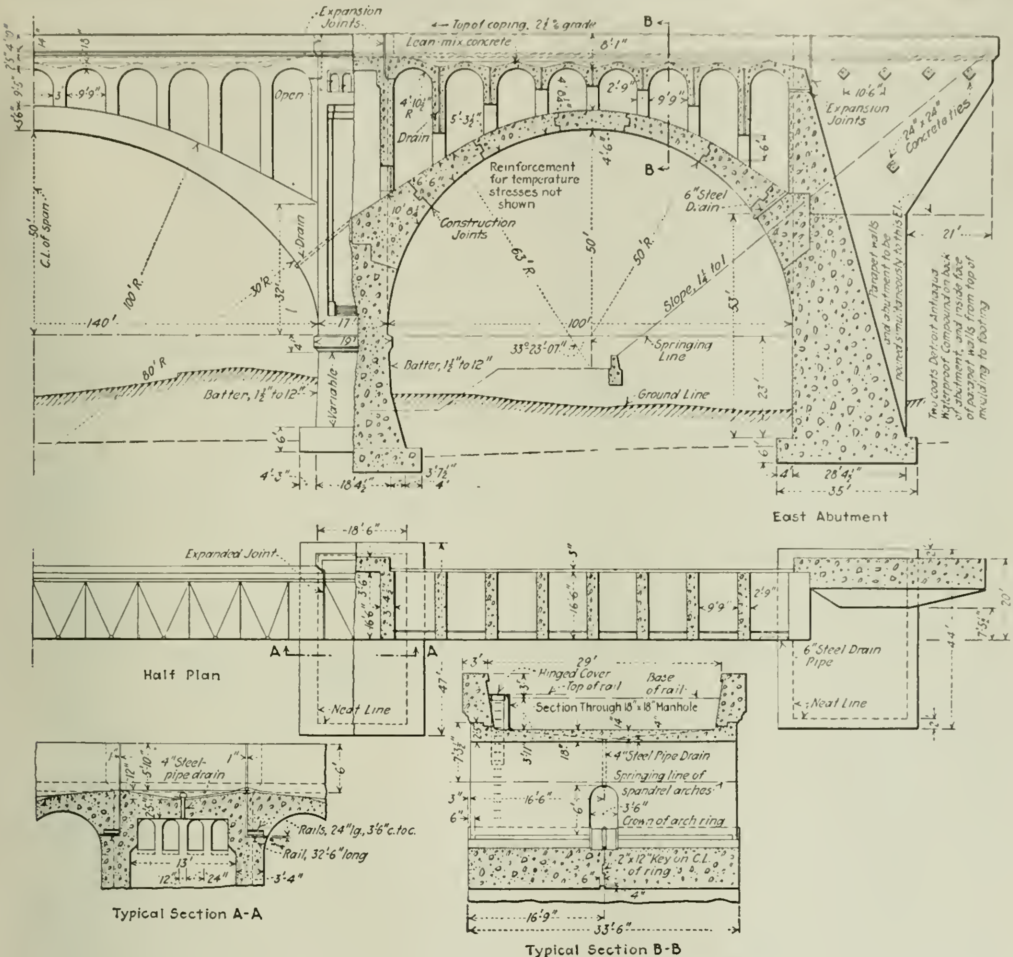

FIG. 3—DETAILS OF THE BIG FOUR RAILWAY BRIDGE ACROSS THE GREAT MIAMI RIVER AT SIDNEY, OHIO

mix have a slump of about 7 in., while the concrete made of separate aggregates worked nicely with a 3-in. slump. In one structure where a premixed aggregate was used throughout, the gravel being handled in small quantities and in such a manner that little or no segregation occurred, the fineness modulus remained nearly constant, it was found that concrete could be mixed with good results to a consistency represented by a slump of 4 in.

Unless it is certain that the grading of the premixed aggregates is proper and will remain fixed, there seems little justification for its use. The ease of handling from a single stockpile is of some advantage, but this is far outweighed by the cost of the additional cement required in the wetter concrete of equal strength, and by the increased workability of the mixture made from the separate aggregates used in the proper proportion.

There has been an almost general condemnation, in which the writer joined, of the tower and chute as a means of distributing concrete, as this method seems to require very wet mixtures and often results in complete separation of the mortar and stone. On this work, however, there has been several thousand yards successfully placed by chutes, much of the concrete being drier than any heretofore handled by other methods and delivered with no separation. Possibly the use of excess water is largely habit and probably the segregation is due to the use of improper materials poorly proportioned and insufficiently mixed.

The Abrams method of designing concrete mixtures was employed on several of the larger structures representing about 50,000 cu.yd. of concrete, and as a check test specimens are made at frequent intervals.

These test pieces are 6x12-in. cylinders, made in accordance with the A. S. T. M. Standard (Serial C-31-21) except that instead of taking the sample from the form it is drawn directly from the discharge of the mixer, so that the actual slump of the sampled batch could be measured. From three to six specimens were made for a day's run, from different batches, stored in wet sand and tested at the end of 28 days. About three hundred specimens, representing various mixes, and

slumps ranging from 1 in. to 8 in., have been broken to date, and several hundred tests will be made before the completion of the work.

The first results were disappointing; many of them showed strengths lower than expected and the others were quite erratic. While it was considered that average care had been exercised in making the specimens, investigation showed that there had been some minor departures from the recommended methods, especially in capping and storing the pieces, and after this was corrected the results were quite consistent, agreeing closely with the tables published by Prof. Abrams.

The concrete work will not be completed for several months, when additional information will be available from which more definite conclusions can be drawn, but it seems apparent:

1. That the method of designing concrete mixtures, as worked out in the laboratory, is applicable under field conditions and that a concrete of predetermined strength can be obtained with considerable accuracy, by using the proper mix and consistency.

2. That quite dry concrete, of aggregates properly proportioned, can be worked without difficulty and handled by the usual methods, and with considerable saving in cement over that necessary in the wetter mixtures of equal strength.

3. That a specification, simply defining the mix as 1:2:4 and 1:3:6, etc., without establishing some further requirement as to the consistency and grading of the aggregate, means little from the standpoint of strength as the results may vary 100 per cent, and consequently such a specification is uneconomical.

4. That better results can usually be obtained with concrete made from separate aggregates (sand and stone) than from a premixed aggregate (gravel).

5. That unless inspectors who are familiar with this method of proportioning concrete are available, it is scarcely practicable on small work as it takes them some little time to learn the mechanics of the tests, and longer to completely grasp the theory, so as to be able intelligently to vary the mix under the different conditions of weather, material, and pouring. Where frequent sieve analyses and slump tests are made it requires a good deal of the inspector's time, and on large and important work a special man to make the necessary tests would probably be justified.

The Walsh Construction Co. of Davenport, Iowa, has the general contract for the grading and masonry, and is constructing the Miami River Bridge. The work is being done under the general direction of C. A. Paquette, chief engineer, C. C. C. & St. L. Ry. Co.

Reports on Decay in Douglas Fir

Because Douglas fir is one of the most important timbers of the United States and because it is very susceptible to diseases caused by four fungi which attack it, the United States Department of Agriculture has made preliminary investigations to determine the extent of such damage and the amount of defective timber. The results of the investigations so far made have been published in the department's bulletin No. 1163, which may be had upon request from the Department of Agriculture in Washington. The facts so far established are that young stands or second growths are relatively immune from decay, but it is not yet known at what age this immunity ceases.

Sewage Distribution Tests With Butterfly-Valve Control

Variation of Pressure at Taylor Sprinkler Nozzles Obtained by Cam Control of Valve—Time-Pressure Curve

BY HENRY R. KING
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IN THE course of recent experiments on sewage distribution by means of sprinkler nozzles the author was impressed by the value of a butterfly valve for close control of variations in loss of head. By using the butterfly valve data can be obtained which may be more easily applied in the design of dosing tanks and other arrangements for trickling-filter control than the data which are now available. The experiments were made by the writer last year as a part of work for a thesis at the University of Illinois.

Previous experiments in sewage distribution have generally been tests of the distribution occurring with different types of nozzles when discharging at different fixed pressures. Examples of these are the recent tests

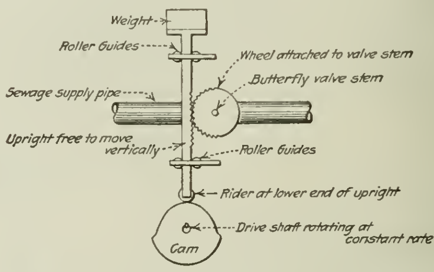


FIG. 1—METHOD OF CONTROLLING BUTTERFLY VALVE TO GIVE VARIABLE SPRINKLER-NOZZLE PRESSURE

of sprinkler nozzles by the Pacific Flush Tank Co. of Chicago and by the Purdue University testing station. The results obtained at these places have considerable value and afford examples of the best data available for designing controls for trickling filters.

Since in the operation of trickling filters a variation of pressure must occur at the nozzles to secure a uniform distribution, some difficulty arises when it is attempted to apply data given for nozzle operation at fixed pressure to conditions of varying pressure. The desired information may be arrived at by a tedious mathematical computation which has proven sufficiently difficult to result in a difference of opinion among engineers as to the proper shapes for dosing tanks.

In the sewage distribution experiments performed by the writer, a battery of three $\frac{15}{16}$-in. Taylor circular-spray nozzles, spaced 14 ft. apart on the apices of an equilateral triangle, was used. Instead of operating these nozzles under various fixed pressures, as has been the usual practice in such experiments, a variation of pressure at the nozzles was effected. To secure this, a butterfly valve (see Fig. 1), operated by a cam revolving at a constant rate, was placed in the supply pipe to the distribution system. Sewage was supplied from a tank in which a constant level was maintained. The butterfly valve served to produce a head loss between the tank and the nozzles, the extent and variation of

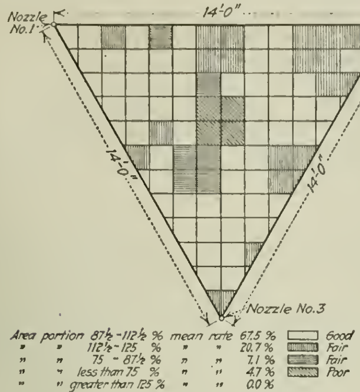


FIG. 2—RELATIVE SEWAGE DISTRIBUTION BY NOZZLES

which depended on the shape of the cam operating the valve.

To study the distribution effected, the triangular area between the nozzles was marked off into 1-ft. and smaller areas of different forms (Fig. 2). Pans, with their tops at the same elevation as the nozzles, were placed on these subdivisions. The spray that collected in these pans was measured after each dosing cycle. Distribution was considered good when between 87½ and 112½ per cent of the mean rate. For the underdosed area receiving 75 to 87½ per cent of the mean rate, the distribution was considered fair. The distribution on the remaining area was considered poor whether underdosed or overdosed.

The cam was symmetrically shaped (Fig. 1) so that the pressure at the nozzles rose from zero to a maximum and returned to zero, thus giving a symmetrical pressure-time curve. In the experimental procedure a cam was designed theoretically and tested. It was then altered until a satisfactory distribution was obtained on the triangular area between the nozzles. Fig. 2 is a graphical representation of the final distribution effected.

In Fig. 3 the head on the 1⅝-in. Taylor circular-spray nozzles, spaced 14 ft. apart, is plotted in relation to time for the distribution shown in Fig. 2. The curve shows the relation of the head to the decimal parts of the total time for a variation of head from zero. The data

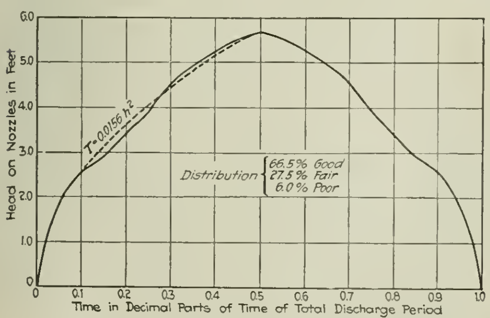


FIG. 3—PRESSURE-TIME RELATION DURING DISCHARGE PERIOD OF SEWAGE-SPRINKLER NOZZLES

Taylor 1⅝-in. circular spray nozzles were spaced 14 ft. apart, as shown in Fig. 2. Each nozzle discharged 18.15 gal. in a one-minute discharge period and had 170 sq.ft. effective sprinkling area.

for this curve were obtained by noting the positions of the cam and the simultaneous pressures at the nozzles, as observed from a pressure gage connected to the distribution system adjacent to one of the nozzles. The angular position of the cam divided by the total angle of discharge gave the decimals plotted as abscissas in the diagram.

It is evident that curves similar to that of Fig. 3 for all sizes and spacings of sprinkler nozzles would be particularly valuable for designing dosing controls for trickling filters. Information presented in such form would have decided advantages over the data that are now furnished the engineer. It is the pressure-time curve in which the engineer is interested and which he must obtain to design a dosing tank properly. If such curves were provided him, together with the distribution results that had been experimentally obtained in their preparation, the design of trickling-filter controls would be considerably simplified.

The ease with which the pressure-time curves could be used for determining the proper shapes for dosing tanks is apparent from Fig. 3. The actual curve approximates a parabola. Therefore the time from zero head to any head upon the nozzles should vary approximately as some constant times h^2 for nozzles and spacing the same as used in the test. Let A equal the horizontal sectional area of the dosing tank at any distance above its bottom and T equal the time from zero head to any head upon the nozzles or from the pressure-time curve $T = k'h^2$. The rate of discharge $= k'' \sqrt{h}$; $dV = Adh$; $dT = Adh \div k'' \sqrt{h}$.

Taking the derivative of T as given by the pressure-time curve, $dT = k'''hdh$, and equating, $k'''hdh = Adh \div k''\sqrt{h}$ and $A = k\, h^{3/2}$. Therefore for a 14-ft. spacing of 1⅝-in. Taylor circular-spray nozzles (disregarding frictional losses) the horizontal sectional area of the dosing tank should vary as some constant times its height above the nozzles raised to the 3/2 power.

Other factors would necessarily have to be considered in such a design but the general shape of the dosing tank could be obtained from the relation given.

Sewage Gate-Valve Forced Off Pump Main

A 12-in. gate-valve on the pump-well end of a branch pipe 20 ft. in length, connected with the 14-in. force main at the sewage pumping station of Natick, Mass., was recently forced off by the pumping pressure so that the contents of the entire length of the force main (6,000 ft.) and also of one sewage-bed were emptied into the pump well. The gate was on the extreme end of the branch pipe and was held in place by an ordinary lead joint, but there was a bead at the spigot end entering the gate-valve. There was no pipe beyond the gate leading into the well. The pressure ordinarily carried by the gate, which had been withstood for twenty-seven years, was about 40 lb. The gate was customarily kept closed and was opened only when it was desired to repair the force main. *Engineering News-Record* is informed by Frederic I. Winslow, Framingham, Mass., who sent the information given above, that it is probable that the action of gases from the sewage caused the lead in the joint to deteriorate to such an extent that the joint gave way. To lower the level of the sewage in the pump well, fire engines were used and the sewage was pumped to the ground so that the gate could be replaced.

Large Eyebar Suspension Bridge in South America

Span of 1,114 Feet Under Construction in Brazil Has Chain of Eyebars with New Form of Stiffening Truss

A COMBINED highway and railway bridge under construction at Florianopolis, in the province of Santa Catharina, Brazil, connecting the island on which the city is located with the mainland, represents the first application of modern eyebar-chain construction to suspension bridges. It is no less interesting because of its unusual stiffening truss construction, which, in connection with the use of eyebars for the chain and the unloaded backstays, results in a high degree of rigidity and economy. Because of its long main span, nearly 1,114 ft., this structure will take rank among the largest suspension bridges in existence. It was designed by Robinson and Steinman, of New York, as consulting engineers for Byington and Sundstrom, of São Paulo, Brazil, contractors for the bridge.

In the original design for the crossing, whose span is controlled very closely by the conditions of the site (see the location plan), a wire-cable suspension bridge was contemplated. This design had a parallel-chord stiffening truss with hangers at all panel points. When, however, the American Bridge Co. made a tender of heat-treated eyebars under a guarantee of 75,000 lb. per square inch minimum elastic limit, permitting a working stress of 50,000 lb. per square inch to be used in the chain, the structure was redesigned to take advantage of eyebar construction, with the result of showing a distinct economy in total cost and permitting the stiffness of the main span to be increased very greatly. The eyebar-chain design, shown in the drawings, is now being carried out.

Special Features—From the design details on p. 593 it will be seen that the towers are two-column steel bents with battered legs and with line bearing at the base, while the stiffening trusses have curved top chords so disposed as to give maximum depth at the quarter-points, the top chord in the middle section being formed by the suspension chain itself. This novel combination of chain and truss yields large savings in steel due to the elimination of the middle half of the top-chord and other members, and to the more economical truss outline in which the depth conforms to the variation in bending moments along the span. The traffic requirements are satisfied by a 28-ft. clear roadway width, which fixed the truss spacing at 33½ ft. Accordingly the cross-section involves no features beyond the ordinary. The backstays are unloaded, going down directly to masonry anchorages, one of which is on rock while the other is carried by a pile foundation including both vertical and batter piles. The approaches are steel viaducts with spans of 185 ft. directly adjacent to the towers.

Loading—The loadings assumed for the design of the various parts of the structure vary from 1,850 lb. per lineal foot of bridge for the chain and 2,000 lb. for the trusses (the latter with 10 per cent impact) to a 6-ton truck or 60 lb. per square foot (with 25 per cent impact) on the roadway stringers, and a 50-ton electric locomotive followed by 2,000 lb. per lineal foot (50 per cent impact) on the railway stringers. Wind was taken at 25 lb. per square foot on the suspension bridge and 30 lb. on the viaduct, and the temperature variation was taken at the moderate amount of 30 degrees rise or fall, in conformity with local climatic conditions. In comparison with these figures it may be noted that the total dead load is 4,370 lb. per lineal foot of main span, or about 4,000 lb. for structure and deck excluding the water main which extends along one side of the roadway.

With this loading the greatest allowable stresses were set at 50,000 lb. per square inch for the eyebars of the main chain, and 20,000 lb. per square inch in the stiffening trusses. Some margin below these amounts was maintained, however, and the final stresses in the chain do not exceed 46,500 lb. per square inch, and those in the trusses 18,500 lb. per square inch, as calculated by the ordinary, approximate method. In the case of the stiffening trusses, additional margin is represented by the difference between analyses of the structure by the ordinary method and by the more exact or deflection method; the latter showed considerably lower stresses, by about 25 to 30 per cent, but no reduction in section was made to suit these stresses. The reduction in the chain stress was made possible by the smaller weight of the combination stiffening truss of variable depth as compared with the parallel-chord truss. The floor framing has its bending stresses limited to 17,000. In all the analyses, the value of the modulus of elasticity of the truss steel was taken at 29,000,000 lb. per square inch and that of the eyebars was taken at 27,000,000 lb.

MAIN FEATURES OF EYEBAR-CHAIN SUSPENSION BRIDGE, FLORIANOPOLIS, BRAZIL.

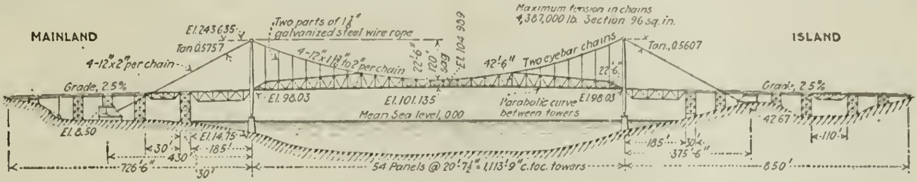
This eyebar-suspension bridge has a span of 1,113 ft. 9 in., which makes it one of the longest suspension bridges ever built. Note the unusual stiffening trusses with use of suspension chain in combination.

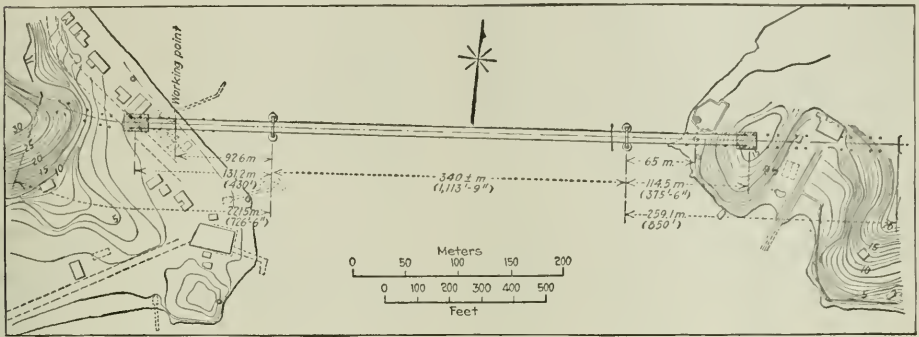
(*On page* 593)

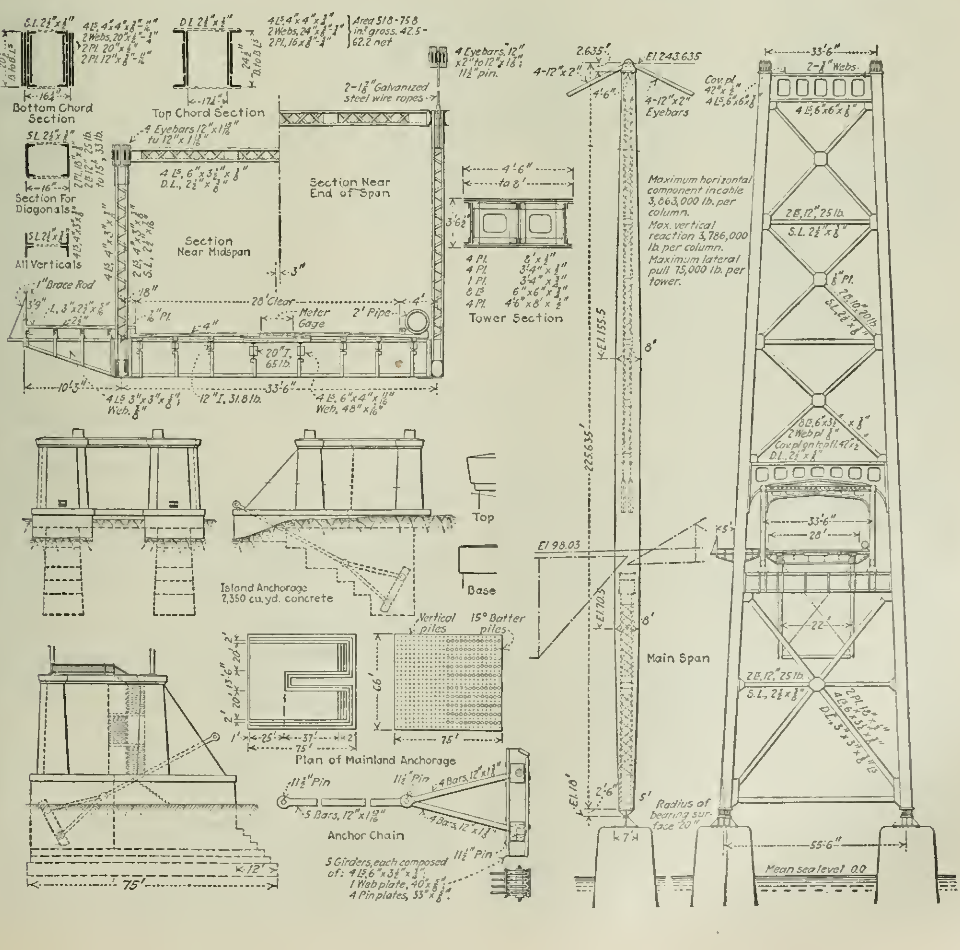
The two chains consist each of four eyebars 12 in. wide, from anchorage to anchorage. The eyebars of the backstays are 2 in. thick, while those of the main span range from 2 in. to 1$\frac{13}{16}$ in., with chain section ranging from 96 to 87 square inches. Steel-rope suspenders are used, consisting of two parts of 1⅞ in. galvanized steel wire rope socketed to clevis attachments at the top chords of the trusses.

Calculations of the deflections of the structure show that under live-load on one-half the span, the quarter-point deflection is only about 13 in., or 1/1,000th of the span, while under full-span loading the center deflection is about 17 in. or about 1/800th of the span. These extraordinarily low values result from the following factors: the use of eyebars in the chains, with their greater section and resulting greater dead weight and reduced elongation; the unloaded backstays; the great depth of stiffening truss at the quarter-points, about double the depth of the originally-planned parallel-chord truss; the large chord-section of the stiffening trusses in the middle portion, where the chains serve as chords; and the novel combination of chain and truss whereby full live-load produces tension instead of compression in the middle half of the top-chord.

Construction and fabrication are now under way and the bridge is expected to be completed by the end of next year.


MAINLAND
ISLAND
Maximum tension in chains 4,387,000 lb. Section 96 sq.in.
Two parts of 1⅞" galvanized steel wire rope
El.243.635
Tan.0.5757
Tan.0.5607
4-12"x2" per chain
4-12"x1⅞" to 2" per chain
Two eyebar chains
120' sag
El.104.909
Grade, 2.5%
El.98.03
El.101.135
El.98.03
Parabolic curve between towers
Mean Sea level, 0.00
El.6.50
El.14.75
54 Panels @ 20'-7½" = 1,113'-9" c.toc. towers
726'-6"
850'


Working point
92.6 m
131.2 m (430')
221.5 m (726'-6")
340 ± m (1,113'-9")
65 m.
114.5 m (375'-6")
259.1 m (850')
Meters
0 50 100 150 200
0 100 200 300 400 500
Feet


Bottom Chord Section
Top Chord Section
Section For Diagonals
All Verticals
Section Near Midspan
Section Near End of Span
4 Eyebars 12"x1⅞" to 12"x1⅞"
2-1⅞" Galvanized steel wire ropes
4 Eyebars 12"x2" to 12"x1⅞"; 11½" pin.
28' Clear
Meter Gage
2' Pipe
1" Brace Rod
33'-6"
10'-3"
Tower Section
4 Pl. 8'x½"
4 Pl. 3'-4"x½"
1 Pl. 3'-4"x¾"
8 Ls 6"x6"x¾"
4 Pl. 4'6"x8'x½"
Maximum horizontal component in cable 3,863,000 lb. per column.
Max. vertical reaction 3,786,000 lb. per column.
Maximum lateral pull 75,000 lb. per tower.
El.243.635
4-12"x2" Eyebars
El.155.5
El.98.03
El.70.5
El.18
Main Span
Radius of bearing surface 20"
Mean sea level 0.0
33'-6"
28'
22'
55'-6"
Top
Base
Island Anchorage 2,350 cu.yd. concrete
Vertical piles
15° Batter piles
Plan of Mainland Anchorage
75'
11½" Pin
5 Bars, 12"x1⅞"
4 Bars, 12"x1⅞"
Anchor Chain
5 Girders, each composed of: 4 Ls 6"x3½"x¾", 1 Web plate, 40"x⅝", 4 Pin plates, 33"x⅝".

Highway Construction in Panama

Traffic Growing Rapidly on Completed Roads—Bridge Building Experience—Local Labor Notably Steady and Efficient for Tropics

BY R. C. HARDMAN
Acting Chief Engineer, Junta Central de Caminos, Panama

HIGHWAY development in Panama is drawing to the close of its first phase and is about to enter upon its second phase. The groups of roads tributary to important ocean ports, begun in 1920, will be virtually completed this year. This constitutes the first development phase. The second phase, now planned and being financed, is the extension of these isolated roads to connect with each other and with the city of Panama. Both the original and the planned routes are indicated on the map, Fig. 1.

Isolated Group Development—Feeling the necessity of transforming the nation from an importing to a possible exporting one, the National Assembly, activated by the progressive policy of the president, Dr. Belisario Porras, passed on March 13, 1919, the first of a number of laws concerning highways and the development of Panama's hinterland. This initiatory law provided for an annual contribution, or road tax, from all able-bodied males between the ages of 21 and 70, who were placed in three categories, of $12, $5, and $3, depending upon the financial standing or earning capacity of the contributor. It also provided for district highway boards to carry on minor works out of the funds so created.

FIG. 1—HIGHWAYS UNDER CONSTRUCTION AND PROJECTED IN PANAMA

This law was followed on Feb. 6, 1920, by one creating a central highway board, consisting of the secretary of the interior and public works, as president; the fiscal agent of the republic, the chief engineer, as executive officer; and two citizens; and this board is to have in its charge the location, construction and maintenance of all roads in the republic and supervision over the local boards created by the first act. As the law contemplated the employment of a foreigner as chief engineer, the U. S. State Department was requested to make a selection and through the Panamanian Legation in Washington J. W. Beardsley, of long highway experience in the Philippines, was named for, and appointed to, the position in August, 1920. Upon his resignation in October, 1921, he was succeeded as chief engineer by R. K. West, of wide highway experience in the Philippines, California and Nevada.

In the budget for the biennium ending June 30, 1921, 75 per cent of the excess of receipts over the amount estimated in the budget was set aside as a road fund. Under the able management of Addison T. Ruan, fiscal agent for the republic, this fund at the close of the biennium amounted to $3,092,225.92.

Topographical Conditions—A word might be said concerning the topography of Panama. The narrow isthmus forming the republic has a high mountainous backbone rising to a culmination in the Volcan de Chiriquí, near the Costa Rican border, at an elevation of some 11,280 ft., and reaching a minimum of a few hundred feet at the Panama Canal. The Atlantic side is, in general, of narrow steep slopes merging into mangrove swamps, while the Pacific slope is much wider, of more gentle declivities, of rolling, grassy plains or llanos, and has a multitude of rivers. Practically all the settlement of the country is on the Pacific side and to the west of the canal. Due to the high tides of the Pacific and the shoal waters near the coast, no natural harbors are to be had. Several small ports, for shallow draft vessels at high tide, furnish the only connection between Panama and the agricultural provinces. Transportation in all the interior districts has been for centuries, and still is, almost entirely by ox-cart and pack-horse for cargoes, and saddle-horse for passengers, over roads and trails which in the dry season are mere ruts and in the rainy season seas of mud, practically impassable. As the rainy season lasts for seven or eight months, the need for passable highways is apparent.

The Central Highway Board, after careful study of the matter, adopted for improvement two sets of roads; one based upon the ports of Chitré and Mensabé, the other based upon the ports of Aguadulce and Obaldía as important points.

The first systems of roads provided for were designed to develop the ports mentioned above, in the vicinities of which several producing sugar mills are in operation, and from which a large part of the beef consumed in Panama is shipped. In the bight of the Gulf of Panama, upon which Aguadulce is located, the convergence of the drainages from the continental divide and the mountains of the peninsula to the south forms a low,

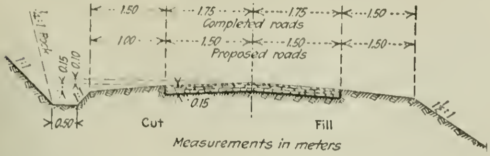


FIG. 2—STANDARD SECTIONS FOR PANAMA HIGHWAYS

flat alluvial area which is very fertile, and which is tapped by the system of roads centering on this port.

Considering the population, economics and probable future traffic, the Central Highway Board very wisely adopted the macadam type of road 3.5-m. surfaced width, with drainage structures of steel and concrete, as the most suitable under the existing and probable future conditions. Provision was also made in grade and structures, for future widening of the road when increased traffic might warrant.

History—Proposals for the two systems of roads decided upon were advertised for in January, 1921. As the board had no technical organization and it was desired to start the work without delay, bids were requested for construction and also for surveys and plans, on the basis of cost-plus-a-percentage, with bonus and penalty clauses. Awards were made to R. W. Hebard & Co., New York, for the Aguadulce system and to the Panama Construction Co., Panama, for the Chitré group, and the work of surveying started in April, 1921, on both divisions.

Each division, sub-divided into four sections, comprised in all, about 135 km. of road. Due to various causes, among which was the business depression and transference of funds to other branches of the government, of the 270 km. in the two divisions, only about half of the proposed program has been authorized and is actually under construction.

In addition to the work in the interior provinces, there was planned a highway from the city of Panama to Juan Díaz, with a short branch to the ruins of Old Panama, which was destroyed by Sir Henry Morgan in 1671. Of this section, 3.37 km. are of concrete, 6 m. in width; 5.30 km. of bituminous concrete, 5 m. in width, and 10.60 km. of oiled macadam, 3.5 m. wide. This is the only highway out of Panama on Panamanian territory and affords an outlet for the rich agricultural districts to the east which have been lying dormant because of a lack of transportation facilities. As an indication of what may be expected in the way of development, a comparison of present traffic on this road with conditions of two years ago is enlightening. The writer, early in 1921, went to Juan Díaz in an automobile, engaged after considerable effort, for $7.50. In the last week of March, 1923, a traffic count at Juan Díaz showed a daily average of 231 motor vehicles, with a maximum of 372 and a minimum of 163. The fare in any one of a number of motor buses is now 50c. for the round trip. On the first or concrete section of this road, the daily motor-vehicle average count was 1275.1, with a *total motor-vehicle registration of but 1,220.* The maximum for this section was 2,942 and the minimum was 853.

Types of Roads—On the interior roads, which are not yet fully completed, equally remarkable traffic increases are expected. Where two years ago motor-vehicles (other than airplanes) were unknown, large numbers of passenger cars and light trucks are in operation, and bus services between towns, which are already connected, have been established.

The roads at present being completed in the interior are, as before stated, of the light-surface type, macadam or gravel with permanent structures of concrete and steel. The width of surfacing adopted was 3.5 m. on a grade width of 6 m., shoulder to shoulder. Structures, however, were designed for a 5 m. clear width, with the exception of long steel spans which are 4 m. This clearance on steel spans was fixed partially by that of some long steel spans already existing on the adopted routes and by the large number and consequent great cost of steel bridges required on the proposed work.

The typical cross-section of the road is as shown in

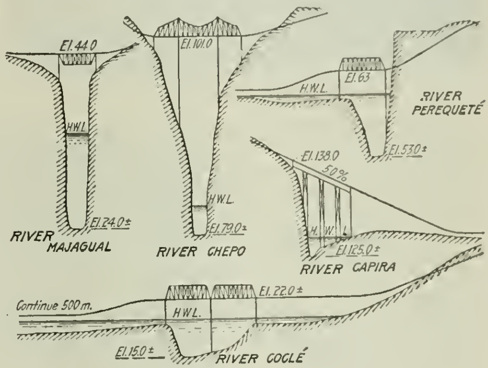


FIG. 3—TYPICAL STREAM SECTIONS AND BRIDGES

Fig. 2. The width of surfacing, as well as its thickness, was the subject of much discussion and study, and those adopted, after a year's observation since the completion of certain portions of road, have been proven to be ample for the amount and weight of traffic.

Construction in the main has been largely by hand labor, especially on earthwork. Mechanical equipment for earth moving has not shown the most favorable results due to the lack of capable operators. A certain amount of patience is necessary to secure the interest of the local operative candidates. One crew has been developed for use on a blade grader drawn by a 40-hp. tractor which has performed very satisfactory service, and with additional practice and training excellent results may be expected. One favorable feature is that the native becomes a steady worker after learning the use and object of mechanical appliances.

Considerable difficulty was anticipated in securing common labor in the provinces, but happily without justification. A steady reservoir of labor has been available, which, although untrained in any but agricultural work, has proven itself fairly adaptable and efficient. Studies made for the year 1922 show that the attendance efficiency of hourly men, measured in terms of hours worked to possible hours of work, has a steady increase throughout the year. Aiding in this was the medical and sanitary supervision exercised by the contractors and an uncinariasis campaign carried on by the Rockefeller Foundation over a part of the period. The common labor is also very quiet and manageable, which in itself tends to increase efficiency in attendance.

Efficiency in output has been good for tropical labor;

FIG. 4—ASPHALT ROAD NEAR PANAMA

especially is this true on task work. On excavation in ordinary earth, tasks of four to five cubic meters are given, depending upon conditions. The average task laborer moves 5 cu.m. in from seven to eight hours. Quarries operated by task labor show an output of about 7 cu.m. per man per nine-hour shift.

An interesting experiment was made with a small gang on earth borrow to determine the merits of the task system. The results were startling. Twenty-one men under a native sub-foreman moved 8 cu.m. in 9 hours. Five of the same men the next day moved 23 cu.m. in the same period by task.

Proposed New Development—As the roads now completed and under construction in the interior are merely for the development of the country adjacent to the ports, their full purpose will not be realized until the systems are connected to each other and to the capital, Panama. Panama, in common with all other undeveloped nations, is distinctly provincial in nature, due entirely to lack of means of transportation between the integral parts. Consequently proper united action for the benefit of the country as a whole is difficult, and only by furnishing connections can unified action be expected. Realizing this, the president, Dr. Belisario Porras, has secured the necessary legislation for the floating of a loan to cover the cost of bringing the present roads to the capital.

The map, Fig. 1, shows the roads already constructed and to be finished by the end of the fiscal year, and those proposed to be built with the proceeds of the authorized loan of $4,500,000, negotiations for which are now under way.

From the point where the present construction stops, at Natá (founded in 1519) to the Canal Zone boundary is approximately 160 km., over a terrain extremely varied, running from low, alluvial river bottoms, through high, grassy plains, broken and eroded waste lands, to high, fertile jungle-covered hills at its terminus at the Canal Zone boundary. Unfortunately, during the construction of the Panama Canal, no provision was made for a permanent crossing, so that now no means exist for transportation from one part of the republic to the other except by water, or by horse across the lower guard gates on the locks. Consequently, a system of highways such as is contemplated, will be defeated in its purpose without the co-operation of the United States government in providing a permanent crossing of the canal and the constructing of a highway from the canal to the boundary. That such co-operation will be given is not to be doubted, as the military value of the work will equal, if not transcend, its economic importance, not only by enabling the rapid movement of the troops over a now practically impassable region, but by the much greater factor of opening up territory to the cultivation of foodstuffs sufficient to sustain the military and civilian population in case of possible blockade by an enemy fleet. Under present conditions, due principally to a former policy of isolation and the depopulation of the Canal Zone, contiguous to the only available transportation—the Panama Railroad—practically all foodstuffs are imported from abroad, or are brought to Panama by water.

The proposed road connecting Natá with the capital presents some difficult terrain, the Natá end for several kilometers being through river bottoms subject to overflow and necessitating practically a continuous fill for about 15 or 16 kilometers. It then merges into a high, grassy plain gradually changing into waste lands characterized by deep, badly eroded gullies and deep, narrow stream channels. In 9.6 km. of this section there will

FIG. 5—TYPICAL LABORERS' CAMP

be eight stream crossings with some 640 m. of steel bridges—nearly 7 per cent of the distance. Leaving this broken country, the line crosses high, jungle-covered hills near Capira, merging again onto grassy plains in the vicinity of Chorrera from which point the wooded hills continue to the Canal Zone boundary.

Owing to the extremely broken topography along streams, in some cases 10 per cent grades are necessary for short distances, while on the Capira hill section 7 and 8 per cent grades are required to reach the summit of the entire line which is at 203 m. above sea level. In general, no grade will exceed 7 per cent. The maximum curve planned is 40 deg., metric-radius about 29 m., although this may be exceeded in some unavoidable instances.

Owing to the nature of isthmian topography, which in the hill sections is made up of numberless small round-top hills with no semblance to order or regularity, the alignment is not simple, although in the plains sections tangents several kilometers in length are easily obtainable.

FIG. 6—"CASCAJO" ROAD NEAR AGUADULCE

"Cascajo" means "gravel," but the soil near Aguadulce which is composed of clay, feldspar, decomposed feldspar, hematite and limonite is also so called.

On the entire route from Natá to the Canal Zone, the projected line shows a total of over 2 km. of steel structures in a distance of about 165 km., having an estimated weight of some 1,600 tons. This work presents the greatest construction difficulty, as transportation in a territory devoid of roads is a serious problem. Not only must steel and cement be hauled from the ports, but in many cases stone, gravel and sand must also be transported long distances. Sand in some sections is unobtainable, in others practically a pure quartz sand is found in large quantities.

Cross-sections of five of the 38 major streams to be crossed in the 165 km. are shown in Fig. 3. These show the three types of stream, the deep, narrow gorge of the waste lands district, the unbalanced bank type of the hill sections, and the low overflow stream of the plains area. Cantilever spans are proposed for some of the wide, deep gorges, as timber for falsework is not available locally and imported sawed timber is almost prohibitive in cost.

Streams of the type of the Capira and Perequeté are usually at the foot of long heavy grades, on the high bank side, that at the Capira being approached by 1,340 m. of an average grade of 4.85 per cent.

The surfacing problem is a difficult one as good rock is very scarce and gravel is even more so in certain sections. Several kilometers of roads now under construction have been surfaced with a soil known locally as "cascajo," which is found over an area of several square kilometers and is composed of clay, decomposed feldspar, hematite and limonite. The material when taken out is yellow, but after a few days on the road becomes an iron oxide color, very hard and practically impervious. In other sections is found a sand-clay mixture which with some addition of sand will form the hard or Class A material of the State Highway Testing Engineers and Chemists conference. In the hill sections, suitable stone is available with reasonable hauls.

Of the other proposed roads, those out of the city of Colon will be the most beneficial, opening up as they will some very productive lands. The short road from the end of the railroad in the western end of the country will tap some very fertile lands on the slope of the Volcan de Chiriquí, which have recently been acquired by a large group of colonists from southern California. The route to Chepo to the east of Panama is but an extension of the road for which some traffic statistics have been given above, and with the western extension to Santiago will provide a continuous road from east to west of some 320 km. through a region which is expected in the near future to place Panama on the list of exporting nations.

FIG. 7—TYPICAL REINFORCED-CONCRETE GIRDER SPAN ON NEW WORK

Old bridge visible in background.

Since the beginning of the highway work two years ago, great enthusiasm has developed along highway lines; enthusiasm which has in many instances resulted in work being done on short connections by voluntary contributions of labor and transportation.

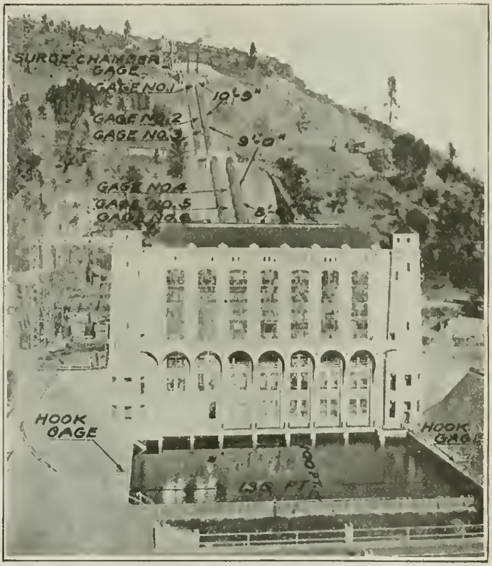
The personnel of the organization handling the highway work is J. M. Fernández, secretary of interior, as President; R. K. West as chief engineer; F. H. Baldwin, sub-fiscal agent for the republic; Rafael Neira A., and Gregorio Miró, members, and Alfredo O. Boyd, secretary. Credit for assistance on financial lines must also be given to Eusebio A. Morales, secretary of the treasury.

Test of Friction Losses Made on Large Penstocks

Ideal Arrangement for an Accurate Measurement of Large Quantities of Water—Tests of Friction Losses in Tunnel

Summary of a paper on Tunnel and Penstock Friction Tests, Pit No. 1 Hydro-electric Development, presented at the P.C.E.A. Convention, June, 1923, by R. A. Monroe, Department of Engineering, Pacific Gas and Electric Co.

AN IDEAL opportunity to make an accurate determination of pressure tunnel and penstock friction losses is offered by the arrangement of the Pit No. 1 Development of the Pacific Gas and Electric Co., particularly as two parallel penstock lines afford a ready means of measuring the penstock friction, and an accurate measurement of the large quantities of water utilized is afforded by a standard weir located at the lower end of the stilling basin in the power house tailrace. The upper portion of Pit. No. 1 penstock is composed



LOCATION OF PENSTOCK AND WEIR GAGES

of butt strap riveted pipe, and the lower portion of lap-welded bump-joint pipe so that it is possible to obtain a direct comparison of the loss in these types of pipe.

The conduit for Pit No. 1 power house consists of about 1,000 ft. of open canal, 10,160 ft. of concrete lined pressure tunnel and 1,372 ft. of steel penstock. The tunnel is connected to the penstocks by a surge chamber which consists of a circular well 60 ft. in diameter and over 60 ft. in depth designed to serve also as a spillway. The water after passing through the turbines is discharged into a stilling basin and measured over a weir before passing through the tail canal into the Pit River.

Tunnel Friction Tests—The tunnel is of horseshoe section 14 ft. 3 in. high by 13 ft. wide and has an area of 156 sq. ft. and a hydraulic radius of 3.42 ft. At a point about 1 000 ft. from the upper portal, there is an angle of 36 deg. From this point to the surge chamber the tunnel is on tangent. The section for 400 ft. from the surge chamber is circular with a diameter of 14 ft. having a flaring section where it enters the surge chamber.

The surface of the tunnel lining is not particularly smooth and even. Wood forms coated with oil when first constructed were used for the side walls and roof. After the forms were stripped, the rough patches and stone pockets were plastered over and the entire area brushed over with a neat cement grout which resulted in a smooth, almost glazed finish. Ordinarily, the alignment of forms was very good, and in cases where excessive offsets occurred they were chipped off. The invert was placed by hand without forms and presents a rather rough uneven appearance.

For securing the loss of head in the tunnel, the difference in water level between the intake canal at the tunnel portal and the surge chamber was taken. The water surface elevation at the intake was obtained from a staff gage fastened to the vertical wall of the portal structure immediately above the grizzly. At the outlet portal of the tunnel the surge chamber served as a huge manometer in which all small fluctuations were damped and close readings were made possible by an attached water gage. These gages were set on U.S.G.S. datum to read actual water elevations.

The loss of head in the tunnel was determined by a simultaneous reading of the gates at the intake and surge chamber after steady flow conditions had been established. For the lower flows the excess water in the river was turned out at the intake dam so that no spill existed at the surge chamber. The water level at each end of the tunnel oscillated for a considerable period after any change in flow, and it was necessary to hold a steady load at the power house for an hour or more before steady conditions were obtained. The discharge was measured by the weir for quantities up to 1,000 sec.-ft., and by current meter measurements in the intake canal for larger flows when the weir became submerged

The computations of tunnel friction are based on the assumption that the head lost in entrance is balanced by the regained velocity head at the surge chamber and that the balance of the velocity head is lost in the surge chamber or is carried into the penstocks. This assumption may not be correct but the resulting error in any case is negligible. Data and results are as follows:

Flow	729 sec.-ft. Kutter's coefficient	n = .0130
"	997 "	n = 0128
"	1,280 "	n = .0126
		Mean = .0128

The tunnel was designed on a basis of n = .014, which has proved conservative.

Penstock Friction Tests—The Pit No. 1 penstocks consist of two lines of pipe, each composed roughly as follows:

281 ft. of 10 ft. 9 in. diameter triple riveted butt joint steel pipe;

532 ft. of 9 ft. diameter lap-welded bump-joint steel pipe;

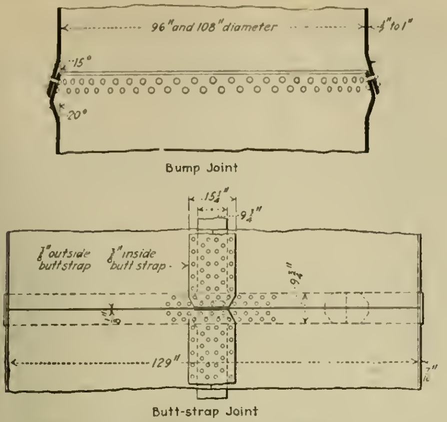
433 ft. of 8 ft. diameter lap-welded bump-joint steel pipe

These sections of pipe are connected by taper sections averaging about 30 ft. in length, the entire length of the penstock being 1,372 ft.

There are no horizontal angles in the penstock except at the entrance to the powerhouse tunnel where the two pipes diverge slightly. There are five vertical angles, averaging about 20 deg. each, two being in the 9 ft. diameter bump-joint pipe and three in the 8 ft. diameter bump-joint pipe.

The penstock friction tests were made by means of a differential U-tube gage connecting the two pipe lines one of which was idle and the other under flow. One arm of the U-tube was connected to the idle penstock, this arm being under static pressure, while the pressure on the other arm was reduced by the velocity and entrance head and the loss due to overcoming friction. The deflection of the U-tube multiplied by the difference in specific gravity between the water and the mercury gave directly the reduction in pressure from static in the operating pipe at the point of observation, the difference in deflections of the mercury column between any two gage boards being a measure of the head lost in that section of the pipe.

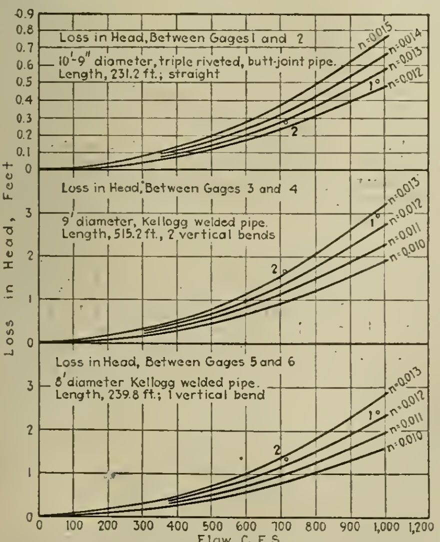
Each penstock was drilled at six correspondingly opposite points throughout its length and tapped for ½ in. piezometer connection. The points were selected to be as near as possible to the upper and lower ends of each diameter of pipe. The upper point, 1, was placed directly below the top penstock anchor. The next two points, 2 and 3, were placed



DETAILS OF PENSTOCK JOINTS

above and below the 10 ft. 9 in. to 9 ft. 0 in. taper respectively. Points 4 and 5 were placed above and below the 9 ft. to 8 ft. taper respectively. Point 6 was placed near the lower end of the 8 ft. diameter pipe.

Before starting the penstock tests, water was allowed to run through the idle penstock for a short time in order to make sure that the temperature of the water in both penstocks was the same and avoid the necessity of correcting for temperature. The operating machine was then brought to a steady load and held there until uniform flow conditions were established throughout. Before making a series of readings, dead water and air in the pipe connections were blown out through the pet cocks on the gage boards and the surge in the penstock was throttled by the needle valve in the steam gage fitting at the top of the board. The position of the mercury meniscus on each arm of the U-tubes was read and recorded. From four to five readings at intervals from 1 to 2 minutes were made at each station, the time of each reading being recorded. It was found that by throttling the surge with the needle valve the U-tube deflections could be estimated to thousandths of a foot. A signal



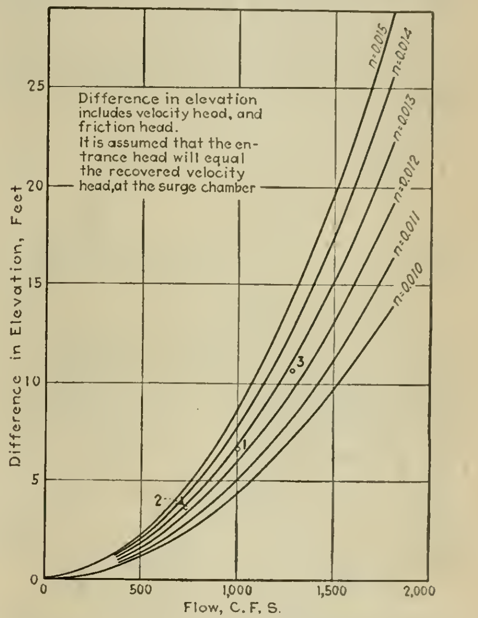
LOSS IN SECTIONS OF PENSTOCK FOR VARIOUS FLOWS ASSUMING VALUES OF "N" IN KUTTER'S FORMULA

system was used so that the recorded deflections for each were made simultaneously. Both weir hook gages were read at approximately 5-min. intervals throughout the test, and the electrical output of the generators also served as a check on the quantity of water measured.

Two series of penstock tests were made, one with the generator carrying full load under a flow of 982 sec.-ft. and one with three-quarters load and a flow of 714 sec.-ft.

Tap 5 on the penstock had been placed within 9 in. of a bump joint and the deflections at this point were all in excess of what they should have been on the basis of the velocity head loss through the taper between gages 4 and 5, plus the friction loss in this distance, based on the value of "n" in Kutter's formula as determined in the 9-ft. diameter section.

A check on the measurements of friction loss for the several sections of pipe is afforded by the loss in head for the entire line as indicated by the power house pressure gage



DIFFERENCE IN ELEVATION BETWEEN TUNNEL PORTALS FOR VARIOUS FLOWS AND VALUES OF "N"

readings, there being one such gage on each penstock. This check is extremely rough, an error of a foot or more being quite possible due to the coarseness of graduation and the vibration of the indicating needle. The results were:

Flow Sec.-Ft.	Friction Coefficient	10 Ft. 9 In. Riv. Pipe	9-Ft. Bump Joint	8-Ft. Bump Joint
714	Kutter's "n"...	0.0128	0.0131	0.0127
	Williams-Hazen "C"	120	113	115
982	Kutter's "n"...	0.0125	0.0127	0.0123
	Williams-Hazen "C".	120	114	115

From the results obtained for the penstock pipe it would appear that the 10 ft. 9 in. diameter riveted steel pipe had a slightly lower coefficient of roughness "n" than the 9 ft. diameter lap welded bump joint pipe. The section of riveted pipe tested was of large diameter and straight between the gages while the welded pipe had two bends of about 20 deg. each in the length between the gages. No satisfactory data for loss of head in bends in large pipe are available but it is evident that for large diameters welded and riveted pipe are practically on a par as regards friction loss and that a value of $n = 0.013$ in Kutter's formula or $C = 115$ in the Williams and Hazen formula can safely be used for new pipe. The excessive U-tube deflection at Point 5 placed 9 in. from a bump joint indicates that there is considerable disturbance of the water in the vicinity of the bump joints.

Suburban Electrification at Melbourne, Australia

Multiple-Unit Electric and Steam Main-Line Trains on Same Tracks of 145-Mile 1,500-Volt D. C. System Completed in 1923—Economic Results—Quicker Service Increases Traffic and Revenue

IMPORTANT IMPROVEMENTS in train service and operating expenses have resulted from the electrification of the extensive suburban system of the Victoria Government Railways at Melbourne, Australia, which electrification was completed over the entire system early in 1923. Notable features in this new installation are the operation of suburban electric and main-line steam traffic on the same lines; the higher speed and better service at lower cost, resulting in increase in traffic and revenue; the adoption of through routing instead of having all trains terminate at the city station; and the supply of current in large quantities by the railway power plant for general power purposes. All trains have American motor, electrical and brake equipment.

This suburban system includes 145 miles of line with 346 miles of track. From the map, Fig. 1, it will be seen that the system consists of a number of radiating lines which extend through numerous residential districts and to a maximum distance of 26 miles from the central passenger station at Flinders St. There are about 2,376 electric suburban trains daily in and out of this station and approximately 240,000 passengers are handled daily. With main line and freight trains the total daily traffic at Flinders St. is about 2,640 trains. Electric traction is only for the suburban traffic; main-line trains will continue to be operated by steam locomotives over the electrified portions of the railways, but main-line electrification is being considered by the Railway Commissioners.

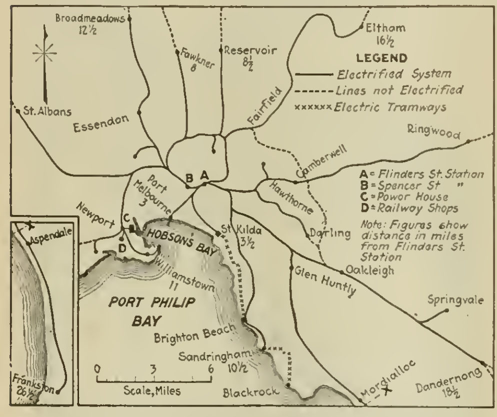


FIG. 1—ELECTRIFIED SUBURBAN LINES AT MELBOURNE, AUSTRALIA

Electrification of the suburban service was authorized in 1912, when the traffic had developed to such an extent as to necessitate either additional tracks to increase the capacity for steam traction or a change to electric traction to increase the traffic capacity of the existing tracks. Contracts were let and work was commenced in 1913, but war conditions caused protracted delay and increased the cost considerably. The first electric train was run in May, 1919, between Essendon and Sandringham, a distance of eighteen miles, and since then the work has proceeded rapidly, so that in June, 1922, about 80 per cent of the suburban traffic was operated by electric trains.

Supply of current at low prices for power purposes is an important feature of the project, since the peak demand for railway service is reached only during the short rush-hour periods of morning and evening. A steadily increasing cost of coal is a factor in the economy due to electric service. Thus the original estimates showed an economy when the price of coal was about $2.50 per ton, but in 1919 the price had increased to $4.60 per ton delivered at the power station. The total expenditure to June 30, 1922, was $27,484,200, which was expected to be increased by $3,250,000 before completion. On the other hand, some of the expenses were properly chargeable to such accounts as general power supply, line improvement and signaling, so that the final cost for electrification will be reduced accordingly.

Economic Results of Electrification—In the annual report of the Victorian Railways Commissioners for the year ending June 30, 1922, the results obtained were presented as follows:

A marked increase in business has resulted from the electrification of the various lines. The economic efficiency of electric train operation compared with steam locomotive working has made possible an average increase of about 35 per cent, as compared with the previous steam train time-tables, in the total number of trains scheduled, the cost of which under steam traction would have been prohibitive. The fast and frequent electric train service now provided during the slack hours has encouraged considerable additional traffic. On 95 miles of electrified line, out of a total of 145 miles, the extra traffic due to electrification (after allowing for the normal expansion that would probably have occurred had steam traction continued and for other factors) is valued at approximately $850,000 per annum, while the increase in the number of passenger journeys is estimated at 12½ per cent. Present indications are that the annual interest on the scheme will be offset by the increased traffic induced through the improved train service afforded by electrification.

Local or Wonthaggi slack coal is utilized at the Newport power house for the generation of electricity, and the use of this cheaper grade of fuel and the elimination of steam locomotives from the suburban system have enabled considerable savings to be effected in the cost of train operation. It is estimated that to run the present electric train mileage under steam conditions would require approximately double the quantity of coal now consumed at the power house to generate current for train operation. In addition the coal for locomotives would require to be of higher quality and would be relatively more expensive, while the advantages of the higher speed and the greater flexibility of the electric train would not be available under steam.

An important advantage of the electrification scheme is that it has enabled the central station at Flinders St. to be used largely as a through station instead of a terminal, and has deferred costly duplications of tracks and the provision of other facilities which would have involved expenditures amounting to several million pounds. If electrification had not been adopted, a large outlay would have been required for new locomotives and additional carriages to operate the suburban train services; and even then the great improvements in speed and frequency afforded under electrification would not have been practicable had steam working been continued.

The original project of establishing a railway traction scheme has developed in another highly important direction, namely, the supply of power for industrial purposes. The total monthly output from the Newport power house is now approximately 14,770,000 units, of which 6,400,000 units are being sold for other than railway purposes.

Electric System and Power Station—A 1,500-volt direct-current system was adopted, since a comparison of alternative bids for systems using 1,500-volt direct-current and 11,000-volt single-phase alternating-current indicated that the former would be about 23 per cent lower in first cost and 22 per cent lower in annual operating expenses.

The power station of 100,000 hp. capacity is located at Newport, near the mouth of the Yarra River, an arm of Port Phillip Bay, since the requirement for condensing water is about 6,000,000 gal. per hour when working at maximum capacity. Structural steel framing is used for the building, with walls of cement plaster on expanded-metal lathing. It is U-shaped in plan, with the turbine room and switch room extending across the full width and with two boiler rooms forming the legs. A low structure between the boiler rooms contains laboratories, store rooms and locker and toilet rooms. Beyond each boiler room is a coal pile straddled by a steel trestle on which travels a locomotive crane handling a grab bucket. There is ample space for a proposed duplicate power house.

Six turbo-generators of 12,000 hp. constitute the present main power equipment, with two 350-kva. machines for starting the auxiliary apparatus when all the main turbines are shut down. Room is provided for two more generating units. Steam is supplied by twenty-four water-tube boilers carrying 210-lb. pressure, each boiler room having twelve boilers in six batteries on opposite sides of a central firing room, with a low smokestack to each battery.

Coal from 15-ton drop-bottom cars is dumped into a track hopper and after passing through crushers is fed to bucket conveyors which deliver it to overhead bunkers of 3,000 tons total capacity or to the coal storage yard. This storage coal is reclaimed by the locomotive crane mentioned above and delivered to conveyors for filling the bunkers. Suction conveyors remove the ashes, but narrow-gage tracks with ½-ton cars are provided for emergency.

Transmission Cables and Trolley Wires—Current generated at 3,300 volts is transformed to 20,000 volts for transmission to fifteen substations where it is transformed to 1,500 volts for delivery to the overhead wires. Another substation controls supply to the railway shops and two 600-volt substations provide for current supply to the St. Kilda & Brighton and Sandringham & Blackrock electric tramways (Fig. 1). In the city the transmission lines are laid mainly in trenches in the streets, owing to the limited space along the railway tracks, but in outlying districts they are carried on brackets on the poles for the overhead wires, as shown in Fig. 2.

Overhead contact wires or trolley wires are suspended from catenary cables carried by light steel bridges 300 ft. apart, with tension devices on anchor bridges at intervals of 3,000 ft. At each bridge the wires are held from swaying by horizontal arms or pull-offs attached to the posts. For curves, one pull-off is attached to a rigid vertical member depending from the bridge, as in Figs. 2 and 3. For double-track these bridges have tapering posts composed of two 6-in. channels with web lacing and a top member consisting of two 6-in. channels with attachments for the catenary cables (Fig. 3). For more than two tracks a light horizontal truss is used, with hangers to carry the catenary cables. For long spans and the complicated wiring over station approaches, two-hinged "arch" trusses are used, having vertical side members resting on shoe pins. The largest of these "arch" bridges, shown in Fig. 3, has a span of 120 ft. and a truss depth of 7 ft., with the bottom chord 30 ft. above the rails.

Since the catenary cables serve as feeders they are electrically connected to the trolley wires at 600-ft. intervals, owing to the low conducting power of the hangers, which have a chain link connection to the wire to allow for vertical motion caused by the passage of the pantagraph collectors on the motor cars. These cables are of copper for the main tracks and of galvanized steel for the side tracks and yards. At the Flinders St. station, four double-track main lines pass

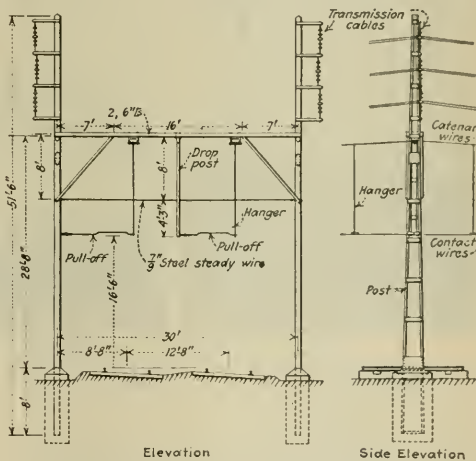


FIG. 2—BRIDGE CARRYING TROLLEY WIRES AND TRANSMISSION CABLES

through the coach yard, and here the catenaries for the yard tracks are carried by transverse wires attached to the cable bridges over the main tracks.

The contact wires have a normal height of 16½ ft. from the rails, with a maximum of 18 ft. at road crossings and a minimum of 14½ ft. under highway bridges. This minimum gives a 4-in. clearance above the maximum limit of main-line equipment and 12-in. below the bridge structure. At low bridges the supports are placed out of the line of the blast from steam locomotives.

Track and Terminals—All tracks are of 5 ft. 3-in. gage and are spaced 11 ft. 8 in. or 12 ft. 8 in. c. to c. Track construction consists of 80-lb. and 100-lb. rails spliced with six-bolt angle-bars and spiked to hardwood ties 10x5 in. and 9 ft. long in 1½-in. stone ballast 10 in. deep under the ties. The tie spacing is 34 in. c. to c. or 20 in. at rail joints. These lines are mainly double-track, but with some four-track and six-track stretches and about twenty miles of single-track. The maximum grade is 2 per cent and the sharpest curves are 10 deg. on the viaduct approaching the main passenger station at

Flinders St. Transition curves are used on all sharp curves. Automatic three-position block signals of the semaphore type are used (Fig. 3).

There are two important city stations, the principal one, at Flinders St., having thirteen through tracks in alternate groups of three and two with four island platforms and two side platforms. These station tracks converge into a four-track approach at each end. A few blocks distant is the Spencer St. terminal station, with two through tracks and twelve stub tracks. All stations have high platforms. At the suburban stations the platforms are usually for six-car trains but these are being lengthened for eight and ten cars.

Train Equipment and Service—Multiple-unit trains are used for the suburban service, composed of 47-ton motor cars with and without driver's compartment and 27-ton non-motor trail cars. Each train has alternate motor cars and trailers. Six-car trains are operated ordinarily, but provision is made for longer trains. Although the cars are of 5 ft. 3 in. gage, they and their electrical equipment are so designed as to admit of a future change to the 4 ft. 8½ in. gage.

About half the cars are a combination of American and European types, having transverse seats and a center aisle, but with sliding side doors; transverse bulkheads with sliding doors divide the cars into first- and second-class sections and smoking rooms. The other cars are of the European type with transverse compartments and swinging side doors. All cars are mounted on four-wheel trucks. Their seating capacity is 80 and 84 passengers for motor cars and 90 and 94 passengers for trail cars. Each motor car has four 140-hp. motors and a pantagraph collector operated by compressed air; the collector is fitted with renewable copper wearing plates filled with graphite grease.

Electric trains have been introduced gradually and steam trains correspondingly retired. An average increase of 30 per cent in speed is one result, owing largely to the rapid acceleration with electric trains, so that the time of the various trips is reduced by three to eleven minutes. The maximum speed capacity on level track is 52 m.p.h. All trains are equipped with Westinghouse brakes. A 2-minute service is operated on some of the inner lines, and from 2½- to 3-minute for the outlying portions during the busy period. Electric locomotives for the suburban freight service are proposed, as steam locomotives are wasteful of coal.

With steam operation, practically all suburban trains made the Flinders St. station a city terminal. But the service has now been improved by making through trips on electrified routes between outlying points, thus reducing the switching and delay in the city station. Such routes are from Williamstown east to Oakleigh and Glen Huntly, and from Sandringham north to Broad Meadows (Fig. 1).

Cost and Economy—The capital cost is put at about $30,000,000, with annual costs of $2,550,000 divided equally between operating expenses and interest. The cost has increased enormously beyond the original estimate of 1912 as a result of additions and enlargements of the original plans and also very largely due to the great increase in prices following the World War. Thus the turbo-generator equipment increased 100 per cent; electrical equipment for power house, substations and cars, 80 per cent; high tension cables, 78 per cent, and overhead wiring equipment 67 per cent. Labor costs also increased 70 per cent.

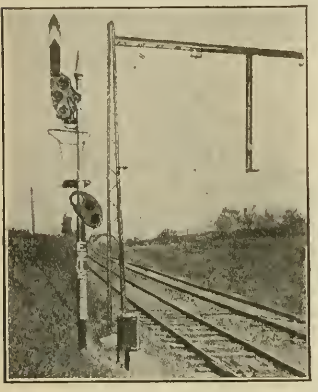
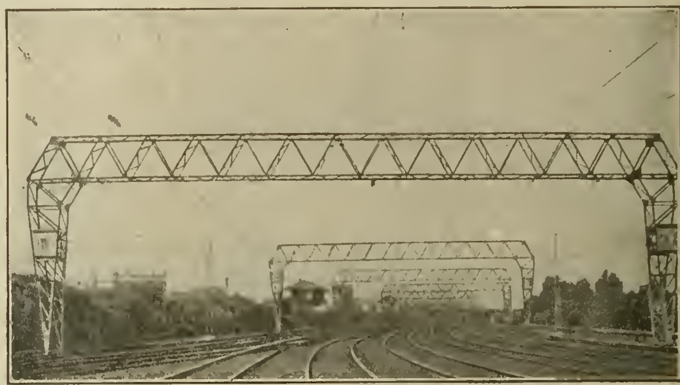



FIG. 3—BRIDGES FOR OVERHEAD WIRING ON MELBOURNE SUBURBAN LINES
At left, automatic signal and bridge for catenary cables on double track. At right, 120-ft. two-hinged arch trusses carrying catenary cables for group of tracks.

On the other hand, large operating economies have been secured. In 1921, the results of five lines operated by electricity indicated a saving of $230,000 in coal and $250,000 in staff and rolling stock, combined with an increased revenue of $955,000 due to better service. For that year, the power house required 54,000 tons of coal at $350,000, while an equivalent service by steam locomotives (but at lower speed) would have required 91,000 tons at $640,000.

This electrification was considered by the Victorian Railways Commissioners as early as 1898, and in 1908 a report was made by C. H. Merz, of London, who predicted that it would reduce operating expenses and increase traffic and revenue. Under an agreement made in 1912 the work has been planned and carried out by Merz & McLellan, consulting engineers, London, England, with E. P. Grove as their engineer in charge at Melbourne. British and Australian manufacturers supplied most of the material, but all electric equipment for the cars was furnished by the General Electric Co., New York.

Through the Reclamation Country

By F. E. Schmitt
Associate Editor, *Engineering News-Record*

A SERIES OF ARTICLES on Federal Land Reclamation is to start in *Engineering News-Record* in a few weeks. It will give a history of the twenty-one years of government irrigation, state the many problems of operation—engineering, agricultural and financial—analyze the various complaints that are being so emphasized by those who are seeking a reform of the current law and methods and seek to present some views as to a constructive policy in the future. Through it all will run the evident theme that irrigation, from planning, through construction to operation, is a continuing engineering problem.

As a part of the preparation of the series Mr. Schmitt is now traveling through the West, visiting irrigation projects, studying developments and interviewing builders, operators and settlers. He will write a series of letters of running comment on the situation as he sees it on the ground. These are not the final result of his trip but they will serve to acquaint our readers with the actualities of reclamation as revealed to an unprejudiced investigator.

This is the second letter. The first appeared in the issue of October 4.—*Editor.*

Grand Junction, Colo.

SEEN AT close range, a reclamation project in full-size operation is impressive. It is a community of many thousands of people grouped around and among the parts of a vast water-supply machine which spreads out over a hundred square miles or more. The machine must be operated: the required amount of water according to daily request or a fixed schedule of rotation must be admitted at each farmer's headgates, disputes between adjoining users about supply or overflow of water must be prevented, consumption must be measured, canals, gates and structures must be kept in order. Finally, hardest of all, payment for the water must be collected. The manager has a combined administrative, engineering and excise job of peculiar difficulty. He not only has to operate and maintain and repair his machine, but he must keep it in gear with the community. The successful manager with his water-masters and ditch-riders should know the family history of each one of his thousand or more farmers, how many cows he milks, what oil stocks he bought, whether he can pay his mortgage interest this fall, and why he is making a failure.

On the ideal reclamation project the job would be simpler—the manager would be an operating automaton with cash-register attachment. The ideal project is one on which every family is contented and happy and each farmer pays his debts, puts money in bank regularly and finally buys out his neighbor. But probably there is no such ideal project, just as there is no such community in the unirrigated world. Some men do not do as well as their neighbors; others become failures. There are quite a lot of failures on the reclamation projects (I have seen three projects so far) and the amazing part of it is that some of the failures now developing are men who have been there from the start. There are the skillful and the unskillful; the thrifty and the unthrifty. The latter kind doesn't manage to pay its debts and finds it impossible to meet the annual water charges and the installments of the construction charge which the nation advanced free of interest for twenty years. Largely the three projects are still in process of evolution though they are up to 14 or 15 years old; and the troubles incident to evolution are quite obviously at the root of most of the complaints and protests that are heard. There is still much pioneering to be seen, which answers an advance question. The rough work and hardship of starting to farm on irrigated desert is not all of the past. It appears that the period required to catch up with the game of making a living out of the allotted farm unit is not over after two or five or fifteen years, in a great many cases.

Scores of farmers are existing in the most primitive condition, scratching for a living, in debt and getting deeper in; and hundreds have left. Some never had anything, some have lost what they had at the start. This man quit, that one was foreclosed by creditors. There are a few abandoned farms, and it will take more pioneering to get them in operating shape. Plenty of prosperous farmers can be found, men who have not only made money but have built up thriving farms. But there are the others also. The settlers pioneered when they started, and needed a chance, a breathing spell to get going. Many still need a chance.

Making successful farmers out of pioneers is a many-sided problem. Numerous trouble-making factors are involved in converting raw irrigated land into a self-supporting farm community, and there are various opinions about them. But prominent among them are two facts which are early apparent, namely, that there is much poor land on the projects and many bad farmers. Some people say that "the bad farmer is found on the poor land." And a Federal Land Bank man whom I met said "that is where we get the majority of our loan applications." Nevertheless the two facts are separate. The poor land was there before the settlers came and the bad farmer was not made such by the land.

These facts are probably commonplaces to men in the irrigation states, but the man in the humid regions and particularly the non-farming citizen, who may have much to do with working out the future of reclamation, does not think of them as important factors. It may be that commonplaces of this kind make up the main part of the problem of operating reclamation successfully.

What To Do With Poor Land—First as to poor land. A reclamation project area includes both smooth and rough ground, flat and steep (or rolling) topography, good soil and poor soil; it may have areas of hard clay or troublesome zones of drifting sand. There are acres of ground that are practically non-arable. In some cases the settlers in a poor district were allotted larger areas than those in the good. But with this exception, all farmers on a project are on equal terms: they pay the same for water (annual charge for operation and maintenance) and they are expected to pay the same per-acre share of the original cost of the works (construction charge). Their taxes may be slightly lower because of lower valuation.

Most of the farmers on the poor land are just hanging on. It was poor land originally, and much of it should never have been included in the reclamation. This last was stated positively by an agricultural expert whom I met on one of the projects and was supported by other men of almost equal qualifications. On some projects much land has been injured by alkali or waterlogging (seepage) troubles not yet cured, but that

is not in question now; there is poor land today that was poor at the start, and it would have been well if engineers and soil experts working together had kept it out of the reclamation.

Why they did not seems to be a somewhat complicated question. The original reclamation law as interpreted by executive officials left the land open for homestead entry while the irrigation works were being built; the result was that on early projects good and poor land was taken up by settlers in the definite expectation of obtaining water, and it would not have been practicable later on to refuse to supply the men who had been unwise or unlucky enough to settle on poor land. Co-operation between soil experts and engineers did not go far enough, according to our present lights. Knowledge of soils was imperfect, and knowledge of irrigation agriculture was imperfect. The Department of Agriculture has maintained a dozen or so experiment stations on the projects for many years, and is still learning something about cultural and soil questions. In fact, successful irrigation farming seems to involve not only more labor and a different skill from that demanded by ordinary farming, but a somewhat different science, which is only partly worked out as yet.

Remedies—Unwise inclusion of poor land is chargeable to a number of agencies, among whom the engineer is bound to take his share of blame. However, the question today is not who was at fault, but what to do about the poor land—how to prevent continuing failures on it, with steady trouble and expense to the country at large, the local community and the settlers. Two lines of thought are being followed in this matter.

One involves classification of all land on a project into good, less good, etc., and adjustment of the terms of repayment accordingly. Such classification has been carried out on a few projects (notably on the North Platte), by varying methods, but apparently has not yet been put to use. The share of construction cost on the poor land could be lowered, but that on the good land cannot be raised because the farmer holds a contract which limits the amount he must repay. The time allowed for repayment might be varied, a longer period being fixed for poor land than for good; but the repayment period is laid down in the law by Congress, and at present is alike for all. On future projects it would seem quite possible to grade the construction charge according to land quality. On the existing projects—those which because of poor land are not doing as well as they should—it may be necessary for Congress to authorize extensive readjustments of burdens according to land quality.

The worst of the land ought to be abandoned—this again in the judgment of agricultural men who have watched the farmers' results. Where land is so rough that proper leveling is unduly costly for the settler, so that he is likely to use inefficient irrigation methods or be seriously hampered in getting under way, the advisability of doing some leveling at government cost suggests itself; but on this last subject decided differences of opinion exist.

Paternalistic Suggestions—The other way proposed for dealing with poor land is based on developing the right farming methods for such land (readjusting the size of the farms to suit, where necessary) and teaching these methods to the farmers, with the help of some means of insisting that they adopt them—if such means can be found. This is also a method proposed for dealing with the bad farmer, namely, to make him into a good farmer rather than let him go to the dogs. In either light, such an instructing and assisting process would require a large organization and a strongly administered agricultural purpose on the part of the government, neither of which exists. The Reclamation Bureau is not an agricultural organization and is said to have no authority to use the reclamation fund for such work, while the Department of Agriculture appears to have no recognized responsibility for the success of the reclamation projects, besides having no funds. On the other hand, the states in which the projects are located seem to find plenty of troubles of their own without bothering much about nursing the irrigation communities; that is Uncle Sam's business! County agents and state experiment and demonstration work help a little, but they do not go far toward reaching the incompetent farmer.

With reference to the bad farmer: while some people want him to be advised and helped, others would eliminate him just as early as possible. They claim that unskilled farmers—ex-school-teachers, bookkeepers or dentists—have no more business on a reclamation project, where the nation has invested much money, than a farmer has in dentistry or teaching. They want to select the men who go on the projects and accept as settlers only able, strong, experienced farmers with ample money and credit.

The underlying idea of such selection of course would deny the right of trying to found a farm home in the West to all except those few who could meet certain tests or inquiries. People who are not ready to admit that selection in advance is feasible or desirable say that there should be automatic selection, by practical trial; let the fittest survive! Those farmers that fail to make a success, fall behind on water and construction payments and are short of credit at the bank, should be closed out and the successful farmers alone be retained—with special treatment for the occasional farmer whose bad luck is not his fault. Stated this way, the process seems a little cold-bloodedly businesslike, particularly if the unsuccessful farmer has been handicapped by poor land. But it is the method which is necessarily applied on all private irrigation projects and which operated in all the farm pioneering that has gone on from the earliest days; and it is the method of every other business and occupation besides.

Reorganization of Alsace-Lorraine Railways

One of the more difficult of the problems of adjustment which the French Parliament is called on to solve as the result of the re-incorporation of Alsace-Lorraine into French territory is the relation of the Alsace-Lorraine railroads to the French railroad legislation. The possibility of operating the Alsace-Lorraine railroads directly by the state was at one time considered, but rejected. By a plan now advocated the Alsace-Lorraine railroads will be operated by the Compagnie de l'Est, but upon a special account and under the direction of an office located at Strasbourg. The proposed plan also provides that the three Departments of the restored provinces shall be represented on the Railroad Council (Conseil des Chemins de Fer). Employees will retain all rights which they have earned and the special features of the railroad operations, such as fourth-class tickets, Sunday tickets, etc., will be conserved.

New Logarithmic Equation for Friction Losses in Pipes

By F. W. Greve
Associate Professor of Hydraulic Engineering, Purdue University, Lafayette, Ind.

Among the large number of formulas available for the determination of friction losses in pipes, those of the exponential type possess the greatest advantage. All of them, no matter what the type may be, depend upon coefficients which vary with the diameter and length of pipe, velocity of flow, etc. The formula herein described has been devised with the aim of reducing the number of variables to a minimum. The basic equation for its derivation is,

$$h_f = A(v)^B \qquad (1)$$

where h_f is the friction head, or the head lost due to friction in 1,000 ft. of iron pipe, A is a coefficient dependent upon the diameter of the pipe, and B is a constant exponent for all diameters. The coefficient A may be expressed in terms of two other constants, E and F, thus enabling computations to be made without reference to book or tables.

The formula (1) is empirically derived from the plotting of the logarithm of the friction head against the logarithm of the velocity on rectilinear cross-section paper, or, better yet, the derivation of the ratio of these two quantities when plotted on logarithmic paper. The graph is a straight line when plotted on logarithmic paper, and since its position is determined by three points it is only necessary to plot the minimum number of values of friction head and velocity. An easy mathematical solution for this latter graph is by the centroid method. The centroid of all the plotted points is first obtained by finding the mean values of friction head and velocity. The points on either side of this centroid are then treated in a like manner to locate their respective centroids, thus determining three points that establish the straight-line graph. A graphical check is readily applied by measuring the slope B, with the velocities plotted as the abscissas, and ascertaining the value of the coefficient A, which is the value of the friction head for a velocity of 1 ft. per second.

VARIATION OF THE COEFFICIENT, A, WITH THE DIAMETER, d

d, in.	1.0	1.25	1.5	2.0	2.5	3.0
A	10.4	7.49	6.22	4.86	3.76	3.03
d, in.	4.	5.	6.	8.	10.	12.
A	2.15	1.70	1.34	0.960	0.757	0.597
d, in.	16	20	24	30	36	42
A	0.429	0.330	0 267	0.204	0.166	0.140
d, in.	48	54	60	66	72	......
A	0.119	0.104	0.0917	0.0819	0.0744	.....

The values of the various constants noted in this article are based to a large extent on Williams and Hazen's "Hydraulic Tables," and have to do with iron pipes that have been in use for moderate periods of time.

The values of A and B listed in the accompanying table were first obtained as previously outlined. The exponent B is a constant and equal to 1.85 for all sizes of pipe under consideration. The accuracy obtained with a fixed value of B is well within practical limits, for no two pieces of pipe, even when new, show exactly the same friction head for a given velocity.

The formula, $h_f = A(v)^B$, is simple and easily manipulated with the aid of the accompanying table, which shows the variation of A with the nominal diameter in inches. With the idea of eliminating the variable coefficient, A, from the equation, the values of A were plotted vertically against the diameter, d, on logarithmic paper, the graph resulting therefrom being a straight line of the form,

$$A = E(d)^F \qquad (2)$$

where E is a constant coefficient; d is the nominal diameter of the pipe in inches; and F is the tangent of the angle that the graph makes with the d axis. The value of F is negative, showing that the graph extends from the upper left towards the lower right of the diagram; or that the value of A decreases with increase of d. Combining equations 1 and 2, there will result,

$$h_f = E(d)^F(v)^B = 10.96(d)^{-1.169}(v)^{1.85} \qquad (3)$$

$$\text{Log } h_f = 1.03995 - 1.169 \log d + 1.85 \log v \qquad (4)$$

Thus for any iron pipe, the friction head per 1,000 ft. of length can be expressed in terms of one variable, namely the velocity. Besides the advantage of simplicity and ready adaptation to accurate plotting, the exponential equation cited above eliminates the necessity of resorting to the cut and try method of solution, as exemplified in the commonly used formula,

$$h_f = \frac{fL(v)^2}{2gd}$$

where the velocity or the discharge is to be calculated.

German Labor in French Building Trades

Paris Correspondence

A fact generally recognized is the shortage of many kinds of labor in France, in mines, in railway construction, in agriculture, notably in masonry and in the building trades in general.

An interesting experiment has been made during the past eighteen months or so in the Liberated Regions of North France by the employment in the building trades of German labor under conditions which if they do not bespeak a wholly liberal interpretation of the relations of the employer and the employee have at least produced interesting results on both sides.

In the region of Montdidier the Société Parisienne d'Enterprises has employed eighty German workmen recruited through the labor bureau of Treves, but only after serious investigations as to the sentiments, honesty and capacity of the workers in question. Of this number thirty were ultimately rejected as undesirable and the fifty remaining, divided into two groups, have been employed on construction and building jobs at the trades of masons, plasterers and tile workers. Invariably they have produced satisfactory results, as well from their deportment in a lately invaded country and for the quantity and the quality of the work they have turned out. Their pay has ranged from 35 to 40 francs a day (at normal dollar exchange, \$7 to \$8) of which 10 francs is paid the contractor for their food and lodging.

An impartial estimate of the worth of this labor, which was recruited from the Rhineland provinces, was made by the consulting architects and it was considered that it produced results which were technically excellent and rapid. Their relations with the neighboring populations were invariably correct, no complaints having been made at any time. They worked chiefly under orders which were passed to them by a Swiss engineer trained in the construction trades and speaking French and German. In summing up it is the opinion of the French government labor bureau that the experience had given most satisfying results.

From Job and Office

Hints That Cut Cost and Time — For the Contractor and the Engineer

Designing Steel Details With Attention to Drainage

By Arthur M. Shaw
Consulting Engineer, New Orleans

WHILE it is generally recognized that structural steel, exposed to moisture and atmospheric action, is susceptible to rapid corrosion, an examination of many bridges and other steel structures would convince an observer that it is still pertinent occasionally to suggest that more attention be given to the design of details in order that complete drainage may be effected, if this be possible. The accompanying photograph (Fig. 1) well illustrates the result of failure to provide such drainage.

FIG. 1—STEEL CORRODED BY LACK OF DRAINAGE

The steel members shown consist of two 3-in. standard angles placed as corner protections to the concrete slot for receiving sliding canal gates at the end of a flume. Shortly after the flume was placed in operation (about eight years ago), the system of control was changed and the gates were discarded, thus making it unnecessary to afford any protection to the angles shown.

It will be noted that the photograph shows that one of the angles appears to be in good condition while the angle at the opposite side of the opening has lost practically its entire effective section by corrosion. The 6-in. scale lying across the opening will give an idea of proportions. The sketch (Fig. 2) shows these angles in section as "Angle A" and "Angle B," respectively. It is shown that each of these angles is tipped slightly from the vertical, to conform to the inclined position of the sliding gates, angle *A* being in such a position that it drains readily, while the back edge of angle *B* is depressed about 3/8 in. below the level of the concrete work, forming a water trap from which no outlet was provided. Not only was the top leg of angle *B* destroyed for a considerable portion of its length but the vertical leg was so corroded as to retain no material structural strength.

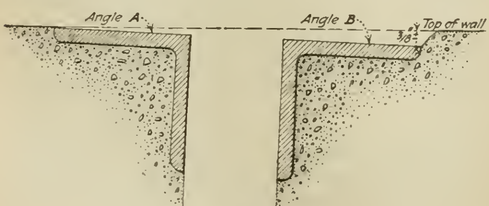


FIG. 2—ANGLE SECTIONS SHOWN IN FIG. 1

In the structure shown, there were three pairs of angles, all similarly placed. In no case did the drained angles show any material reduction in section and in no case did the undrained angles fail to show a sufficient reduction in section as to render them unfit for any useful purpose, though the central section (shown in the photograph) was the most extreme example of destruction.

How One State Aids Contractors in Locating Road Materials

By G. H. Henderson
Office Engineer, State Board of Public Roads, Providence, R. I.

IN ADDITION to the standard plans and specifications at the disposal of prospective road bidders, it is the practice in Rhode Island to furnish the contractors with all the information at our disposal concerning the availability of local materials, such as sand, gravel and stone purposed to be used in the proposed construction.

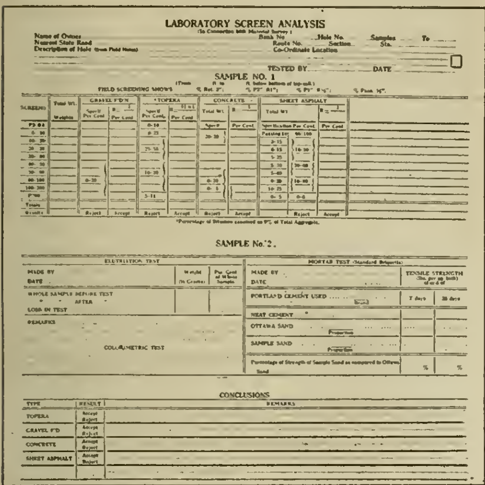
On the quantity sheet of the standard plans, as is customary, are given summaries of the cuts and fills between stations, the locations and quantities of foundations, pipes, catch basins, guard rail, masonry etc. The quantity appearing in the proposal form opposite each item agrees approximately with the quantity appearing upon the quantity sheet of the plans.

The purpose of the material survey is not to render unnecessary personal search by the contractor for suitable material for the job, but to aid him in his search. It calls to his attention certain sources within reasonable distance of the job where materials passing specifications may be obtained, and the approximate quantity available. It saves him unnecessary investigation of certain gravel banks or sand pits which are known from tests to be of inferior quality, or which fail to pass the specifications in other respects. Further information is given such as owner's names, their willingness to sell, length and character of haul and water facilities. There is no guarantee on the part of the state that the banks will run true throughout as per the samples taken and tested. The state does not own any banks nor is there any law which permits it to purchase.

The information for the material survey is obtained by a material survey force working under direction of our testing engineer, who also has charge of our testing laboratory. The force consists of a nucleus of two men regularly employed in this work and is augmented from time to time by men from other departments of our work. Material survey work is practically continuous and will be until the whole state has been covered. It is our policy to use men in this work who are temporarily out of employment in their regular capacity. Resident engineers and assistants at the completion of a contract and until construction work resumes, either join the material survey force or are used to augment

the field surveying parties or the office force, according to the experience and ability of the men.

A material survey for a contemplated contract consists in the locating and testing of all known sources of supply of mineral aggregate within reasonable distance of the job which is purposed to be used in the work. The final selection of the type of pavement or foundation often depends upon the data obtained from the survey. In the case of gravel or sand banks sufficient test holes are dug over the area of the bank to insure representative samples. The average depth of the test holes over the top area of the bank is 6 or 7 ft., while if there is a working face, by stepping down, greater depths are obtained. Fifty-pound samples are taken and run through the 2-, 1- and ½-in. screens in the



DATA GIVEN CONTRACTORS IN SCREEN ANALYSIS

field. The aggregate passing the ½-in. screen is sent to our laboratory and there run through the colorimetric, elutriation and screen analysis tests. The screens used in the laboratory screen analysis cover the specifications for sheet asphalt, Topeka, concrete and gravel foundation. The aggregate in the bank from 2 in. up to one and two-man size rocks is determined in the field and stated in terms of percentage.

The knowledge obtained and conclusions drawn from the tests as to the possibilities of a bank are passed on to the contractors interested in the contract. It is issued in pamphlet form under the caption "Material Survey," and is accompanied by a sketch map covering the vicinity in which the contract is located. On this map, which is drawn to scale, the location of roads is shown and the portion included in the contract marked for contrast. The gravel and sand banks are shown in their relative location and are marked with numbers corresponding to those listed in the pamphlet.

For the benefit of the contractor in the field, station signs are posted at every 1,000 ft. along the job, and also direction signs and arrows leading to each bank or pit. The bank numbers are painted on the signs so that the contractor has little difficulty in finding a particular bank after seeing its relative location on the map.

Part of a page from the material survey pamphlet furnished the contractors for a job now under contract is shown herewith. For the sketch map accompanying the pamphlet we photograph the portion of the Standard U. S. Topographical Sheet covering the area desired after properly noting and marking the sheet. Photostat copies are then available in any number desired. The record sheet used by the material survey force in the field is undergoing a change at the printers and is not given, but a specimen laboratory screen analysis record sheet is shown.

MATERIAL SURVEY

Contract No. 2304 Federal Aid Project No. 17
State Road—Louisquisset Pike
From Marieville 3.13 miles northerly.
Type of Pavement—Reinforced Concrete. Length 3.13 miles.
Local Materials Required:
Gravel for Gravel Foundation......4500 cu. yd. approx.
Sand for Concrete Pavement........3800 " " "
Coarse Aggregate for Concrete Pavement ....5600 " " "

Sand and Gravel tests by R.I.S.B.P.R. testing laboratory.
Stone Tests by Pittsburgh Testing Laboratory.

GENERAL DESCRIPTION OF AREA

Circles on the accompanying map show the location of local gravel banks and rock quarries found after a careful survey of the territory within a reasonable distance of this contract. All banks have been marked in the field as well as road stations given on nearest telegraph poles (every 1,000 ft. of contract length). In most cases pits have been left open for inspection at each bank noted.

Only one gravel bank passed the specification for gravel foundation, requiring 40 per cent to pass 1 in. size. Others passed smaller sizes required. Most of the banks passed the requirements for sand for cement concrete pavement with the exception of Bank No. 19 and No. 23.

Stone is abundant and generally of good quality. Very few stone walls are available. Ledges encountered in Section II will yield most of stone required (estimated at 4,000 cu.yd.). Tests show that this ledge stone passes quality specifications for concrete coarse aggregate. Gravel Bank No. 22 with 40 per cent to 70 per cent of gravel over ½ in. up to one-man size should furnish large amount of stone. This stone passes quality requirements.

Data on Gravel Banks

Bank No. 19.
Owner—W. E. Nicholds—does not care to sell.
Location—Station 2,600 approx. Left Sec. II.
Accessibility—0.5 mi. west of State Rd. over gravel road—easy grades—weak bridge 8 ft. span.
Description—Large bank, 13-ft. face with considerable clay in evidence. Limited in amount by owner to approximately 2,000 cu.yd. of material.
Conclusions—Samples of material did not pass gravel foundation or cement concrete spec.

Bank No. 21.
Owner—Paul Cimini—will sell.
Location—Station 800 approx. Left Sec. III.
Accessibility—1,000 ft. west of State Rd. on gravel road with slight upgrade to job.
Description—2,000 to 3,000 cu.yd. available in 6-ft. to 9-ft. face under 12 in. to 14 in. loam.
Ledge outcrops at various points in bank.
Conclusions—For gravel foundation (only 28 per cent over 1 in. size, with 40 per cent called for) but passes specifications on smaller sizes.
For cement concrete—sand and gravel passed all requirements.

Bank No. 22.
Owner—Mrs. Jane Bradley—will sell (consult boss farmer at Fair Oaks Farm).

Location—Station 250 approx. Left Sec. IV.
Accessibility—0.7 mi. west of State Road on narrow gravel road, easy grades.
Description—Large bank, approx. 10,000 cu.yd., containing large quantity of heavy gravel. Six-foot to 9-ft. face under 12 to 18 in. loam. Coarse aggregate 40 per cent to 80 per cent over ½ in. up to one-man size.
Conclusions—Samples of sand and stone passed all requirements for gravel foundations, and cement concrete specifications.

Steam Shovel Places Heavy Water Pipe

IN THE construction of a dam for the Tipton Water Co. in the mountains near Tipton, Pa., the contractor had to place a line of 36-in. cast-iron pipe and also one of 24-in. pipe. The method used is shown in the illustration. The pipe was brought in on the narrow-gage railroad at the left. Lengths were picked up by the shovel and swung to place. The shovel moved ahead as each length of pipe was set so as to be in position to place the next length. A considerable saving of time and labor was gained. A. L. Anderson & Brothers, Inc., of Altoona, Pa., is the contractor with A. F. Ponesmith superintendent in charge of the work.

From Job and Office

Hints that Cut Cost and Time

Low-Water Bridge Built in Kansas

BY CHARLES O. BOYNTON
County Engineer, Gove County, Kansas

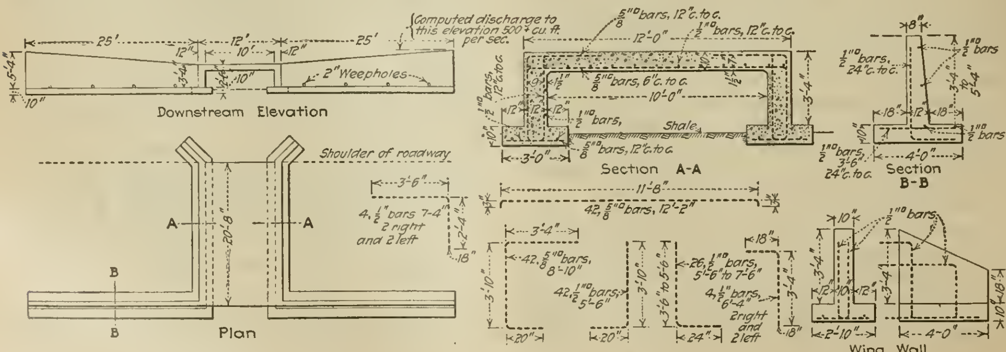
IN PARTS of western Kansas, in common with many other similar localities, where grazing land predominates and where the rainfall is insufficient for general farming, the funds available for roads and bridges are very limited. The Kansas law limits the mileage of county roads in the western part of the state to about 150 miles, the minor roads being designated as township roads and maintained by the township officials. The funds available for the county roads amount to a little more than $100 per mile for construction and maintenance and from this money must also be built culverts and bridges on township roads where the span is in excess of 5 ft.

Except during seasons of unusually heavy rainfall, the streams are generally dry. Then, when it does rain heavily, the rise is sudden but the crest soon subsides. This characteristic, coupled with the light traffic and insufficient funds, has caused the "low-water" crossing to be much used in preference to the ordinary bridge. The low-water crossing is designated so that the opening below the floor is sufficient to pass the ordinary low water flow while the high-water level may be considerably above the floor level. The short interruptions to the light traffic at times of occasional floods do not justify the additional expense of regular bridges.

The accompanying drawing shows a low-water crossing recently completed by Gove County. It is estimated that the ordinary high-water discharge will seldom exceed 500 cu.ft. per second, although occasional floods will greatly exceed this amount. The flood peak in excess of the 500 sec.-ft. would last but a very short time, a few hours only, and probably do but little damage to the approaches. The 10-ft. opening is ample for the ordinary low-water flow. Walls extending out from the culvert 25 ft. in each direction along the downstream side of the roadway fill act as dams or retaining walls to hold the fill. They are set into the bedded shale. Their top rises gradually from the floor level 2 ft. to their ends, thus forming a notched spillway 62 ft. in length. A short apron is provided, but the water cushion at times of flood is relied upon to prevent undercutting. The gravel roadway is not expected to scour.

This structure contained 30 cu.yd. of reinforced concrete and was built by force account for $575, including the excavation but not including the filling or the overhead expense. A reinforced-concrete high-water bridge would have cost about twice as much. This crossing was built on one of the township roads and replaces a culvert having sidewalls supporting a wood floor, the approaches to which have washed away several times.

The new structure was designed and built by Charles O. Boynton as county engineer.



LOW-COST BRIDGE FOR LOW-WATER CROSSING ON TOWNSHIP ROAD IN KANSAS

From Job and Office

For Contractor and Engineer

Irregular Areas in Yardage Problems Solved by Geometry

By J. R. Jahn
Irrigation Engineer, Berkeley, Calif.

To compute yardage in canal or levee work the following method can be used to advantage. For single computations a pair of triangles and a pencil will give the solution in the time usually taken to check the planimeter or figure out the area constant for the scales used.

It is convenient to plot the cross-section on profile paper and any convenient scales for the horizontal or vertical distances can be used. If plate "A" paper is used these scales are ¼ in. horizontal = 5 ft., and ¼ in. vertical = 1 ft. In their proper positions draw the subgrade and sides or banks. The inclosed polygon will then represent the area in the cross-section of the cut or the fill at the given station. The volume may be found by the pyramidal formula or by simple multiplication, if the area of cross-section be known.

Fig. 1 gives the "key" to the solution: the base of the cut being given zero width for simplicity in this case. *a*, *b* and *c* are points on the ground surface and the area (*abc*) is desired.

Produce *oa*; draw a_1b parallel to *ac*; connect a_1 and *c*. The triangle (aa_1c) has been substituted for the triangle (*abc*) and has an equal area since the base *ac* and the altitude of the triangles are the same. Since oaa_1 is a straight line, the triangle (oa_1c) has the same area as the polygon (*oabc*). If now, *y* be the intersection of the ordinate or vertical from *o* with the line a_1c, the distance *oy* can be read on the profile scale. Likewise the horizontal distance a_xc_x may be found.

The area oa_1c is then $\frac{1}{2}(oy)\ (a_xc_x)$. (See triangles oya_1 and *oyc*.)

In Fig. 2, *cd* is the base of the proposed cut and *da* and *cb* are the banks or sides, the slopes conforming to the distorted scales used. In addition to the transformation of the cross-section of the ground surface into a straight line, the triangle (oa_1b) is substituted for the trapezium (a_1bcd) by drawing a line through *d* parallel to a_1c to intersect *bc* produced. The area is again $\frac{1}{2}\ (oy) \times (a_xb_x)$.

Fig. 3 shows the method applied to levee estimates. As many sides *abc* . . . . as desired can be used. The problem then consists of substituting single lines for pairs until the polygon is reduced to a triangle.

I have found this method very useful in getting a quick check on the approximate area of parcels of land, mapped to scale and the accuracy is often surprising. A little ingenuity is required in order to keep the figure within the bounds of the drawing. The area of the resulting triangle is found by multiplying the scaled base and altitude and taking one half the product.

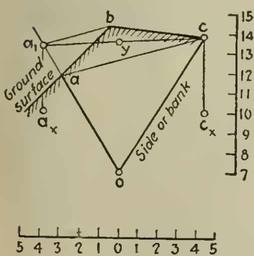


FIG 1

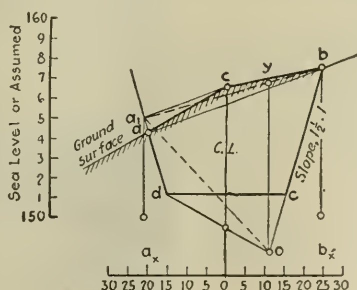


FIG. 2

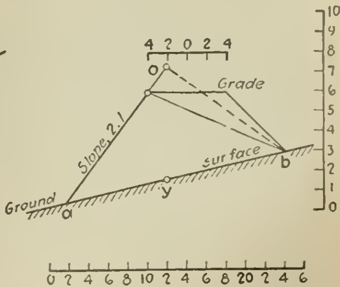


FIG 3

COMPUTATION OF AREAS BY METHOD OF REDUCING POLYGON TO EQUIVALENT TRIANGLE

Houses Barged Across Kanawha River

To MAKE room for the new state capitol at Charleston, W. Va.; a whole community, comprising 32 houses, was barged across the Kanawha River by John Eichleay, Jr., Co., of Pittsburgh. The houses were set upon blocking 40 ft. above barge floors.

Drainage Across Side Roads

In carrying drainage of a road side ditch across intersecting roads ordinary practice in placing culverts is to install them on the line of the side ditch of the main road. One disadvantage of this practice is that the width of the side road often determines the length of culverts to be used. If this culvert, which is the exact width of the intersecting road, be laid as indicated above, it necessitates too sharp a turn from the side road into the main road or vice versa. Charles O. Boynton, county engineer at Gove, Kan., has established a practice of placing the culvert across the side road back from the side ditch line of the main road about 15 ft., thereby permitting an entrance curve from the side road to the main road and affording a much better turn.

Concrete Shed Protects Railroad Track from Mud Slides

ALONG the upper reaches of the Sacramento River in California the Southern Pacific R.R. traverses a canyon in which mud slides have been troublesome. The slides were so frequent at the point where the track enters the east end of Tunnel 9 that a reinforced-concrete shed was built somewhat similar to a timber snowshed, but strong enough to carry a load of mud and rock. The outer wall, as shown in the accompanying picture, has openings which aid in ventilation and avoid entirely closing off the passenger's view.

"MUD SHED" PROTECTING PORTAL OF TUNNEL

Formula for Parabolic Railway Curves

BY L. PIÉRARD
Draftsman, Canadian Pacific Ry., Winnipeg

FOR computing the length of vertical parabolic curves and the largest offset midway between the ends, railroad engineers in Canada are using a formula briefly stated as follows:

Having selected the rate of change (usually 0.05 for sags and 0.10 for summits, in railroad work), the length of the curve in stations (100 ft.) is found by dividing the algebraic difference in grades by the rate of change. This gives the B.C. and E.C., the P.I. of tangents to a parabola being equidistant from the points of tangency. The offsets equal one-half the rate of change multiplied by the square of the distance (in stations) between point of offset and point of curve.

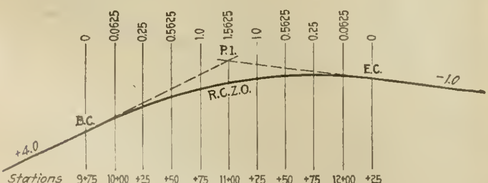


DIAGRAM FOR COMPUTING PARABOLIC CURVE

Referring to the formula for vertical curves suggested by Stanley J. Nichols in *Engineering News-Record*, Sept. 13, p. 443, using the grades given in that example and the rate of change as 2.0, we would then have the following:

P.I. is at Sta. 11 + 00

$$\text{Length of curve} = \frac{4-(-1)}{2}$$

$$= 2.5\text{ Sta.} = 250\text{ ft.} \begin{cases}\text{B.C. at Sta. } 9+75\\ \text{E.C. at Sta. } 12+25\end{cases}$$

$$\text{First offset at Sta. } 10 = \frac{2}{2}\times\left(\frac{25^2}{100}\right) = 1\times\left(\frac{1}{4}\right)^2 = 0.0625$$

$$\begin{aligned}\text{Second offset} &= 0.0625\times 2^{-2} = 0.25\\ \text{Third offset} &= 0.0625\times 3^{-2} = 0.5625\\ \text{Fourth offset} &= 0.0625\times 4^{-2} = 1.0\\ \text{Fifth offset} &= 0.0625\times 5^{-2} = 1.5625\end{aligned}$$

Offsets taken from E.C. as starting point will have the same values as those taken from B.C.

From Job and Office

Hints that Cut Cost and Time

Jet Aids in Sluicing Material Delivered to Fill on Pier

THE INNER deck floors of the transit sheds in the Ballantyne Pier at Vancouver, B. C., are supported on a gravel fill retained on one side by concrete sheet-piling and on the other side by a retaining wall. Gravel for the fill was brought to the job on barges and some study was given to the question of the cheapest method of lifting the material from the barges and

SLUICING GRAVEL DOWN A FLUME INTO FILL

From Job and Office

For Contractor and Engineer

delivering it to the fill across the 100-ft. width of pier already decked over.

An aid in finding an easy method was the 10-in. water main down the center of the pier that was used to operate the water jets in sinking cylinders through hard material, and from which some water could be spared without overtaxing the pumps. At the outer side of the pier a hopper was erected and from it a flume was built to the area to be filled, 100 to 150 ft. distant. The gravel was clammed from the barge into the hopper by means of a floating derrick and a 3-in. pipe discharged continuously at the bottom of the hopper, the jet being directed down the flume. This arrangement was described in *Engineering News-Record*, Sept. 13, 1923, p. 440. Some 5,000 cu.yd. was placed by this method, which was developed by the Northern Construction Co. of Vancouver, of which William Smaill is chief engineer.

Street Widened by Moving Concrete Curb and Gutter Sections

By J. D. Adams
Secretary, Engineers Club of Sioux City

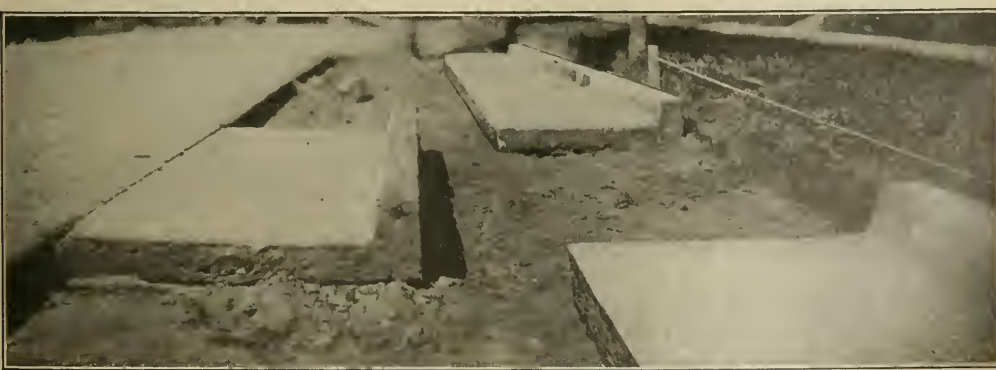
PUT to an enormous expense of widening over sixteen blocks of streets to care for the increasing traffic, City Engineer L. J. Hintgen of Sioux City, Iowa, devised every possible means of saving money. One of the stunts was the setting back of a curb and gutter unit. When the curb and gutter were placed several years ago the expansion joints were made entirely through the concrete, making each section a distinct unit. A force of men with crowbars succeeded in moving the sections very rapidly.

The work was done on a contract at 34 cents a foot. The bid on new curb without the gutter was 58 cents. Thus a saving of 24 cents a foot besides a 2-ft. strip of gutter was made. There were only 600 ft. of this kind of gutter, the balance being concrete curb alone, or stones. The stone curb was moved for 29 cents a foot.

Flangeways Kept Clear of Asphalt—In paving the Ballantyne Pier at Vancouver, B. C., flangeways or grooves were left along the rails of the railroad tracks in the usual manner when placing the concrete. When the top dressing of asphalt was put on, however, a wooden filler was put in these grooves extending up to and covering the top of the rail. The upper surface of the filler strips was made to conform to the grade to which the asphalt was to be finished. Using this method, the black top material was dumped, spread and rolled freely without concern about the grooves. The work was therefore finished more quickly than if care had to be used to keep the flangeways clear. After the material had cooled, the wood strips were removed from the grooves and both track and pavings were ready for immediate service.

Tanks Are Built Roof First—A novel method of erection which permitted all assembling and riveting to be done on the ground was employed in building four oil storage tanks 83 ft. in diameter and 33 ft. high for the Union Petroleum Co., Belgium. The top ring was erected first, resting on supports and jacks at the ground level, the jacks being inside the tank. Then the arched ribs for the roof were placed and roof plating riveted on. Then this completed section was raised by jacks to permit the placing of the second ring, the first ring being supported on blocking and the jacks then released. There were thirty-two 5-ton jacks with lifting racks 63 in. high, the ring plates resting on the claws at the bottom of the racks and being held from slipping by vertical pins set in holes in the claws. After the last raise the lowest ring was riveted to the shell and the bottom. In raising, the foreman stood in the center of the tank and at his command the man at each jack gave a turn to the crank handle. This method is described briefly in the "*Water Tower*" by Jules Mahy, managing director of Mahy Frères, Ghent, Belgium.

Derrick Made of Standpipe Roof Trusses—In the erection of two 2,000,000-gal. standpipes 60 ft. in diameter and 100 ft. high, at Dallas Texas, construction methods were complicated by the necessity of providing a derrick high and heavy enough to place the steel plates forming the standpipe, as the usual methods of erection could not be employed. In a recent issue of *Water Tower*, published by the Chicago Bridge & Iron Works, is explained the method whereby trusses forming the conical roofs of the tanks were so detailed as to form a full-circle derrick. Sixteen of the 24 trusses forming the roof were used in assembling the mast, which was approximately 130 ft. high and 8 ft. square. The boom, 35 ft. long, was made of two trusses. There being 24 trusses to each standpipe, the derrick was located out of center so that the six remaining trusses could be raised and placed in final position before dismantling the derrick. The plates in the lower sections of the standpipe weighed 5 tons and those in the upper courses 1 ton, though the sections were each of the same size: about 7 ft. wide and 24 ft. long.



MOVING CURB AND GUTTER SECTIONS TO ALLOW FOR STREET WIDENING IN SIOUX CITY

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Grant Smith: An Appreciation

Sir—In reading over your description of work done by Grant Smith (*Engineering News-Record*, Oct. 4, p. 571) I realize how impossible it is to indicate the scope of work handled by him, or to indicate his position in the construction industry. He always avoided publicity, moved so quietly, and thought into the future to such a degree that comparatively few knew he was the head of the organization which built Shoshone Dam, removed 7,000,000 cu.yd. of earth by sluicing Denny Hill, Seattle, into the bay, and handled the removal of some 26,000,000 tons of earth in one contract for the Department of Natural Resources of the Canadian Pacific Ry. In the most active period of this latter mentioned work, which was also the most active period of the Panama Canal construction, more yardage was moved month by month in this location on the Canadian prairie than was moved in the Canal Zone.

It is probable that if statistics were prepared, it would be found Mr. Smith headed organizations which had actually constructed more miles of tunnel, more miles of railroad and moved more yards of earth, than any other person in this country.

Silent, industrious, honorable, he believed that publicity added nothing to man's achievement. He sought to carry out all his contracts according to the original intent of the agreement so completely, and his dealings with all men were so honorable, that he had a following of associates, employees and sub-contractors comparable with none in our construction history.

M. J. Whitson,
Stone & Webster, Inc.
New York, Oct. 8.

G. W. Fuller at the London Institution of Sanitary Engineers

Sir—No name is better known among water and sanitary engineers in England than that of George W. Fuller. His work is almost as well known in England as in America. It was therefore very gratifying to sanitary engineers here to know that Mr. Fuller was coming to England with the intention of reading a paper, and with the idea of improving the very friendly relations which already exist between the engineers of the two countries.

Isadore Mendelsohn, corresponding secretary of the Conference of State Sanitary Engineers, Washington, D. C., recently asked for information on the object and work of the Institution of Sanitary Engineers. His letter was sent to me, as president, and I suggested that if an American engineer would read a paper in London before the Institution, the result could not fail to be advantageous. It is further to be noted that in my presidential address of last January I drew attention to the advantage of the special consideration of methods of sanitation and drainage, having regard to American practice. There was an immediate response to this suggestion. It was expected that Prof. George C. Whipple of Harvard University would write a paper, to be presented by Mr. Fuller on a visit to London. Later on it was decided that Mr. Fuller would present a paper of his own. This resulted in a most interesting review of American Sanitary Engineering Practice, read by Mr. Fuller before a representative meeting of the Institution of Sanitary Engineers, held at the International Shipping, Engineering and Machinery Exhibition at Olympia on Sept. 10. Preceding this meeting a number of representative engineers received Mr. Fuller at lunch, among them being E. A. Sandford Fawcett and Dr. H. T. Calvert, respectively chief engineer and chief chemist of the Ministry of Health; Prof. E. R. Matthews of the Office of Works; Prof. Henry Adams, Dr. Hele Shaw, A. J. Martin, Henry C. Adams and G. M. C. Taylor, the latter representing his father, Midgeley Taylor. Letters were received from a great many other engineers who were unable to attend, including J. D. Watson of Birmingham, H. E. Stilgoe, chief engineer of the Metropolitan Water Board, and W. J. E. Binnie.

It is certainly very desirable that the connection between engineers on both sides of the Atlantic should be strengthened. It is understood that an International Convention of Sanitary Engineers will be held at the British Empire Exhibition, which is to be opened next year at Wembley. This will be one of the largest and most important exhibitions held in the country It is to be hoped that American engineers and scientific workers will contribute papers upon suitable subjects to be read at the convention.

London, England, Sept. 11.
H. C. H. Shenton,
President, Institution of Sanitary Engineers.

Reference Books for Japanese Engineers

Sir—Referring to the letter published in *Engineering News-Record*, Sept. 6, 1923, p. 401, from Dr. J. A. L. Waddell, containing an appeal to American engineers for financial aid to Japanese engineers, there still exists an opportunity for us to give expression of our feeling of interest and sympathy for the engineers of Japan who have suffered so severely through earthquake, flood and fire. It is suggested that, in addition to any contributions which may be made for immediate and emergency relief, through established agencies, the engineers of this country might undertake to establish a memorial library or section of a library, which would be distinctly a contribution from the engineers of America to the engineers of Japan, this library to be made up of the latest editions of representative reference books on engineering subjects. It might also include, if procurable, bound volumes of leading technical journals. Most Japanese engineers read English and it is believed that such a library would be of substantial benefit.

If the above idea appears practicable, it is suggested that there probably is no American engineer having so wide an acquaintance with engineers of Japan, or an acquaintance extending over so long a period of years, as Dr. Waddell and that he might be prevailed upon to make inquiry as to the present status of engineering reference libraries in Japan with a view to securing data concerning specific losses and needs and also the most suitable and representative organization to which such a library might be dedicated. If it should develop, as is quite possible, that certain valuable reference libraries have been destroyed, an especially strong appeal could be made to the engineers of America.

New Orleans, Sept. 28, 1923.
Arthur M. Shaw,
Consulting Engineer.

More About Cat-Tails!

Sir—I read with a great deal of interest the article on p. 509 of the Sept. 27 issue in which you suggest that your Colorado correspondent may find it more profitable to cultivate rather than to eradicate his cat-tails.

If he is looking for suggestions I might say that within the last week I had a call from a man who has been experimenting with a light-weight concrete. When pressed for particulars as to the mix, he informed us that it was a 1:4:12, being respectively one part cement, four parts of sand and twelve parts of chopped up cat-tails. Further investigation disclosed the fact that the last figure was somewhat doubtful and the evidence was more that the mix was one part cement, four parts sand and ¼ acre of cat-tails.

If your correspondent can find a use for a concrete which has good nailing and insulating qualities according to our informant, and possesses a resistance to compression of somewhere between 50 and 75 lb. to the square inch (he did not say for how long) we won't make any charge if you want to pass this information(?) along to him.

New York City, Oct. 1, 1923.
W. F. Lockhardt,
Portland Cement Association.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Completion of the Providence-Palmer branch of the Grand Trunk R. R. is reported to be under way. This is the 75-mile section of the Grand Trunk R.R. which was abandoned at the outbreak of the war. A considerable portion of the grading had been done at that time.

Flood Waters Rising in Gary, Ind. Sewers after each hard rain have caused an exhaustive survey to be instituted by City Engineer W. P. Cottingham for data in connection with plans for the new municipal pumping station. The new plant will be situated on the Grand Calumet river where the storm sewers empty.

A Party of Officials of the Great Western Ry. of England, including G. Bulkey, docks engineer, has been visiting Canada to study methods of handling coal and grain at Canadian ports. It is also understood that one object of the visit is to interest Canadian concerns in the possibility of using Welsh coal.

Another Substantial Gain in the Net Earnings of the Canadian National Rys. is shown in the August operating reports. The gross earnings were approximately \$22,000,000 and the operating expenses \$20,000,000, leaving a net of slightly over \$2,000,000 as compared with similar earnings for August, 1922, of only a little over \$1,000,000. For the eight months ending in August, the net earnings were slightly over \$5,000,000 as compared with a deficit of over \$1,000,000 for the corresponding eight months in 1922.

Boston City Council Has Voted to accept the act for the extension of Dorchester Tunnel. The work is estimated to cost \$4,000,000 and to take from two to two and one-half years. Bids will be advertised within a few months and work will be started early next year. The new statute provides for the extension of the present Dorchester Tunnel from Andrew Square under Boston and Power Streets and Dorchester Avenue; for the construction of tracks in Harrison Square and thence for transportation over the Shawmut branch of the New Haven R.R. to Mattapan Station.

Secretary Hoover Has Appointed a committee consisting of Dr. George K. Burgess, chairman; Dr. F. C. Brown, H. D. Hubbard, and E. W. Libbey, to receive and disburse funds for the relief of dependents of those killed and injured by the explosion at the Bureau of Standards on Sept. 20, 1923. The committee at its first meeting designated Mr. Libbey as secretary and Mr. Hubbard as treasurer. It will be the duty of this committee to receive and disburse funds contributed for the relief of the injured and the families of those who were killed. Some contributions have already been received.

Missouri May Finish \$60,000,000 Road Program in 4 Years

The Missouri State Highway Commission has recommended to Governor Arthur M. Hyde that the contemplated time for the completion of the state's \$60,000,000 road program be reduced from 10 to 4 years, and that provision be made by the state for road maintenance funds. The commission estimates an average of \$200 a mile per year will be required to maintain the roads of the best type and from \$300 to \$800 a mile for the cheaper types. With sufficient maintenance the commission estimates the road program can be finished in 1927 with 90 per cent of the primary roads of the all-weather type. The Missouri Automobile Club recently went on record as in favor of an additional \$5 a year tax on automobiles, the money to be used for maintenance of roads. This would produce approximately \$2,000,000 annually.

First Concrete in Piers of Carquinez Strait Bridge

On Aug. 29 the first concrete was poured in the north anchor pier of the vehicular bridge to be erected across Carquinez Strait, one of the upper reaches of San Francisco Bay. Contract for the foundation work has been let by the American Toll Bridge Co., holders of the War Department permit, to Duncanson & Harrelson, contractors of San Francisco.

It is believed that this structure will be the third longest cantilever bridge thus far constructed and the longest one devoted exclusively to vehicular traffic. There will be two 1,100-ft. spans and two 500-ft. spans, the former consisting of two 300-ft. overhanging arms and a 500-ft. supported span. Previous reference to this bridge appeared in *Engineering News-Record*, Jan. 18, p. 135, and Mar. 22, p. 557.

New Sewage Disposal Plans for Madison, Wis.

With unexpectedly rapid increase in amount of sewage flow at Madison, Wis., the present sewage disposal plant (see *Engineering News-Record*, Sept. 11, 1919, p. 510) is already overloaded, the amount of pumpage estimated for 1930 having been reached in 1920. Plans for a new plant southwest of the city have been prepared by E. E. Parker, city engineer, and await approval by the State Department of Engineering. The effluent from the present plant is discharged into Lake Monona, but the new plans provide for discharging the effluent from both plants into the Yahara River which flows out of the lake. A bond issue of \$850,000 has been authorized, and bonds for about \$250,000 have been sold. Part of the land has been purchased. It is expected to do the excavation during the coming winter and to build the concrete work in the spring.

Many Millions to Be Spent by Southern Pacific

Starts Work on 118-Mile Line Over Cascade Mts.—New Double-Track Into Portland

The 1923 construction and improvement program of the Southern Pacific Company has as its main feature the completion of a new main line from Kirk to Oakridge, Ore. (Natron Cutoff), and line change to reduce grade and curvature from Black Butte to Grass Lake, Calif. Material is being assembled to lay five miles of track out of Oakridge, Ore. this year, on grade constructed in 1913; a contract has been let for 30 miles from Kirk, Ore., and work was started Sept. 1. The remaining mileage is being located.

Double-track work includes: building a new double-track entrance into Portland, Ore., double-tracking portions of transcontinental main line in the Sierra Nevada Mountains between Blue Canon and Truckee, Calif. portions of transcontinental main line in the Pequop Mountains between Wells and Montello, Nev., and portions of San Joaquin Valley main line in Tehachapi Mountains between Bakersfield and Mojave, Calif.

Line Changes

Line changes include: changes in alignment at various points on the main lines between San Francisco and Los Angeles, to reduce running time, involving construction of a tunnel at Rocky Point, near Metz, Calif. and line revision at other points; line change near Mott, Calif., to get rid of a long, high trestle, and another line change together with the construction of second track, and a gauntlet-track bridge, at Yuma, Ariz.

Minor construction includes: branch lines in Imperial Valley, Calif., Calipatria easterly; and in San Joaquin Valley, Magunden westerly; the new freight terminal and automobile handling facilities at Los Angeles, and industrial trackage in San Francisco.

In the line of new structure the company will build new stations at Sacramento and Glendale, Calif., Reno, Nev., and Ogden, Utah; rock crushing plants at Santa Margarita, Calif., Palisade, Nev., and Lucin, Utah; a tie-treating plant for creosoting ties, at Wilmington, Calif., an up-to-date planing mill at Sacramento, and machine shop at Los Angeles.

The program also includes installation of many miles of 110-lb. rail (the heaviest rail in use on the Pacific Coast) to replace 90-lb. steel; ballasting and reballasting of portions of the transcontinental main line Sparks, Nev., to Ogden, Utah, and Los Angeles to El Paso, Texas; construction of and improvement to station buildings at various points; construction of new sidings and extension of passing sidings; installation of automatic train-control devices and additional block signals; enlarging and concrete lining tunnels; construction of team tracks, etc.

Reciprocal Registration Operates in 12 States

Council of State Board of Examiners Reports Plan is Now an Established Fact

Reciprocal registration of engineers in twelve states that have laws regulating the practice of engineering is an established fact. Reports at the meeting in Chicago, Oct. 1 and 2, of the Council of State Board of Examiners indicated that Arizona, Florida, Oregon, Minnesota, North Carolina, South Carolina, Louisiana, Michigan, Iowa, West Virginia, Indiana and Colorado had ratified the articles of agreement on the subject adopted by the Council at last year's meeting. It is a plan to reflect in the examination for a reciprocal "card" a standard even higher than that required by any one of the states in the Council. The cards, which were printed by the Council and made available for the first time at the meeting, are the means of certification of the applicant's qualification from one state to another.

In the states accepting the agreement the card will be *prima facie* evidence of an engineer's qualification for a license in that state but it does not waive legal fees or such information other than evidence of qualification as required to conform to the rules of the examining board.

Qualification Requirements

The principal qualification requirements (See *Engineering News-Record*, July 27, 1922, p. 156 and Oct. 12, 1922, p. 629) are as follows: Qualification shall be determined upon the basis of a detailed professional record on file in the state of which the applicant is already a registrant. Thorough consideration of this record shall constitute examination. Professional experience gained after eighteen years of age shall be considered as beginning only when the applicant shall have entered upon a position in professional engineering work requiring "original thought and responsibility." Examples of when experiences would begin to count are as follows: In the field, a position equivalent to that of a transitman; in the office, design not tracing; in teaching, a full time instructor in a recognized school. A progressive record of engineering experience for ten years, four of which is to be credited by graduation from a recognized school, is required.

Richard L. Humphrey, chairman of the State Board of Examiners in Pennsylvania, presented the situation in his state (not yet a member of the Council). The adverse minor court decision in the Stevenson case (see *Engineering News-Record*, Aug. 2, p. 180) has not halted the work of the board. About 2,500 engineers have registered and $90,000 has been collected.

Reciprocal relations with Mexico and Canada are under consideration by the Council. A. B. Carter, Oregon, stated that his state has established reciprocal relations with British Columbia and Alberta.

The Council will meet next year the second Monday in November at Washington, D. C. The following officers were elected: President, Prof. G. M. Butler; vice president, G. F. Taylor; secretary, T. Keith Legare, Columbia, South Carolina.

One Dismissed as Result of Canal Bureau Investigation

The investigation into irregularities in the purchase of supplies in the canal bureau of the department of public works which was inaugurated by Governor Smith last week under the provisions of the Moreland law is to cover a period of nine years. Exorbitant prices, far in excess of current market quotations, charged the department by an Albany mill supply firm were adduced by the testimony taken last week, but so far no collusion has been shown.

J. W. Grady of Syracuse who was assistant superintendent of the department of public works has been dismissed from the service by Superintendent Frederick S. Greene.

New York Section of Am.Soc.C.E. To Open Fall Meetings

The first meeting of the New York Section of the American Society of Civil Engineers for the 1923-24 season is to be held Oct. 17 at the Engineering Societies Building in co-operation with architectural organizations of the city. The subject will be "The Relationship and Responsibility of the Architect and the Engineer in the Matter of Safety in Building Construction." Speakers include J. Vipond Davies, William Cullen Morris, R. C. Bastress, Robert D. Kohn and John Lowry, Jr.

Power Companies Merge

The Pennsylvania State Water & Power Resources Board has approved the application for incorporation from the Watts Water & Power Co. and the Juniata Water Power Co. These companies expect to build a dam at Iroquois on the Juniata River, which will form a reservoir of 1,500,000,000 gal.

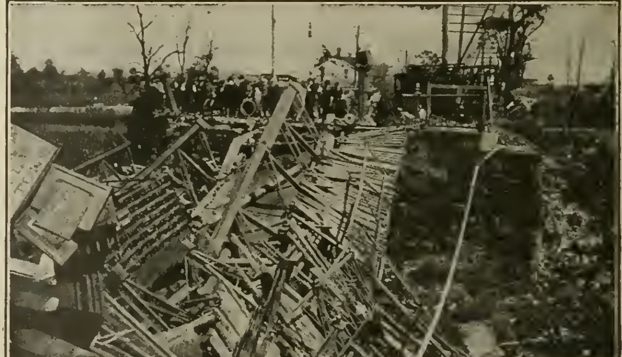
Fred R. Low New President of A.S.M.E.

As a result of the recent election of the American Society of Mechanical Engineers, Fred R. Low, New York City, editor of *Power*, published by the McGraw-Hill Co., has been selected as president for the coming year. The vice-presidents elected are: H. Birchard Taylor, Philadelphia, Pa.; George I. Rockwood, Worcester, Mass.; and W. J. Sando, Milwaukee, Wis. William H. Wiley is the new treasurer. The nomination of Mr. Low for president was made in a convention in Montreal in the summer.

Fail to Get License to Develop Lock 17 on Warrior River

Acting upon the report of its engineers, the Federal Power Commission has concluded that it would not be justified in granting a license to the Alabama Power Co. for the development of power at Lock 17 on the Warrior River. The engineers report that the primary horsepower which could be developed on the Warrior River can be greatly increased by the construction of three storage reservoirs upon the upper reaches of the river and that the power site at Lock 17 is the key to the power situation in so far as the storage reservoirs are concerned; that no power company would undertake to build these reservoirs without first controlling the power site at Lock 17. The engineers also pointed out that the Alabama Power Co. has already undertaken two large projects on the Coosa and Tallapoosa Rivers and that it could hardly be expected to undertake the development at Lock 17 for some years. The Alabama Power Co. has been given until December 1 to file objections to the findings of the Commission's engineers.

Overloaded Truck Wrecks Canal Bridge



A FIVE-TON truck, piled high with radiators and boiler parts, completely wrecked the Hudson County bridge over the abandoned Morris Canal at Garrison Ave., Jersey City, N. J., about midnight, Oct. 2, 1923. The driver escaped without injury and no one else was on the bridge at the time. The bridge consisted of three 75-ft. Pratt pony trusses, pin connected, carried on cast-iron end posts resting on stone masonry abutments. The bridge was built in 1874 and shows no indication of alterations other than the addition of a solid floor. Its capacity was plainly marked on large boards at each end as 8 tons, including truck and load. The steelwork appeared in good condition.

No doubt exists as to the cause of the failure, but the way in which it occurred is not yet clear. There is no indication of failure in any of the top chord members, and as the critical members of the lower chord are all in the mud, they cannot be examined until the debris is cleared away.

Moffat Tunnel Bids Present Unusual Details

Bidding on a six-mile mountain railway tunnel is so unusual that the following note as to the bids for the Moffat Tunnel in Colorado is of particular interest and is from information furnished by R. H. Keays, chief engineer for the Moffat Tunnel Commission.

Under the first call, bids on a unit price basis were to be received on Sept. 12, but no regular bids were received. There was, however, received from Ulen & Co., New York City, an irregular bid on a profit-sharing basis, naming a lump sum of $6,075,000, which included $486,000 profit. In fairness to other parties who might like to present similar propositions it was decided that this bid should not be considered. Immediately after its receipt other bids were received on a similar basis from many different contractors, none of which was considered.

It was then decided by the Board of Consulting Engineers to prepare a blank proposal for the use of the bidders which would put them all on approximately the same basis. This proposal named a preliminary lump sum bid of $5,250,000, using the preliminary quantities as in the plans and specifications, the contractor to be required to name unit prices which, multiplied by the preliminary quantities, would amount to the above sum.

It was specified that if the work cost less than this sum the savings were to be shared equally with the contractor, in which case he would also get his fixed fee as stated below. Assuming that the actual cost of the work amounted to the above sum, the contractor was asked to state a fixed fee for which he was to do the work. If the work cost more than this sum, the contractor was to have 50 per cent of the extra cost deducted from his fixed fee, until his fee was reduced to a minimum fee, which he was also required to name.

A proposal on this basis was received from four bidders: Ulen & Co., New York City; Peter Seerie, Denver, Colo.; James McIlwee, Denver, Colo., and Hitchcock & Tinkler, New York and San Francisco. These last bidders named a maximum and also a minimum fee of $140,000 and their proposition was accepted. All extra work not mentioned in the unit quantities the contractor will perform on a percentage basis, being allowed 5 per cent on the cost of the work in question. In the final accounting, the amount of $5,250,000, mentioned above, will be adjusted in proportion as the quantities may vary from the estimated amount.

Power Developments in Minnesota

The increasing demand for power in the neighborhood of Duluth, Minn., has stimulated great activity on the St. Louis River. Between Cloquet and Fond-du-Lac there is a total fall of 576 ft. The Northwestern Paper Co. is developing 40 ft. of this head at Cloquet and the Phoenix Utility Co., an operating company of the American General Electric Co., has already developed or is developing the remainder of the head except 53 ft. at Midway, and is now preparing plans to develop this last section. The present plans of the Phoenix Utilities Co. will involve an estimated expenditure of $5,000,000.

H. M. Howe Memorial Service

A memorial service for the late Dr. Henry Marion Howe, president of the A. I. M. E. in 1893, will be held at 5 p.m., Oct. 25 in the Cathedral of St. John the Divine, New York City. This is the afternoon of the meeting in New York City of the American Iron and Steel Institute, which has established the Henry Marion Howe Lecture in tribute to Dr. Howe. The memorial meeting will be largely musical, but with short addresses, one of the speakers being Dr. Michael Pupin of Columbia University.

Ford Motor Company to Build Large Tunnel

Detroit Correspondence

The Ford Motor Co. expects to start construction in the immediate future on a new condensing water tunnel at its River Rouge plant. This new tunnel will be approximately 25 ft. in diameter and 12,000 ft. long. The present 12 ft. 8 in. tunnel was driven through very soft material by the shield method, using concrete blocks for the lining and back-filling around the outside with packed gravel. As the nev tunnel is to be driven through similar material it is expected that the new tunnel will be driven by the same method that was used in driving the former tunnel.

Steel Erection Derrick Falls

Failure of a guy cable caused the fall of one of four large guyed derricks employed in the erection of the steel frame of the headhouse for the Chicago Union Station, on Sept. 19. By good fortune nobody was hurt and very little damage was done to the steel framing. Both the mast and boom crumpled up where they fell across the floor girders, as shown in the accompanying view, while the head of the mast, with its mushroom plate for the attachment of the guys, was bent back at a sharp angle when it struck the street. These steel derricks are of box lattice construction with 125-ft. masts and 115-ft. booms and can handle 40-ton loads. Each mast is stayed by eight 1¼-in. wire cables, but under the conditions of erection the guys are not of equal length. It is stated that in hoisting a relatively light load with the derrick in question the load on the guys was not equally distributed but became concentrated on one of the short guys, which broke under the strain.

FALLEN DERRICK AT CHICAGO UNION STATION

Bureau of Standards Explosion Caused by Gasoline Leak

Explanation of the cause of the explosion in the dynamometer laboratory of the Bureau of Standards Sept 20, 1923, resulting in the death of four employees and the injury of six, is given as follows by the board of inquiry which investigated the accident at the request of Herbert Hoover, Secretary of Commerce.

"The explosion was caused by the ignition of a mixture of gasoline vapor and air in the altitude chamber. The research under way was concerned with comparative tests of fuels of differing volatility, and aviation gasoline was under test at the time. The board believes that the presence of the gasoline vapor in the chamber was due either to a leak in the feed line leading to the carburetor of the engine or to a leak from the carburetor due to the sticking of the float mechanism. This conclusion is supported by a remark made by one of the members of the testing staff an instant before the explosion, to the effect that the gasoline readings which he was taking indicated the presence of a leak.

"The condition of the set-up following the fire is such that it is not possible to establish which one of the above causes occasioned the leak. Since it is known that only three gallons of gasoline had been drawn for the test, that the engine had been running from about 11 to 12 o'clock with the chamber open, that the chamber was closed at about 12:30 for the purpose of running at a lower temperature, and that the engine had been operated from about one to two o'clock with the chamber closed, it is believed that not more than a quart of gasoline could have escaped into the chamber. This amount, however, if evaporated would have been sufficient to account for the energy of the explosion.

"The probable source of the ignition was a back-fire through the carburetor. Support to this conclusion is given by the statement of one of the survivors that he heard the engine backfire immediately before the explosion.

"The explosion threw out of the chamber a closed apparatus containing about 10 gal. of heavy lubricating oil and about 5 gal. of toluol, breaking the pipe connections and thus releasing part of the contents which furnished additional fuel for the fire which followed. The explosion also shattered the fuel-measuring system used in the test, which was outside the chamber and contained about two quarts of gasoline. This was the only gasoline supply involved in the fire.

"Special mention should be made." continues the statement, "of the action of C. M. Smith, engineer in charge of the ammonia plant, who after being blown out of the building and badly cut about the head, returned to the wrecked chamber and shut off two ammonia valves, and then went to the refrigerating plant in the basement and operated it to pump the ammonia out of the coils in the wrecked chamber. This action may have prevented further loss of life and the destruction of the entire building by fire."

L. J. Briggs.
Chairman.

Board of Inquiry—L. J. Briggs, F. C. Brown, E. F. Mueller, W. S. James, and H. D. Hubbard.

Random Lines

Odds Are Agin 'Em

It is almost hopeless, says the Minneapolis *Journal,* for the autoists to try to destroy all the locomotives at the railroad crossings. The Baldwin works alone are turning out a locomotive every hour.

* * *

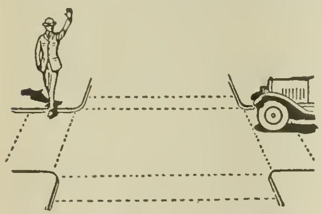
From a sob story in the Chicago *Tribune:*

"And the grief stricken mother went over again the story how she shot her 19-year-old son 'To save his soul.' He wouldn't work, loafed all the time, because he could not get a job at his profession as a Civil Engineer after graduating from the Crane Technical High School. He would not do anything else and chose the easy way of stealing."

* * *

A Magnificent Gesture

In New Orleans they have either achieved the desirable end of humbling the automobile driver or they are breeding an especially virile crop of pedestrians. The accompanying sketch is from the new traffic rules just issued in the Crescent City. After some stirring escapes at Sixth and Broadway in Los Angeles, Michigan Ave. and Madison in Chicago, Market St. near the Palace Hotel in San Francisco, the Campus



Martius at Detroit, and Fifteenth and New York Ave. in Washington—not to mention at all the god-like disdain the New York City motorist displays toward the pedestrian—we wonder at the calm bearing of the southern gentleman crossing Carondelet St. As a gesture it is magnificent, but we trust he has his family well protected with insurance. Probably the driver is not shown in the picture because the language that he is emitting has distorted his countenance beyond fair presentation.

* * *

The Inspired Compositor

According to the Associated General Contractors news letter a well known drill maker has announced a policy of price reduction *commisserate* with the reduction in manufacturing and material costs.

* * *

"Sale of Naval Vessels for Scrapping Purposes" is the title of a catalogue just issued by the Navy Department. We thought that was just what the Washington Conference was aimed to prevent.

Lee H. Landis Is Made General Manager of Alaska R.R.

The Secretary of the Interior has announced the appointment of Lee H. Landis, of San Francisco, as general manager of the Government railroad in Alaska, effective Oct. 1. The appointment of Mr. Landis is the result of an announced decision on the part of the Secretary of the Interior, now that actual construction of this railroad is practically completed, to place an experienced railroad man in charge of its operation.

Mr. Landis' experience in the transportation business began over thirty years ago as an agent and train dispatcher on the Philadelphia & Reading R. R. Since that time he has been a general agent in the operating and traffic departments of the Santa Fe and the Southern Pacific, general manager of the Phoenix & Buckeye R. R., general manager of the Ocean Shore R. R., assistant to the president of the Tidewater Southern R. R., president and general manager of the San Jose Terminal R. R. of California, and general manager of the Fresno Interurban Ry. During the war, Mr. Landis was a major of engineers in the Engineering Corps in Europe for two years, during which time he served in various capacities in the transportation department of the A. E. F. He is now a lieutenant colonel in the Engineer Reserve.

Since the close of the war Mr. Landis has served as industrial commissioner of the Western Pacific Railroad System, with headquarters at San Francisco.

New Zealand Starts Development of Its Vast Power Resources

Estimates of the amount of available water power in New Zealand, forwarded to the Department of Commerce by Vice Consul J. C. Hudson, show a total of 4,076,700 hp., of which 759,700 hp. is in the North and 3,317,000 in the South Island. In the distribution of power resources, the South Island is in an advantageous position as the bulk of its potential supply is located near the deep water sounds of the west coast, where there are many sites suitable for electro-chemical and electro-metallurgical industries.

A program for water power development has been laid out in which the important sites of the North Island will be utilized. These include Lake Waikaremoana, which has sufficient storage capacity to run the proposed generating plant for 21 months without rainfall, and the Waikato River project which tops Lake Taupo. The first installment will involve an estimated expenditure of £15,000,000 for the headworks, plant and transmission line to Auckland, and will develop 50,000 of the 138,000 hp., which it is estimated can be ultimately obtained.

State commitments up to the end of 1923 for the Lake Waikaremoana project amount to £110,000. By the end of 1924 it is planned to spend £1,075,000 when it is expected that 24,000 hp. will be available from this source. The method of financing hydro-electric development in New Zealand is chiefly through State aid, no projects of importance being promoted by private organization. Southland province with some assistance from the State is carrying on its development through the Southland Power Board.

A.G.C. Committee Studying Bidders' Responsibility

In order to define responsibility as applied to construction companies and to devise practical means of selecting responsible bidders for a given project, the committee on ethics of the Associated General Contractors has begun an intensive study. By this procedure the association hopes to remove the disagreeable controversies that frequently result when engineers disqualify contractors as irresponsible bidders. According to an announcement made by the A. G. C., in the co-operative work which the association has been doing with the joint conference on contracts and the American Association of State Highway Officials, the inter-departmental board of contract and adjustment and various local agencies, practically each issue discussed has been connected with the question of a bidder's responsibility. The opinion has often been heard that engineers and public officials would be glad to adopt certain contract principles if they possessed the means for awarding contracts to responsible companies only.

The committee on ethics in undertaking this work is desirous that construction companies throughout the country give it their careful thought and forward to the Washington office of the A. G. C. any suggestions. The committee defines the elements of responsibility as follows: (1) Financial strength, which includes not only a financial statement to indicate the condition of the bidder's business, but a statement of funds available for the project and banking references; (2) personal experience of construction manager, proprietor, partner or company official in charge of construction; (3) construction plant available for the project; (4) construction performance record; and (5) personal references for successful construction service.

The committee suggests that certain qualifications be put upon bidders before they are allowed to submit proposals, instead of after bids are received, so that the principal ground upon which a disqualified bidder can secure taxpayers' injunction, namely, the award of a contract at a higher price, is removed. Various other reasons for qualifying bidders include a saving of the expense in field investigation and estimating on the part of any who cannot qualify for a particular project.

101 Contractors Bid for 11 Road Jobs in North Carolina

The North Carolina State Highway Commission awarded contracts recently for eleven projects. There were 101 bidders for the work. The total mileage let was 72.99 miles, costing, exclusive of the usual 10 per cent for engineering and contingencies, $1,885,718. Of this there were 56.95 miles of standard concrete paving, which cost $30,340 per mile including grading, draining, bridges, culverts and all other items of construction.

The remaining 16.04 miles let consisted of earth or topsoil roads and cost $7,424 per mile including all items of construction mentioned above.

The reinforced concrete bridges and culverts, included in the above figures, amounted to $178,871, or about $2,450 per mile of road constructed.

Civil Service Examinations

NEW YORK STATE

For the following Civil Service examinations apply to the New York State Civil Service Commission, Albany, N. Y. The positions are open to applicants not residing in the state of New York. Both examinations are to be given on Nov. 3.

Assistant Sanitary Engineer—New York State Department of Health, salary $3,000 to $3,500. The duties of the position require a knowledge of the design, construction, operation and supervision of water supply systems, water purification works, sewerage and sewage disposal systems and prevention of stream pollution; also four years' experience in such work.

Assistant Sanitary Engineer—New York State Department of Health, salary $2,100 to $2,500. The duties of the position include investigations and reports on construction and operation of water supply and sewerage systems and water and sewerage treatment works, community sanitary conditions.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga., Nov. 12-16.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Meeting, Washington, D. C., Nov. 13-15.

AMERICAN ROADBUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 14-18.

The Engineering Institute of Canada, Montreal Branch, resumed on Oct. 4 its weekly meetings, this week's topic being "The St. Lawrence Deep Waterways" presented by E. A. Forward, consulting engineer, Montreal.

The Society of Terminal Engineers held its regular meeting, with a dinner, in New York City Oct. 9 and on the subject, "Co-Ordination of Railroad and Marine Terminals," Col. Edward Burr, formerly U. S. district engineer officer, first New York district, was the speaker, the discussion being taken up by Francis Lee Stuart, J. J. Mantell, vice-president of the Erie R.R., Col. Charles Hine, and E. H. Lee, vice-president of the Chicago & Western Indiana R.R.

The Engineers Club of Philadelphia and the Philadelphia Section of the American Society of Civil Engineers will hold a joint session during the afternoon and evening of Oct. 16 at which the pollution of streams with special reference to industrial wastes will be discussed. The speakers will be Dr. W. H. Frost, surgeon of the U. S. Public Health Service, George W. Fuller, C. A. Emerson, Jr., Col. F. C. Boggs, Almon L. Fales, W. L. Stevenson, Maj. J. A. Vogleson, and J. W. Ledoux.

The Boston Society of Civil Engineers at its monthly meeting Oct. 19 will have as speakers giving "Brief Talks on Engineering and Construction," W. F. Williams, commissioner of public works for Massachusetts; J. W. Rollins, of Holbrook, Cabot & Rollins, contractors for masonry and concrete construction; W. H. Sayward, secretary of the Master Builders Association; J. Parker Snow, consulting engineer; C. T. Main, industrial engineer; and C. R. Gow, engineer and contractor for foundations.

Personal Notes

ERNEST R. ROBINSON, now water supply engineer for the Solvay Process Co., chemical manufacturers, Syracuse, N. Y., was formerly engaged in civil engineering work for the Hudson River Bridge Co., of New York City.

H. E. TEWELES, who had been constructural designer for the United States Gypsum Co., Chicago, Ill., is now connected with Albert Kahn, architect and engineer, Detroit, Mich., in the same kind of work.

JOHN R. NICHOLS, formerly chief engineer of Monks & Johnson, Boston, Mass., has opened a consulting engineering office at 161 Devonshire Street, Boston, for practice in the design and construction of industrial plants and general structural and construction engineering.

H. B. MILLER, assistant city engineer, Chicago, has been dismissed from office by Col. A. A. Sprague, commissioner of public works. Mr. Miller held his position on temporary appointment by the former administration. Major Myron B. Reynolds, engineer of waterworks design, is acting assistant city engineer, pending a permanent appointment.

EXUM M. HAAS, Cleveland, Ohio, who until recently was manager of the railroad department of the H. K. Ferguson Co., announces that he is open for engagement as consulting engineer in locating, laying out and designing railroad shops and terminals, and gap crane and other types of locomotive erecting.

FRANCESCO MAURO, engineer and architect, has terminated his connection with Martin J. Lide, and has opened an office for the practice of structural engineering and architecture in the First National Bank Bldg., Birmingham, Ala.

PRESTON L. FITE, formerly with the North Carolina State Highway Commission, Greensboro, N. C., and the California State Highway Commission, Sacramento, Calif., has returned to work with the North Carolina commission as resident engineer at Reidsville, N. C., on an 8-mile concrete road project.

MAURICE DEUTSCH, architect and engineer, announces the removal of his offices from 50 Church St., New York City, to the 12-story building which he recently purchased at 35-39 Maiden Lane, New York City, and to which he is adding another floor.

ORLEY GREY, Wabash, Ind., superintendent of the Fort Wayne highway district has resigned to enter the contracting business.

S. J. NORRIS, civil engineer, Oroville, Calif., has been appointed chief engineer of the Honcut-Yuba Irrigation District in Yuba County, Calif.

RUSSELL M. DUFF, Canton, Ohio, has resigned his position as superintendent of state highways in Columbiana County and will take up post-graduate work at Cornell University.

OLIVER ANTRUM HALL, formerly designing engineer, Alaska Road Commission, with headquarters at Juneau and Anchorage, Alaska, has severed his connection with the commission and opened up an office in the Seaboard Building, Seattle, Wash., as engineer on bridges and buildings.

Obituary

MAJOR DANIEL D. PULLEN, Corps of Engineers, U.S.A., died Sept. 24 in a hospital in Washington, D. C., after an illness of two months. He was 38 years of age. Major Pullen was a native of Washington state and a West Point graduate of 1910. He served with the Engineers in France, rising from lieutenant to major, and won the Distinguished Service Cross, the Croix de Guerre and two citations.

WILLIAM P. JONES, resident engineer during the building of the Georgetown loop on the Colorado & Southern R.R., engineer for public works at Denver, Colo., from 1889 to 1901, died suddenly, Sept. 24, at the home of his sister in Louisville, Ky.

F. W. COOK, vice-president of the San Antonio Portland Cement Co., died Sept. 3 in a hospital in Chicago after a two months' illness. Mr. Cook was born in Kentucky and was educated in the University of Indiana and the University of Heidelberg, Germany. He was connected with the San Antonio Drug Co. from 1895 to 1908 and in the latter year organized the San Antonio Portland Cement Co., which is the successor to the older Alamo Cement Co., organized in 1880.

A. H. ANDERSON, professor of engineering at the University of Wisconsin, died at his home in Madison, Wis., Sept. 1. Prof. Anderson was for several years professor of steam and gas in the department of engineering at the University of Wisconsin.

FORRES MCGRAW, secretary-treasurer of Swanson-McGraw, consulting engineers, New Orleans, La., was electrocuted in an accident at the Plaquemine, La., water-works Sept. 19 and death was instantaneous. Mr. McGraw was 27 years old, and the son of John McGraw, general agent at New Orleans of the Southern Pacific Ry. After graduation from Tulane University, he entered the employ of Fairbanks-Morse Co. and later with Mr. Swanson, an employee of that company, established the firm of Swanson-McGraw, consulting engineers. During the War he served as an instructor at Camp Beauregard and at Fort Sill.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Notes on Care of Wire Rope

From a paper by William Constable, mechanical and electrical engineer, Republic Iron & Steel Co., presented Aug. 30 at the annual meeting of the Lake Superior Mining Institute.

Rope used for hoisting and haulage usually ranges in diameter from 1 to $2\frac{3}{4}$ in.

Grooved hoisting drums are preferable to flat-faced drums; pitch of grooves should be $\frac{1}{8}$ in. larger than rope diameter; diameter of drum should be not less than 60 times diameter of rope.

Diameter of head sheave for shaft hoist should be 80 times diameter of rope. The following groove diameters on sheaves are recommended: For rope $\frac{3}{4}$ to 1 in. diameter, $\frac{1}{16}$ in. larger groove diameter; for rope $1\frac{5}{16}$ to $2\frac{1}{2}$ in. diameter, $\frac{1}{8}$ in. larger groove diameter; for rope $2\frac{5}{8}$ in. and upward, $\frac{3}{16}$ in. larger groove diameter.

Attachment of rope to cage or skip should be by means of a wire rope socket with zinc attachment to develop full strength of rope.

Abrasion of rope on inclined haulage work should be avoided by the installation of rollers not less than 6 times the rope diameter and spaced 25 to 30 ft. apart.

When cutting steel wire rope it is essential to place three sets of seizings on each side of the cut to prevent disturbing the uniformity of the rope. Annealed iron wire should be used for seizing purposes.

A wire rope received in a coil should be unrolled on the ground like a hoop and straightened out before attempting to pass it around sheaves.

Wherever a spliced eye, clip or clamp connection is used, it is necessary to employ a wire rope thimble around which the rope is passed to protect it from being mashed or distorted when strain is applied.

Reverse bends should be avoided in wire rope instalation.

Lubrication of wire rope is highly important. A lubricant applied hot will generally give good service because in its heated condition it will penetrate and then, upon cooling, will congeal into a plastic filler throughout the rope.

Japan Admits Building Materials Free Until March 31

Building materials and the necessities of life have been exempted from import duty until March 31, 1924, by virtue of an imperial ordinance promulgated in Japan according to advices received from the Consulate General of Japan, New York City, and forwarded to the Department of Commerce. Under the same imperial ordinance, the import duty on automobiles, other than motor trucks, but including automobile parts and motive machinery, has been reduced by one-half for the same period. Information concerning specific commodities affected by this decree will be furnished upon request by the Department of Commerce, Washington.

New Financing for Lakewood Company

New financing by the Lakewood Engineering Co., Cleveland, Ohio, involves the issue of $400,000 first mortgage, ten-year, 7 per cent sinking fund gold bonds, which are being offered for public purchase at par and accrued interest to yield 7 per cent. The bonds are in denominations of $1,000, $500, and $100, interest being payable semi-annually.

The company, which was founded in 1896, manufactures concrete mixing and handling machinery and trucks and trailers for factory and warehouse haulage. During the year 1922 the company made a profit applicable to interest of $143,609 and for the first six months of the current year earnings have totaled $86,957.

Builders Shun Proper Equipment, Says Manufacturer

A letter to the Editor

Sir—You may be interested to know that the editorial "Building Methods Primitive," on p. 498 of the Sept. 27 issue of *Engineering News-Record* crystallized some thoughts of the writer. On the majority of small building operations you will see time lost and costly errors made because a level-board and string are being used instead of a surveying instrument such as the convertible level or transit. In addition to our own make there are several comparatively low-priced yet reliable instruments on the market at convenient terms to aid the small builder in establishing accurate lines and levels quickly.

In the writer's opinion the cause for the general backwardness in the development of machines for individually small operations is the atmosphere of "doing" in which the builder lives as compared to an atmosphere of "planning." He can be critized more fairly for being too "practical" than he is justified in claiming the engineer to be too "theoretical."

The Warren-Knight sales efforts of necessity have been stronger in selling builders the idea of utilizing a convenient and reliable convertible level or a builders' transit than on the effort to sell our particular trade name. Builders will find manufacturers ready to give the effort for developing time-saving machines for individually small operations if they would show more interest in them. Since the builder is so engrossed in rushing around on a job in actual operation or in hunting for more contracts, perhaps it would pay him to increase his overhead to the extent of securing the services of an engineer who could reduce operating costs by utilizing such equipment as is now available.

This condition covered by your editorial is widespread and worthy of attention.

J. O. Preston,
Warren-Knight Co.

Philadelphia, Oct. 1.

Construction Equipment at Mining Congress

Exhibit Includes Variety of Heavy Machinery—Equipment Problems Discussed in Open Forum

Engineering News-Record Staff Report

For the contractor or the manufacturer of construction equipment the two features of special interest at the American Mining Congress, held in Milwaukee Sept. 24-29 were an exhibit of machinery and appliances and an open forum or series of discussions on subjects relating to mining equipment and methods.

Exhibits — An extensive display of machinery and equipment used in mining and also in metallurgical work filled the floor of the main hall in the Municipal Auditorium. Many of the machines were in operation and one enterprising exhibitor of a mucking or coal-loading machine had dumped a few tons of coal into his exhibit space, the machine continually digging this up from one spot and depositing it in another. On a vacant lot outside the hall another machine of the same type was handling a rock pile.

The number of visitors was rather small, since many of the men attending the Congress were interested in legislative, social and economic matters rather than in actual mining operations. Much of the equipment exhibited is or might be employed on construction work. Without attempting to enumerate all the exhibits the following list indicates appliances of use for general construction purposes rather than for mining exclusively.

Range of Exhibits

1. Excavating machinery—Bucyrus and Pawling & Harnischfeger.
2. Mucking machines for mine or tunnel work—Hoar, Jeffrey, Joy, Myers-Whaley, Shuveloder and Thew. The last named company showed the new machine designed by engineers of the St. Joseph zinc mines and described in *Engineering News-Record* of May 31, p. 981.
3. Portable conveyors for loading cars and handling materials—Manierre and Ottumwa.
4. Industrial locomotives, steam—Baldwin, Heisler and Lima; electric—General, Goodman, Ironton, Jeffrey, Mancha and Westinghouse; gasoline—Milwaukee.
5. Mine and dump cars—Lorain and Western.
6. Mine and industrial track, ties and switches—Bethlehem and Lorain.
7. Drills — Sanderson-Cyclone and Diamond.
8. Pumps—Layne & Bowler, Midwest, Prescott, and Worthington.
9. Wire Rope—Broderick & Bascom, MacWhyte and Williamsport.
10. Explosives—Atlas, Hercules and DuPont.
11. Screening Plants—Allis-Chalmers, Roberts & Schaefer, Robins Belt and Smith Engineering.
12. Chain drives — Chain-Belt and Morse.

Exhibits of a special character were those of the U. S. Bureau of Mines, including mine rescue work and safety appliances, and the Colorado School of Mines. The Milwaukee Public Library exhibited shelves of its books on mining and mining machinery; an attendant was in charge to give information. The

Milwaukee Public Museum also had a case of ore specimens as an example of the exhibits to be found in the museum.

Open Forum—A series of discussions on mine equipment problems was based on practical questions submitted by both manufacturers and mining men so as to bring out the viewpoints of the makers of equipment and the men who use it. A discussion on rock drills related largely to the value of air-drills and churn or well-drills for open workings, but it was stated that no churn-drill now available has sufficiently low head room for use in mines. Economic use of explosives in coal mining was actively discussed by mine operators, miners, state mining officials and makers of explosives. It was generally agreed that there is need for a campaign of education as to the use of explosives. A reduction in the present excessive amount of explosive per ton of coal produced would result in a greater proportion of coal in the larger and more valuable sizes, while there would also be greater safety in mining. It was voted to appoint a committee to consider such a campaign.

The program of discussions was not followed strictly, but among the subjects listed were the following, some of which have a relation to engineering construction work: Shoveling and loading machines for underground work; the caterpillar mount for shovels; mine transportation; crushing and screening; hoisting plant; pumps and mine drainage; underground power equipment and transmission; drilling machines and drill steel; wire rope; use of traveling cranes at mills and smelter plants; applications of welding in mining work; track equipment and standardization of gage for mine tracks; gasoline, electric trolley and storage battery industrial locomotives; safe equipment for hoists, pumps and loading machines in gaseous mines.

Business Notes

Walsh & McGee Steel Co., New York, announces that its new rolling mill constructed on tidewater at Newark, N. J., has begun operation. The mill is designed especially for rolling light steel sections such as ¼ and ⅜-in. round, plain and deformed bars, small angles, channels, flats, tees and other sections.

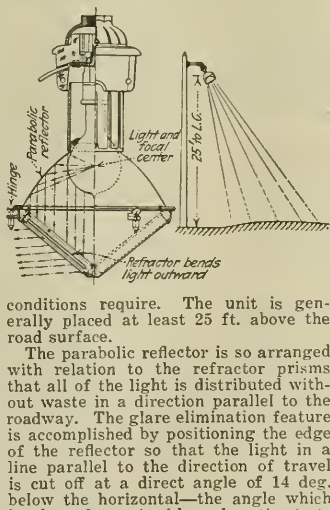
Link-Belt Co., Chicago, according to an announcement just made by its president, Charles Piez, has purchased the Meese & Gottfried Co., San Francisco, Los Angeles, Seattle and Portland, to improve its distributing facilities on the Pacific Coast which had previously been handled by subsidiary organizations under the names of the Link-Belt Northwest Co., of Seattle, and the Link-Belt Pacific Co., of San Francisco. Meese & Gottfried Co., and its predecessors, have been manufacturers of power transmission machinery and distributors of conveying and transmission machinery on the Coast for more than forty years. It is the intention of the new owners to add to the facilities and enlarge present stocks, so that prompter service to its customers will be insured. The new organization will be known as Link-Belt Meese & Gottfried Co., with headquarters at San Francisco. The officials will be: Charles Piez, chairman of the board; B. A. Gayman, president; Harold H. Clark, vice-president and sales manager; Leslie W. Shirley, treasurer; and Richard W. Yerkes, secretary.

Equipment and Materials

Highway Lighting Unit Throws Long Beam Parallel to Road

Through a combination of parabolic reflectors and refractor prisms a highway lighting unit, developed by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., effects a marked economy in the distribution of its illumination by casting its rays along the road in a long, narrow path. Another feature of the unit is the elimination of glare which is not only objectionable to the driver of a vehicle, but has been responsible for many road accidents.

As shown in the accompanying sketches, the lighting unit consists of a porcelain housing containing a Type C lamp, a silver-plated parabolic reflector, and a double set of refracting prisms. The unit is arranged for suspension from a series of interchangeable fittings to be fastened to brackets, mast arms or span wires, as mounting



conditions require. The unit is generally placed at least 25 ft. above the road surface.

The parabolic reflector is so arranged with relation to the refractor prisms that all of the light is distributed without waste in a direction parallel to the roadway. The glare elimination feature is accomplished by positioning the edge of the reflector so that the light in a line parallel to the direction of travel is cut off at a direct angle of 14 deg. below the horizontal—the angle which has been determined by exhaustive tests to be the most practical. The complete highway lighting unit weighs 100 lb.

New Balanced Three-Way Valve for 21-E Paving Mixer

A new three-way balanced valve, designed to prevent leakage by the elimination of metal-to-metal seats common on former types, has been perfected by the Koehring Co., Milwaukee, and is now installed as standard equipment on its 21-E pavers. All of the valve parts which come in contact with water are made of either bronze, brass, rubber or leather, preventing corrosion. The valve, which is equipped with rubber discs and leather plunger (standard Jenkins parts), is balanced, automatically operated, non-freezing, self-draining and accessible.

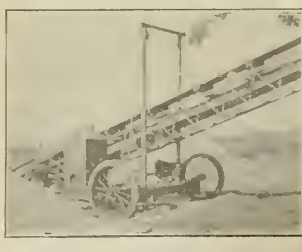
Inspection of the valve can be made easily by removing three bolts and one pin connection, allowing the entire unit to be pulled out of the valve body, as shown in the accompanying illustration. The valve can be dropped back into place without any fitting or adjusting. To turn the three bolts down and make the pin connection to the operating levers, is only a few minutes' work. A removable house protects the valve and outside valve parts from stone, sand

and cement which may drop from the charging skip.

An additional time-saving feature is the automatic opening of the valve to discharge water into the drum by means of an arm which opens the valve when the skip is raised. The time of opening the valve is adjustable in the valve-operating mechanism. A hand control is also provided for operating the valve.

Rubber-Tired Wheels for Construction Equipment

A development in its agricultural type of wheel is announced by the Geneva Metal Wheel Co., Geneva, Ohio, in the form of rubber-tired wheels for construction equipment. With such wheels equipment may be hauled from one job to another by motor trucks at higher speeds than is possible with metal rimmed wheels and also with less damage to the equipment from vibration and impact. The new type of wheel, shown in the accompanying illustration of a mechanical loader handling road material in Ashtabula County, Ohio, has hubs equipped with a



special type of roller bearing. The production of rubber-tired wheels is a new field for the Geneva company and its plant is now being equipped to manufacture this equipment for all standard rubber tire sizes.

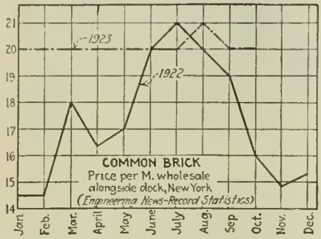
Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Brick and Cement Importations Increasing

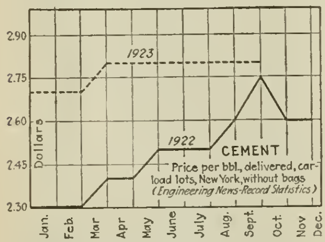
Foreign Brick Receipts During Second Quarter 1200 Per Cent Above 1922—Slight Gain In Cement

Although importations of foreign building materials has never yet been an important factor in the construction situation, the present high price level has given rise to considerable discussion of the subject. Importations of brick and cement are light as compared with domestic production and consumption, but it is worth noting that they appear



to be increasing. In April, May and June of this year 10,379,000 common brick came in through the port of New York, against only 749,000 in the same quarter of 1922. Cement imports through New York were heavier by 41,858 tons in this same quarter of 1923 than one year ago. In addition, 9,687 tons of white, non-staining cement were imported against none last year.

That American brick men are appreciative of the situation is evidenced by



the following statement by the Common Brick Manufacturers' Association of America:

"For the first time during the business career of anyone now manufacturing brick some competition is felt from foreign made brick. This is apparent so far only in the New York market, where considerable quantities of brick from Germany and Holland are reported to be coming in. It is stated that these brick can be purchased on board ship at German and Holland ports for $4 a thousand. It is apparent at once that American manufacturers cannot compete with this low production cost even after transportation and handling on this side of the ocean has been absorbed. This competition is not likely to reach far inland, but would affect Atlantic ports unless the American manufacturers in those locations find some protection."

The amount of foreign shipments to New York in the second quarter of 1922 and 1923, furnished by the Bureau of Foreign and Domestic Commerce, is as follows:

	1922	1923	
	Thousands	Thousands	Invoice Value
April..........	220	5,694	$31,916
May..........	217	2,706	22,741
June..........	312	1,979	17,009
	749	10,379	$71,666

The Bureau of Foreign and Domestic Commerce, of the Department of Commerce, reports that the imports of hydraulic cement in June, 1923, amounted to 11,559 bbl. The total imports in 1922 amounted to 323,823 bbl.

The exports of hydraulic cement in June, 1923, were 77,203 bbl. valued at $236,166.

The effect of competition always shows in the prices. That foreign entry into American brick and cement markets has not reduced prices is proved by the charts for New York.

Recent Unit Bids Throughout the Country

Although it is impossible for *Engineering News-Record* to quote formal prices at hundreds of centers throughout the United States, a workable acquaintance with construction cost in outlying districts may be had by studying the unit bids published in Construction News. For the reader's convenience representative bid prices on various materials and operations applying on a number of the more important contracts awarded during the last two months are presented in the table.

UNIT-BID PRICES ON IMPORTANT MATERIALS AND OPERATIONS IN RECENT CONTRACTS AWARDED

Where Located	E.N.-R. Issue	Nature and Extent of Job	Unit Bid Price
Arkansas..............	Sept. 6	22 mi. single track railway..........	$125,000
Calif., Merced	Sept. 20	6,000 bbl. cement, per bbl.........	3.79
Calif., Los Angeles	Aug. 30	100,000 cu.yd. dredging, per cu.yd..	.244
Calif., Los Angeles....	Aug. 16	2,800,000 cu.yd. dredging, per cu.yd.	.1575
Fla., Sebring........	Aug. 2	8,500 cu.yd. earth excav., per cu.yd.	.33
Ia., Clinton.........	Sept. 13	55,259 cu.yd. excavation, per cu.yd..	.30
		2,817 cu.yd. loose rock excav., per cu.yd.	.50
		5,615 cu.yd. solid rock excav., per cu.yd.	1.75
Ia., Des Moines...	Sept. 13	28,000 sq.yd. 8 in. concrete, per sq.yd..	2.66
Ia., Waterloo........	Sept. 6	91,379 cu.yd. excav., per cu.yd.........	.275
		80,000 cu.yd. channel, per cu.yd....	.375
Ia., Des Moines.	Aug. 30	43,324 sq.yd. vitrified brick on 6-in. concrete, per sq.yd..	3.25
Ia., Denison....	Aug. 30	98,388 cu.yd. excav., per cu.yd.............	.235
		15,100 cu.yd. channel, per cu.yd..........	.35
	Aug. 30	1,300 lin.ft. 8-in. tile, per lin.ft..........	.18
		1,350 lin.ft. 6-in. tile, per lin.ft........	.135
Ia., Anamosa	Sept. 27	106,660 cu.yd. excav., per cu.yd..........	.22
		8,700 cu.yd. channel, per cu.yd........	.48
	Sept. 27	30,690 ft. 6-in. tile, per lin.ft.............	.122
		540 ft. 8-in. tile, per lin.ft...............	.178
		1,325 ft. 12-in. tile, per lin.ft.........	.34
Ill., Chicago.....	Sept. 20	2,000 bbl. portland cement, per bbl.	2.50
Ky., Louisville..	Aug. 9	Pine No. 1 common, 1,670 pieces 2x4 @ 6x8 in. x 20 ft., per M................................	32.00
Mass., Haverhill..	Sept. 6	6,000 cu.yd. dredging, per cu.yd............	2.20
		8,000 cu.yd. earth excav., per cu.yd.........	3.575
		50 cu.yd. rock excav., per cu.yd..........	22.00
Mich., Lansing	Aug. 9	27,314 cu.yd. excav., per cu.yd...........	.55
		77,837 sq.yd. 8 in. con. pavement, per sq.yd...........	1.47
Michigan........	Aug. 9	54,038 cu.yd. excav., per cu.yd................	.65
		85,097 sq.yd. 8-in. rein.-con. pavement, per sq.yd.......	1.46
Minn., St. Paul	Sept. 20	20,000 bbl. portland cement, net, del., per bbl.......	2.80
Minn., St. Paul	Aug. 23	6,645 sq.yd. 3-in. vertical fibre brick, per sq.yd...	1.62
		4,000 cu.yd. crushed stone or gravel, per cu.yd........	2.60
		260 tons asphalt, per ton...............	21.30
		80,000 lb. asphalt filler, in drums, per ton....	26.60
Miss., Senatobia	Aug. 9	520,680 cu.yd. canal excav., per cu.yd.......	.975
Miss., Gulfport.	Aug. 23	15,395 sq.yd. bitulithic, per sq.yd..........	1.37
		16,300 sq.yd. concrete base, per sq.yd.........	1.60
New York......	Sept. 6	15,000 cu.yd. earth excav., per cu.yd.........	2.00
		100 cu.yd. rock excav., per cu.yd.......	6.00
		1,700 bbl. cement, per bbl.............	4.00
O., Canton...	Sept. 27	1 mi. monolithic type brick............	60,943.00
O., Cleveland	Aug. 30	$1\frac{1}{2}$ mi. 24-in. c.i. main................	123,070.00
		$1\frac{1}{2}$ mi. 36-in. c.i. main................	216,783.00
Okla., Fairfax ...	Aug. 23	29,110 sq.yd. vertical fibre brick, per sq.yd.. ..	3.95
		9,980 cu.yd. earth excav., per cu.yd.........	.90
		140 cu.yd. rock excav., per cu.yd.....	2.90
Okla., Blackwell	Aug. 2	8,600 sq.yd. vertical fibre brick, per sq.yd. ..	3.60
		4,800 lin.ft. curb and gutter, per lin.ft.....	1.15
		3,500 cu.yd. earth excav., per cu.yd.........	.80
Oregon.........	Sept. 13	38,000 cu.yd. common excav., per cu.yd........	.32
		3,000 cu.yd. solid rock excav., per cu.yd...	1.00
Tenn., Memphis. ...	Aug. 23	15,000 bbl. cement f.o.b. Memphis siding, per bbl......	3.11
Tex., Ennis.......	Aug. 23	14,500 ft. 10-in. class B, c.i. pipe, per ft..............	2.60
Tex., Abilene...	Aug. 9	40,000 sq.yd. 2-in. bitulithic pavement, per sq.yd.......	2.52
Utah, Salt Lake City.....	Sept. 6	2,174 cu.yd. common excav., per cu.yd.............	.95
		1,550 cu.yd. borrow, per cu.yd................	.50
	Sept. 6	9,625 cu.yd. common excav., per cu.yd.............	.50
		4,375 cu.yd. borrow excav., per cu.yd.......	.50
Washington..........	....	62,000 cu.yd. earth excav., per cu.yd.........	.55
		44,730 cu.yd. common excav., per cu.yd.......	.50
		3,300 cu.yd. loose rock excav., per cu.yd.............	.80

Production and Materials Stocks In Eleven Cities

Substantial Reserves of Brick and Lumber—Cement Output Highest on Record—Drop in Steel and Iron Output

Iron and Steel—Production has fallen off somewhat in both iron and steel during the last month. The average daily pig-iron output during September was approximately 99,811 tons, against 110,816 in August and 124,764 in May, which was the highest month in the history of the industry. The September steel ingot output totaled 3,159,283 tons against 3,506,755 during August and 4,000,695 in May, which was the peak month of the year, according to the American Iron and Steel Institute. While there has been a marked decrease in production and demand, consumption has been kept up in that buyers have been drawing heavily upon their reserve stocks.

Lumber—The present output is about 5 per cent above normal as against 7 per cent above, one month ago and 3 per cent below normal one year ago. Shipments are 105 per cent and orders 115 per cent of normal production, according to the National Lumber Manufacturers' Association. While production fell off slightly, shipments and orders gained during September. One year ago production was 97 per cent of normal with shipments 90 and orders 85 per cent of normal production. The following table shows lumber movements during the four weeks ending Sept. 29, compared with the preceding four weeks:

	Four Weeks Ending— Sept. 29, Ft. B.M.	Sept. 1, Ft. B.M.
Cut	1,078,921,770	1,082,683,351
Shipments	963,864,271	925,944,072
Orders	1,022,552,432	887,295,317

Cement—The August cement output was the heaviest on record, with 12,967,000 bbl. against 12,620,000 for the month preceding. August, 1922, however, totaled 11,664,000 bbl. Reserve stocks throughout the entire country Sept. 1 totaled 6,077,000 bbl. as against 5,716,000 for the corresponding period in 1922, according to the Geological Survey. Compared with this time last year, the cement situation is one of increased production, shipments and stocks on hand.

Brick—Report of the Common Brick Manufacturers' Association of America as of Sept. 1 shows 250,176,000 burned brick on hand at yards throughout the country, compared with 179,574,000 on Aug. 1. There has been a slight decrease in orders on books with a corresponding increase in stocks on hand, since there has been no slackening of production. Northern brickyards are storing brick in anticipation of a heavy 1924 demand. Many of the plants in the agricultural states are closed on account of insufficient demand for brick.

San Francisco—Warehouses fairly well stocked with lime, track supplies and blue annealed steel sheets; large supplies of steel structurals, bars, triangle mesh, metal lath and common brick. Large natural reserves of road oils and asphalt. Plenty of hollow tile, sewer pipe, drain tile, cement and galvanized sheets.

Los Angeles—Supply of building materials keeping pace with demand, with the possible exception of structural steel. Shipments of foreign cement arriving in the harbor.

Denver—Hollow tile and sewer pipe stocks low. Lumber trifle below normal. Plenty of brick.

(*Continued on p.* 622)

Japanese Preparing to Order Quantities of Supplies

Lumber, Steel, Concrete Mixing Machinery and Galvanized Steel Sheet Inquiries Principal Factors

Japan will be in the market for about 260,000,000 ft. of lumber within the next few months, as a preliminary order, the Department of Commerce has been informed. How much of this is to be purchased in the United States depends upon price and delivery. Japan will also seek some steel in this country, but probably not more than 20,000 tons has already been placed with American and Canadian mills.

The U. S. Department of Commerce will take no part in the purchases to be made by Japan, its duty ending with the message asking the co-operation of building materials manufacturers to prevent undue price advances in the face of an emergency. The Japanese Government is assured by the Department that American materials manufacturers will be able to handle all orders from Japan with promptness and dispatch. All transactions will be handled directly with the building materials producers by the Japanese, particularly through such agencies as the Metropolitan Reconstruction Board at Tokio.

Numerous small orders have already been received by American producers for electrical equipment and accessories, wire, wire nails and galvanized steel sheets. Considerable interest is also displayed in motor trucks and railway car equipment. The Ransome Concrete Machinery Co. of Dunellen, N. J., has already shipped an initial order consisting of twenty-seven concrete mixers and several steel towers to the devastated area. Lumber requirements are estimated at three billion feet.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Common brick, Denver, 5,000,000); time required for delivery of carload lots to city job, example: (Sewer-pipe Atlanta, 4 to 5 days); and stocks on hand in general terms, example: (Cement, Cincinnati, scarcity)

	San Francisco	Los Angeles	Denver	Minneapolis	Detroit	Chicago	Cincinnati	New Orleans	Atlanta	Philadelphia	New York
Sewer pipe	Stocks in good shape	No shortage	Supply low	Ample	Normal	Supply low; del. take 1 week to 10 days	Plenty	Scarcity of 4-in. pipe	Del. take 4 to 5 days	Supply ample	Small stocks in sizes above 6-in.
Cement	Well supplied	Sufficient; foreign shipments arriving	Enough	Plenty; del. prompt	No local shortage	Enough	Scarcity	Plenty	50 to 60 cars	No stocks in city; mill del. prompt	Dealers' stocks small; mill del. prompt.
Lime	Fairly well stocked	Plenty	Sufficient	Enough	Well supplied from local and Ohio kilns	Plenty	Enough	No shortage	70 cars	Normal	Market well supplied
Common brick	Large reserves	Demand being met	5,000,000	Large stocks	Plenty in dealers, yards	Sufficient	Ample	Sufficient	Plenty	Supply coming in to meet demand	Heavy reserves being piled in Hudson River district
Hollow tile	Plenty	Supply equal to demand	Stocks low	Sufficient	Small supply	Del. take one week	Plenty	Enough	4 to 5 days	Small stocks	Dealers' stocks small; prompt del. by water
Lumber	Heavy shipments to Japan	Demand not greater than supply	Trifle below normal	60,000,000 ft. in Twin City yards	Stocks decreasing at approach of inventory	Del. take 30 to 60 days	Sufficient	Stocks low on yel. pine	Plenty	Well stocked except West Coast lumber	Del. take 4 to 5 weeks from mill
Asphalt	Unlimited native reserves	Native reserves	Sufficient	Ample	Moderate stocks; del. prompt.	Plenty	Ample	No market	60 to 70 cars	Great scarcity	Heavy reserves in N. J.
Structural steel	Plenty structurals, low on rivets	Supplies now up to requirements	Warehouses well stocked	Enough in warehouses	No shortage	Del. on reinforcing bars take 30 days	Pipe stocks low; other steel items plentiful	Normal	4 to 5 cars	Supply ample for small tonnages	Warehouse stocks sufficient; demand light

(Continued from p. 621)

Minneapolis—Stocks of all materials ample with deliveries prompt. Lumber stocks trifle below normal with an estimated 60,000,000 ft. in Twin City yards, wholesale and retail.

Detroit—Small stocks of hollow tile on hand. Lumber reserves decreasing at approach of inventory time; dealers buying on hand to mouth basis. No local shortage of cement but scarcity reported in nearby localities owing to heavy demand by State Highway Department.

Chicago—Sewer pipe stocks low; deliveries take from one week to ten days. Lumber mill shipments take from thirty to sixty days. Japanese demand has not yet affected the lumber market in this district. Hollow tile demand slightly above normal for this time of the year, deliveries take about one week.

Cincinnati — Scarcity of cement; plenty of all other building materials.

New Orleans—Stocks of pine lumber are low but the demand is inactive. Plenty of other building materials available, with the possible exception of 4 in. sewer pipe.

Atlanta—Plenty of brick and lumber. Between fifty and sixty cars of cement, sixty to seventy cars of asphalt, about seventy cars of lime and from four to five cars of structural steel on sidings.

Philadelphia—Scarcity of asphalt and hollow tile. Well stocked with lumber with the exception of West Coast fir. No dealers' stocks of cement held in reserve as prompt mill deliveries render this practice unnecessary.

New York—Heavy reserves of burned common brick being piled up in Hudson River district. Brick shipments are prompt, and distribution is greater at the present time than during the peak of the building season. Plenty of other construction materials with the exception of sewer pipe. Small stocks in city in sizes above 6 in., mill deliveries slower than month ago.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the the issue of Oct. 4; the next, on Nov. 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.00
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.25	5.30	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	+3.95	3.20	3.45	3.85	3.65	4.10	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	—53%	43%	47%	53–5%	36%	33.2@42.2%	35%	47.42
Cast-iron pipe, 6 in. and over, ton	63.60	—55.00	63.00	60.20	60.50	69.00	62.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.70@2.80	2.60	2.25	2.20	2.50	2.84	2.63	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	+2.00	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+62.00	39.00	52.25	58.50	—44.75@45.75	+48.00	41.00	+29.50	70.00
Lime, finishing, hydrated, ton	18.20	+25.00	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	+1.60	1.75	1.50	1.50	2.70	2.10	2.80	—9.50
Common brick, delivered, 1,000	23.65	11.00	—11.60	11.00	17@19	12.00	15.00	15.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	.115	.0724	.0816	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1179	.102	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	+.98	+1.00	+1.09	1.14	+1.02	+1.12	+1.04	.86	+1.40
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.50@.55	.35@.50	.50	.56¼@.62½	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.88). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.42; 6-in., $119.

Changes Since Last Week

The present irregularity in demand is reflected in the firmness in prices of certain materials and a tendency toward weakness in certain others. Linseed oil, for instance, which is considered a barometer of the paint trade, has taken an upward turn due to higher flaxseed and increased demand. Raw oil advanced 2c. in San Francisco; 3c. in New York, Minneapolis and Denver; 4c. in Atlanta and 5c. per gal. in Dallas.

Lumber is also firmer. Pine advanced $1 in New York and fir 50c. in Seattle and $3.75 per M. ft. in Denver, during the week. A slight decline, however, is reported in Minneapolis on Douglas fir timbers.

Reinforcing bars advanced 15c. per 100 lb. and sand, 11c. per cu.yd. in Dallas. Hydrated finishing lime rose $2.50 per ton and common lump, 10c. per bbl. in Atlanta. Local stocks of steel bars are exhausted in Dallas.

Steel pipe discounts advanced 8 points and c.-i. pipe dropped $5 per ton in Atlanta. Brick dropped $1.50 per M. in Dallas and common lump lime, 50c. per ton in Montreal. Bars remain firm at $2.40 with plates and shapes at $2.50 per 100 lb., f.o.b. Pittsburgh.

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor
FRANK C. WIGHT, Managing Editor

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A Cabinet Officer Needs Educating

THE authoritative statement of Dr. Work's position in the Reclamation Service case, as set forth in our Washington correspondence this week, indicates that the Secretary of the Interior does not even now fully appreciate the significance of his action in removing an engineer from the head of an engineering bureau and placing there a so-called business man. He is still obsessed with the notion that engineering is merely the "building of dams and the digging of ditches" and that dam building and ditch digging can be carried on just as well under the superior direction of an unsuccessful banker as it can under a successful engineer. When he has had somewhat more experience with the intricacies of government irrigation—or possibly when he has received some instruction through the medium of a congressional investigation—he will know that reclamation is a continuing engineering problem, that requires for its supervision somewhat more than the acquaintance with human nature that presumably is the principal asset of the politician and business man, and which the Secretary assumes to be a nonexistent characteristic in an engineer. At any rate he is already learning that what he thought was merely a quiet little political maneuver has assumed proportions that threaten his whole administration.

Municipal Bond Market Overloaded

RECENT indications are that the market for municipal bonds is overloaded. A few weeks ago Detroit received no bids for a bond offering and more recently a fairly large offering by Dallas, Texas, brought no bids the authorities were willing to accept. For several months past higher interest rates have been necessary to secure bids favorable enough to relieve public authorities of worry over impaired credit standing. All this will have some bearing on the fate of bond issues up for approval at the November elections as well as upon the volume of construction work to be offered next year. By now, most of the items to be voted on in November have been fixed beyond change, but thinking voters will consider the bond market and it will also be taken into account by the public authorities in passing ordinances for later bond elections and in placing on the market bonds already authorized.

Convention Contrasts

THOSE who attend many society conventions in the course of a year marvel at the contrasts thus afforded. Most convention programs are overloaded with papers, a considerable percentage of which are not suited to reading and discussion on a convention floor. Too rarely a convention program is as well planned and carried out as was that of the American Public Health Association at Boston last week. Although—or was it because—the convention met in nine sections, besides the general meetings, there was plenty of free time for trips of inspection, and these were well organized. There was also time for discussion of the papers and reports, at least in the Sanitary Engineering Section. It was hinted, above, that sectional organization explains the well ordered character of the A. P. H. A. meeting. Doubtless that had much to do with it, but a little earlier the New England Water Works Association had a convention at Burlington which, with no section meetings, was also well ordered and afforded ample time for discussion. What many of our technical societies need is program planning of a kind that will keep the papers and reports so limited in number, and insure that they are of such a character, as to bring out full and free discussion—for as a rule a society paper not of the sort to elicit discussion should not find a place on a convention program.

Activating Superpower

HERBERT HOOVER, with characteristic directness and clarity of purpose, has taken the only initial step that will lead to the development of the so-called superpower scheme for the Eastern industrial zone. The engineering advantages and difficulties of this huge undertaking have been thoroughly analyzed and made public; there remains now the tremendous inertia of public and private action to be overcome. It is true, as the Secretary of Commerce says, that the federal government could step in to initiate the superpower work by direct action, but that is incompatible with either public policy or private needs. But the government is doing a much more useful work in bringing together the power interests and the state authorities in the Northeastern states to work together to develop plans whereby the numerous legal and statutory restrictions to interstate power transmission may be overcome. Once the public agencies can get together with some joint workable plan, the private interests and the state engineers can proceed along engineering lines to develop the technical requirements of joint production and transmission of power. The Department of Commerce can be trusted to continue to activate the study of superpower and in so doing will hasten the day when it becomes an actuality.

Special Privilege at Muscle Shoals

WHETHER or not the political prophets are right in saying that Henry Ford's first public statement on the Muscle Shoals proposition, noted in the news pages, is the opening gun in his presidential campaign is no concern of ours. We are concerned, however, with the unfair position the Detroit manufacturer takes toward the whole Muscle Shoals controversy. To read his statement one could well believe that an adequate and scientific offer for the government property on the Tennessee was being blocked by predatory political and

financial interests. This is not a fact. What Ford neglects to mention is that his offer is in contravention of the established water power law of the country and that the system of payment proposed is in contravention of any accepted law of economics. Mr. Ford is becoming more and more egocentric. It is perhaps natural that he should come to think he is a law unto himself, but he and his advocates must be made to understand that even his demonstrated efficiency in some lines does not place him in a privileged class before the law. If he is in earnest in his wish to make fertilizer and to distribute cheap power from Muscle Shoals (and this is the first time he has actually said that he would make commercial power) he should make a proposition which not only will adequately reimburse the government in accordance with law but will give more assurance of that intention than the mere spoken word of a man —a superman if you will, but one who can hardly transmit his human qualities by word of mouth to the corporation which will succeed him in a few years.

Winter-Work Records Wanted

LACK of data on winter operations is hampering the work of the agents of the Department of Commerce who are investigating seasonal construction. So few contractors in any community have kept close account that it is virtually impossible to formulate definite conclusions as to the percentage of workable weather and temperature effects on efficiency and costs in that community. These data are needed if we are going to arrive at any true findings concerning the remedies for seasonal work—for two reasons particularly: (1) Since winter construction is an economic problem, owners must be shown that it is profitable to build in cold weather, and (2) winter construction is a different problem in different temperature and storm areas. Very complete data of winter construction operations in Atlanta, Ga., if they should happen to exist, would obviously be of limited service to contractors in Cleveland, Ohio. There is apparently in the difficulties of the Department of Commerce agents an opportunity for associations of builders and general contractors to perform a needed service for the industry—the collection of winter construction data, each organization in its own community. All organizations functioning intelligently this winter would leave very few sections of the country unrepresented in the records of the Department of Commerce. There is a duty to be performed by contractors' associations in discovering the conditions of cold weather work and winter idleness.

Labor Difficulties Up to Building Public

THAT those who complain of labor ills in the building field have the remedy in their own hands has been demonstrated in Chicago for the past two years. While everybody in the building business has not supported the Citizens Committee to Enforce the Landis Award, enough did do so to keep down strife and permit a period of building during an unprecedented boom without interruption of any kind except the delays incident to an extraordinary over-demand for labor. In twenty months building permits have exceeded a half billion dollars and the rate now is about two and one-half times that of any previous period. Graft has gone. Union and open-shop men work side by side without smashing each other's heads. Labor leaders are said to be afraid to call strikes fearing a revolt of the men, although usually a boom period and labor scarcity is considered the heyday of the walking delegate with his arrogant orders to strike on the least provocation. The committee has brought 15,000 to 20,000 men into the city and placed more than 50,000 men through its employment offices.

Naturally, there have been sporadic cases of rioting, bombing and slugging; the committee members have been threatened but the criminal element has been about worn out. Two police have been killed but public sentiment forced the state's attorney to act. Special prosecutors were put to work; $100,000 made available and the volunteer services of prominent lawyers obtained. Twenty labor criminals are wearing prison stripes and several more are in jail, for which the decent laborer is as pleased as the bystanding public.

Apprentice schools have been started. Bricklaying, plumbing, sheet metal work, painting and carpentry can be learned without the onerous restrictions of the unions.

Recently certain contractors who have out-of-town all-union jobs have pulled away from the Landis Award committee and rumors to the effect that the committee was losing ground and would disband have been circulated. At a recent meeting of the Chicago Association of Commerce and a few days later of the contractors and architects the members of the committee, T. E. Donnelly, James A. Patten and John W. O'Leary, emphatically denied any thought of quitting, but they made it plain that the fight was not that of the contractors, nor of the committee, but of the building public. Active support from the public is essential. If the enthusiastic applause greeting this request is any criterion, the committee will stay on the job, and Chicago building will continue indefinitely unhampered by labor troubles.

How Shall We Gage Water-Supply Purity?

NOTHING could better illustrate what many people—wrongly, we think—deprecate as an insidious, rapid and far reaching usurpation by the federal government of powers rightly belonging to the state, than the strong control of the character of public water supplies which is being gained by the Treasury Department through the United States Public Health Service. Based, as are so many other kinds of federal control, on the interstate commerce clause of the Constitution, the Public Health Service put out some ten years ago a bacterial standard for water supplied for drinking purposes on railways and other interstate carriers. This standard it is now proposing to make more rigid and although it has no power to impress these requirements on municipalities the nature of the situation is such that the new regulations will have a potent effect on all public water supplies.

We question neither the power nor wisdom of the federal government in its interstate control nor the choice of the agency for the purpose, but we do urge caution in the methods employed in exercising the control lest there be a reaction against this and other instances of federal control and more particularly lest the Public Health Service, in attempting to promote the public health in one field—a field in which practice is far in advance of that in most other municipal fields—

cause a retardation of progress along other lines which would bring far greater returns for the same expenditure of money. The danger that we have in mind is one that is incident to all work along highly specialized lines unless there is constantly a broad vision of all the needs in collateral fields, or, in other words, a consideration of relative values.

Whether foreseen or not, the Public Health Service standards for drinking water are rapidly becoming the standards for all public water supplies; that is, they are being so considered more and more by sanitarians, state boards of health, the courts, the press and, gradually, the general public. The press and the general public, in particular, have little knowledge of the fact that the B. Coli standard now in use and proposed to be made still more rigid is merely a tentative index of pollution—much like the albuminoid ammonia, chlorine and total bacterial count standards that preceded it. Although this is thoroughly understood by the specialists, it does seem at times as though even they set up the B. Coli standard as a fetich, though there is as yet no certain way of telling whether the B. Coli found in water are of human or animal origin.

In view of such limiting conditions to the B. Coli index, great care should be taken against raising it unduly, since there is no certainty of getting health results commensurate with the possible heavy expense entailed to comply with the standard. This seems to be all the more important since, as we suggested at the outset, the municipal water supplies of the country as a whole seem to be far in advance of almost any other branch of the municipal service coming under the general head of sanitation and public health. If and where this is the case, should not the Public Health Service, and the state and local health services as well, be concerned first of all with the raising of other sanitary and public health services to the level already attained by the public water supply, rather than with forcing the water supply to a still higher level of quality, measurable merely by an index of pollution beset with much uncertainty?

In raising this question we fully understand that the regulation of the quality of water supplies on interstate railway trains and steamers must of necessity be conducted from the viewpoint of protecting passengers from all parts of this and other countries, rather than from the viewpoint of a given individual city. We also understand fully that the water supply of many cities, and perhaps of nearly all the cities of many states, is already well up to the present Public Health Service standard and perhaps has reached the level of the proposed standard or can be brought there quite readily. At the same time, it is evident, from the utterances of federal, state, and local officials engaged in the various conferences that have thus far been held over the proposed new standard, that a considerable number of water-works officials of the country, including those from a number of important cities, are deeply concerned as to the difficulties and expense involved in meeting the proposed new standard—in fact, have not met the old one—and that there is also considerable concern on the part of all the classes just mentioned as to whether the B. Coli standard alone should govern.

Although there has been considerable talk as to the advisability or possibility of giving large weight to a sanitary survey of each water supply, the present indication seems to be that for some time in the future at least, as has been the case in the past, many supplies will be judged chiefly from the bacterial standard. This is due in part to the comparative readiness with which bacterial analyses can be made and interpreted as compared with the sanitary survey. It should be noted that the Public Health Service has no facilities for conducting either bacterial analyses or a sanitary survey. It must rely almost wholly upon state and local supervision of water supplies, merely accepting these or else, in cases of material doubt, refusing certification on the strength of reports that come to it from state sanitary officers.

If there be uncertainty, as there certainly seems to be, as to the weight that is to be given in the future to the sanitary survey as compared with the B. Coli index, the uncertainty is still greater as to paying much if any attention to the typhoid and other statistics of a community that may be regarded as reflecting the character of the water supply. From the very narrow viewpoint of water supply alone this is natural enough, but from the broad viewpoint of public health, both of a given community and of the country as a whole, it seems very unfortunate. Inasmuch as the B. Coli index is an index only and an uncertain one at that so far as its real significance is concerned, why not give material weight to the vital statistics of a community, or that part of them known to be affected by the character of the public water supply, in certifying a water supply from a community, say like Providence, R. I., where during the whole year 1922 and so far in 1923 there was not a single death from typhoid fever? There are many other cities which are in the same general class as Providence so far as complying with either the old or the proposed new B. Coli index is concerned. Some of these communities, like Providence itself, are voluntarily taking steps that will lead within a few years to a water supply of a different and probably much improved character. In much the same way the trend in whole states is toward a materially higher standard of water supply than now exists.

What we urge is careful consideration of the possibility of establishing and administering a water standard along broad enough lines to guard against the possibility that a city may be forced to expend a relatively large sum for the compliance with an arbitrary tentative standard of water quality, with no certain evidence that any lives will be saved or sickness prevented thereby, when the required expenditure could be used for other purposes that would undoubtedly save more lives and prevent more sickness in the community in question. Such consideration should not, of course, go so far as to endanger any traveler on railway trains or steamboats who drinks water taken from that city, even though it be but once a year, but after all what is the better index of the safety or danger of a given water supply: a B. Coli content that may be due to causes that have nothing whatever to do with any disease to which human beings are liable or the vital statistics of the community constantly using the water supply?

We think a careful weighing of the elements that may properly enter into a standard for water supply, including the broader health considerations we have mentioned, will show conclusively that much weight should be given to the sanitary survey and to the vital statistics of a community in deciding whether or not its water supply is safe for use on interstate trains and steamers.

Rigolets Bridge Built to Stand Hurricanes: L. & N. R.R.

Each Pier a Concrete Cylinder Sunk 80 to 113 Ft. Below Sea Level on Gulf Coast—Steel Shells Sunk and Concreted—Truss Spans and Draw—Construction Equipment Floating or on Piles

BUILDING A BRIDGE in an exposed situation subject to tropical hurricanes and to heavy wave action is the unusually difficult condition to be met in the reconstruction of the Rigolets Bridge on the main line of the Louisville & Nashville R.R., about thirty miles east of New Orleans. This bridge crosses a tidal pass known as the Great Rigolets, connecting Lake Borgne and Lake Pontchartrain. The general situation is shown in Fig. 1.

Hurricane Conditions—For many miles on each side of this crossing the railroad traverses a salt marsh along the Gulf coast and is subject to violent hurricanes which at times have caused severe damage to the railroad and to the bridge. During storms of 1909 and 1915 several of the plate girder spans were carried away by the combined action of wind, waves and current. In violent storms the waves reach a height of about 10 ft. above mean sea level or 2 ft. above the bottom flanges of the present girders. The tidal range is only about 15 in.

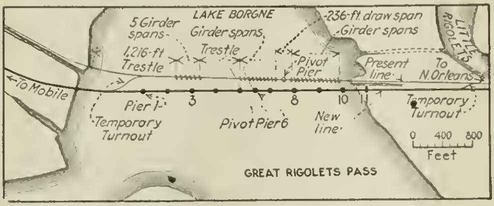


FIG. 1—RECONSTRUCTION OF RIGOLETS BRIDGE: L. & N. R.R.

Tropical hurricanes originating at the eastern end of the Caribbean Sea and blowing through the Gulf have a diameter of about 250 miles, with a velocity of translation of about 12 m.p.h. and a rotary velocity as high as 125 m.p.h., as determined from observations made south of New Orleans. It is this rotary velocity which does the damage. At the bridge the wind may blow in any direction, depending upon the position of the center of the storm in relation to the structure. In the pass the line of current makes an angle of about 64 deg. with the bridge. The highest current velocity determined by measurements is 4.2 miles an hour, when the water was about 4 ft. above normal level and the center of the storm was between Mobile and Pensacola. But the maximum velocity due to hurricanes has never been determined, since men cannot stay on the bridge during these storms and registering instruments could not be used under such conditions.

Old and New Structures—The present bridge at the Rigolets was reconstructed in 1902, but the storm of 1909 destroyed eight of the deck girder spans. A temporary timber trestle was built to close the gap, and in 1911 seven 60-ft. through girder spans were built in place of the original spans. The hurricane of 1915 destroyed sixteen of the girder spans, and these have never been replaced, since the railway company had intended to build an entirely new bridge when financial conditions permitted. For this reason temporary trestles in place of these sixteen spans have been maintained since the storm mentioned.

In its present state, therefore, the bridge consists mainly of two groups of steel girder spans on piers of creosoted piles, these groups being separated by a 560-ft. stretch of creosoted pile trestle with open deck. One group has five through girder spans of 59 ft. 8 in., and the other has twenty similar spans of 52 ft. 10 in. and a 236-ft. through-truss swing span. There is a navigable channel on only one side of the pivot pier. The base of rail is about 13 ft. above mean sea level. Creosoted pile trestles form the approaches. It will be noted by the plan, Fig. 1, that all the old steel spans are on the skew, the piers being arranged in line with the direction of the current. These pile piers are described farther on.

In the new bridge, Fig. 2, which is intended to be substantial enough to withstand any hurricane likely to occur on the Gulf coast, there will be eight through-truss riveted spans 330 ft. c. to c. of bearings, with a 414-ft. swing span. This gives a total length of 3,097 ft. c. to c. of end piers. Special provision will be made for anchoring the spans to resist the force of hurricanes. Ten concrete cylinder piers will support the spans, but the cylindrical pivot pier will be filled solid and the west end pier will be of the usual rectangular plan and supported on piles. By approach grades of 0.3 per cent at the west and 0.25 at the east end, the elevation is raised so that the height from mean sea level is 18 ft. to base of rail and 13 ft. 4½ in. to lowest point of steel.

Location and Approaches—In order to avoid interference with traffic during construction, the new bridge is located alongside but somewhat diverging from the present structure, being placed at a sufficient distance to be clear of all wreckage from the latter, which has been damaged several times by storms. The greatest distance between the structures is 200 ft. At the east end is a curve of 1 deg. 40 min.

Long timber trestles will form the approaches, as the marshes over which the line is located are too soft to sustain the roadbed. There will be 7,769 ft. of trestle at the east end and 3,435 ft. at the west end all with 12-ft. spacing of bents. Creosoted piles in six-pile bents are used for that portion of the trestle which will remain permanently, while green piles in four-pile bents are being used for the portion which will be filled for a solid embankment.

The greater part of the trestling will be filled, and owing to the soft ground it is expected that when this filling is completed there will be more material below the marsh level than above it. Since the placing and compacting of the fill will thus extend over considerable time, the trestles will be constructed of ample strength to carry trains for several years, thus allowing ample time for the embankment to settle and also providing for placing additional material as settlement occurs.

Substructure—Special interest centers in the design of the substructure, with piers sunk in loose material, standing in deep water and exposed to heavy storm waves (see Fig. 2). After careful consideration of these violent lateral forces it was decided to adopt piers

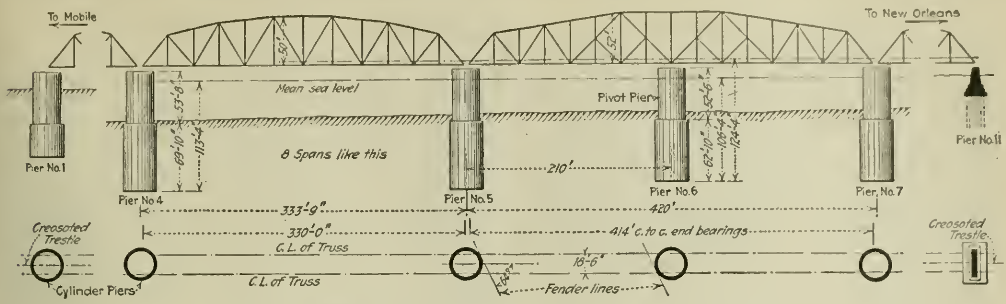


FIG. 2—TRUSS SPANS AND DRAW ON DEEP CYLINDER PIERS

of annular or cylindrical form, the design of which is shown in Fig. 3. In each pier the portion sunk below the bed of the Rigolets will be 34 ft. in outside diameter, while the upper part will be 28 ft. in diameter, the change in dimension being made by a square offset. In both portions the central well will be 16 ft. in diameter, giving a wall thickness of 6 and 9 ft. in the upper and lower portions respectively. This wall will be of reinforced concrete and a 6-ft. slab or cap will form the top of the pier to support the bridge seats.

For each pier a cylindrical steel shell or caisson will be sunk, having dimensions conforming to these above noted. Typical construction of these cylinders is shown in Fig. 4. The sinking will be done by open dredging, but arrangements have been made for capping the shell at any required height with a steel dome, so that the pneumatic process may be adopted if necessary to sink through logs or other obstructions. The annular space between the inner and outer shells will be filled with reinforced concrete as the piers are sunk. When the pier has reached the intended depth the bottom of the well will be filled with concrete to a depth sufficient to insure distribution of the load over the entire base area for the pier. For the pivot pier, however, this filling will be carried to the top of the cylinder and will be formed with a recess 13 ft. square and 18 in. deep to receive the steel grillage supporting the center stand of the swing-span turntable.

In the design of the piers no allowance was made for the steel shell, the reinforced-concrete cylinder being designed to have ample strength and stability in itself. It is expected that the piers will be sunk to depths of 78 to 113 ft. from mean sea level to the cutting edge, or 70 to 80 ft. below the bed, but the actual depths may be varied according to conditions encountered in sinking.

Foundation Conditions—The maximum depth of water below mean sea level at the site of the new bridge is about 45 ft., while under the present bridge it is about 57 ft. It is considered manifest that there has been some scour under the latter and it is the purpose to sink the new piers to such a depth as to be stable in spite of any probable amount of scour.

Borings made on the site of the new bridge do not show great uniformity, the material varying from soft black mud near the bed of the pass to stiff yellow clay, fine sand and some gravel. The mud is of considerable thickness under the shallow water near the shores, but there is very little of it in the deeper water. It is expected that the cylindrical piers will be founded either on stiff gray clay or hard packed sand. The formation of the bed of the pass and of the adjoining salt marshes has been built up evidently with silt from the Mississippi River at a time when this territory formed a part of the delta of the Mississippi.

Pier Construction—The bottom section of each double-shell steel cylinder, about 27 ft. 10 in. high above the cutting edge, will be built up on a dock and then floated to position, where part of a circular cofferdam of steel sheet piling will have been driven. The remainder of this piling will be driven after the shell is floated into position. The purpose of the cofferdam is to avoid the influence of current and to reduce the effect of scour. The cylinder will be sunk by interior dredging assisted by water jets, the shell being built up and concrete filling placed as the sinking proceeds.

Typical details of the steel shells are shown in Fig. 4. They will be of ¼- and ½-in. steel plating, with interior angle rings to which twenty-four radial braces are bolted. This bracing will be furnished for two piers only, being removed in advance of concreting and thus salvaged for the next piers. The conical shell for

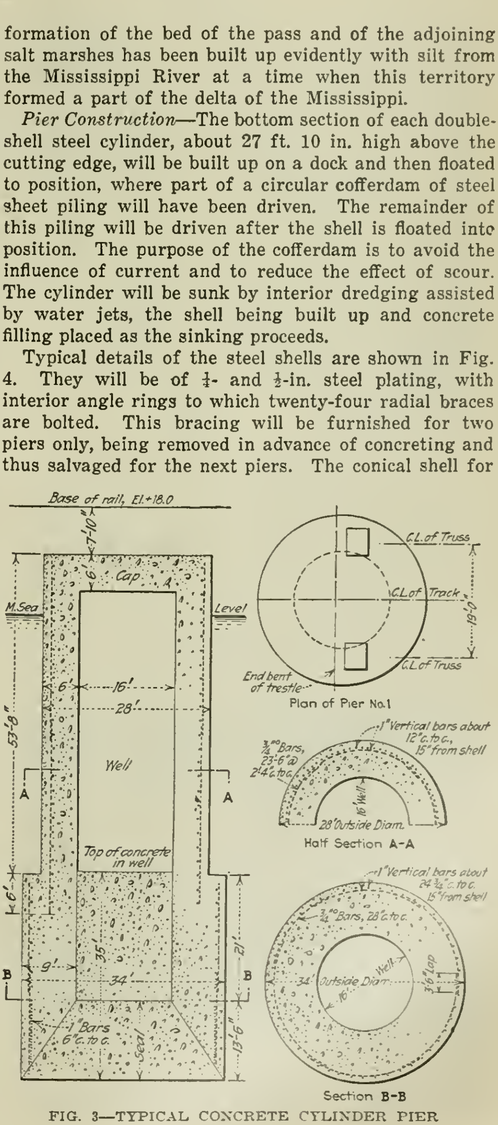


FIG. 3—TYPICAL CONCRETE CYLINDER PIER

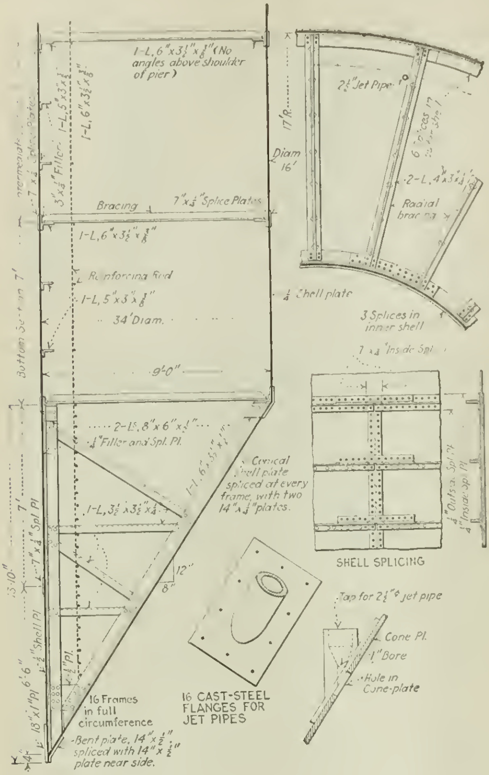


FIG. 4—STEEL SHELL FOR CONCRETE PIER

the cutting edge is braced by sixteen frames and has sixteen cast-steel flanges for 2½-in. jet pipes. Each bottom section, 13 ft. 10 in. high, will be set up complete in the shop and all other shell plating will be fitted to templets at the shop to insure accurate fit. All joints will be calked in the field to make the shell thoroughly watertight. This steelwork will have one shop coat of boiled linseed oil and there will be no field painting.

Concrete of 1:2:4 proportions is specified and will be made with gravel. It will be placed by means of buckets handled by derricks, as the specifications require a mix too dry for chuting. In sealing the well of each pier the concrete is to be placed by a tremie to a height of 13 ft. 10 in. above the cutting edge, after which the water will be pumped out and the concrete placed by buckets. The specifications also require that all laitance must be removed, that green and set concrete must be thoroughly bonded and that all concrete must be made as dense and impervious as possible. In all there will be about 26,700 cu.yd. of concrete. Steel reinforcement will consist of plain round bars of medium steel and it is provided that these must be well protected from moisture on the storage dock before use.

Construction Plant—A contract for the piers and foundations has been awarded to the Missouri Valley Bridge & Iron Co., Leavenworth, Kan., on a modified cost-plus-fee basis. Docks, camps and floating equipment have been provided but actual construction has been held up by delay in getting steel delivery.

As there is no solid ground in the vicinity of the bridge it was necessary to build docks for storage of materials and for camp buildings and other temporary structures. Fig. 5 shows the general plant layout. The railway company built a spur track from the main line extending about 300 ft. into water 10 or 12 ft. deep. Docks for the various materials were built adjacent to this spur in water where the depth was sufficient to load barges and operate a tug. Materials are unloaded from cars on the spur onto the storage docks and transferred thence to barges. Docks for the steel and cement house are on one side of the spur and those for the sand and gravel storage piles on the other side. Views of the plant are shown in Fig. 6.

All these docks are on piles 50 to 60 ft. long, driven about 6 ft. c. to c. The steel dock is 40x60 ft.; the covered cement dock, 24x96 ft.; sand dock, 40x50 ft., and the gravel dock 70x50 ft. Camp buildings, tool houses, office, blacksmith shop and other structures are built on piles with the floors about 10 ft. above the ground level; the piles, spaced 8 to 10 ft., are driven about 15 ft. into the soft mud.

For the construction of the bridge piers, twenty barges have been provided, eighteen of which were built new. The power barge, 32x100 ft., is provided with three boilers, two air compressors, a lighting plant, pumps, air receivers and other equipment. This barge is provided mainly with a view to the possible necessity of sinking by the pneumatic process. One of the compressors can furnish air at 100-lb. pressure for operating pneumatic hammers.

The concrete barge, 36x84 ft., is equipped with a sand and gravel bin, concrete mixer, two derricks, two hoisting engines, a boiler for furnishing steam for all engines, a lighting plant, water and fuel tanks. One derrick is placed so as to transfer the sand and gravel from barges to the bin and the other takes the buckets from the mixer and places the concrete in the pier. As already noted the concrete mix is to be too dry for chuting into place.

For excavating material within the steel shell there are two dredge barges 32x72 ft., each equipped with 50-hp. hoisting engines, boilers, a derrick and a light-

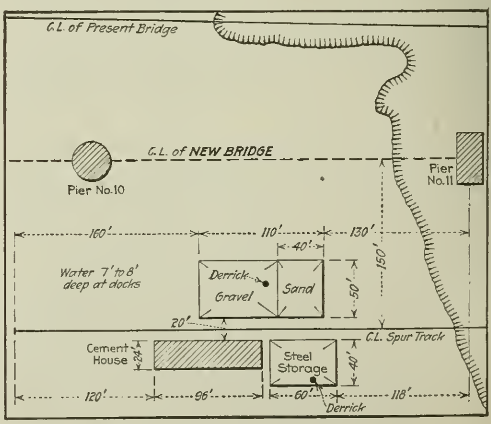


FIG. 5—MATERIAL STORAGE DOCKS

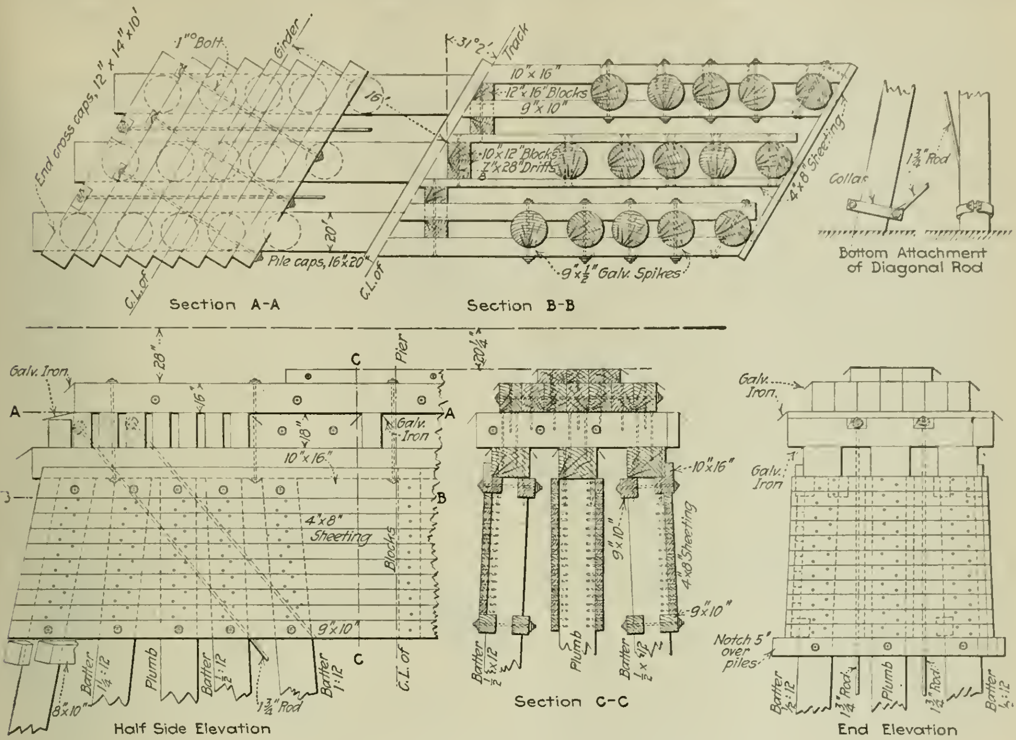


FIG. 7—SHEATHED PILE PIERS OF OLD RIGOLETS BRIDGE

ing plant. Two other derrick barges, 26x64 ft., are equipped with 30-hp. hoisting engines, derrick and lighting plant. Other equipment includes a pile driver barge 26x64 ft., with engine and leads; two cement barges 26x64 ft., with houses; three material barges 20x64 ft. for transferring piles, steel and timber; one fuel-oil barge 16x48 ft., two water barges 18x60 ft., two sand barges 24x70 ft., two gravel barges 24x70 ft. and one gravel barge 25x75 ft.

On a pontoon barge 44x44 ft. the steel cylinders will be built to a height of about 14 ft. and then launched. This pontoon is open on top, with sides about 9 ft. high and floor timbers 12x12 in. running in both directions. After the steel shell is built to the required height, plugs will be pulled and the barge permitted to fill with water. One side of the barge, which is hinged, will then be lowered and the steel cylinder launched into the water and towed into position. There are also a steel tug, a gasoline launch and skiffs.

Adjacent to the steel dock a derrick has been erected for transferring the steel from the cars to the dock and from the dock to the pontoon barge and also for building on this barge the bottom 14-ft. sections of the steel cylinders. On the gravel dock is a revolving derrick with a 60-ft. boom, which transfers the sand and gravel from the cars to the docks and from the docks to the barges. Dredging in the pier cylinders will be done by two 1½-yd. clamshell buckets and concrete materials will be handled by three ¾-yd. clamshell buckets. All derricks are provided with bullwheels and swinging engines.

There are a number of pumps, including two with 10-in. suction and 8-in. discharge for operating jets while sinking the cylinders, and also two hydraulic excavators for excavating the material in the cylinders if it is found possible to handle the material in this manner. A high-pressure oil-engine air compressor is provided on the steel dock for operating pneumatic tools used in building the steel cylinders in the pontoon

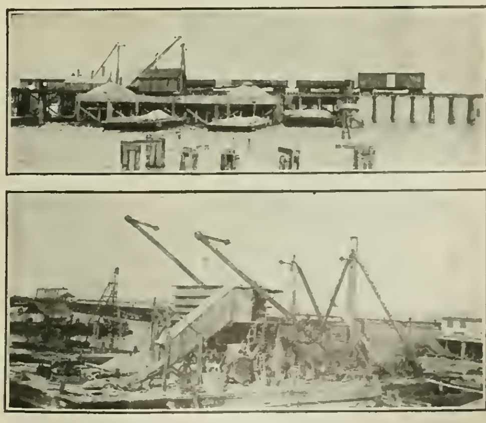


FIG. 6—CONSTRUCTION PLANT FOR RIGOLETS BRIDGE
Above, material storage dock and spur track. Below, floating concreting plant.

barge. There are also air locks, air receivers, feed-water heaters, riveting hammers, calking hammers pipe threading machines and the necessary blocks, lines and other small equipment. A diving outfit has been provided in case it may be required in overcoming obstacles in sinking.

The railroad company is building the approach trestles, already mentioned. It has begun filling them with clay excavated under water at a point about twelve miles east of the bridge, as the ground is so low and flat that no dry filling material is available within reasonable hauling distance.

Old Pile Piers—Creosoted yellow-pine piles for the pile piers of the present bridge were of extra large size and 70 to 100 ft. in length, driven with a penetration of 30 to 40 ft. or as much as it was practicable to secure without damaging the piles. Typical construction is shown in Fig. 7. Piers under deck-girder spans constructed before 1910 had 16 piles each. In the later work the number of piles per pier was 30 under through girder spans, 22 under deck girder spans and 34 for piers supporting adjacent through and deck spans. All piers were braced by diagonal rods placed by a diver, and those under through girder spans had horizontal plank sheathing down to the water line on both sides and ends. In the majority of cases where spans were carried away by violent storms the piles were broken off near the mud line, the entire pier being washed out or a few piles of the pier left standing.

Engineers—Designs for both the substructure and superstructure of this bridge were prepared by the engineering department of the railroad, under the direction of W. H. Courtenay, chief engineer, Louisville & Nashville R.R.; J. M. Salmon is bridge engineer; and G. R. Smiley, chief engineer of construction, has general supervision of the work. George G. Bryson, resident engineer, with a staff of assistants, gives his whole time to the work. For the contractors the construction will be under the supervision of E. H. Connor, chief engineer, and C. F. Creever, general superintendent of the Missouri Valley Bridge & Iron Co., with D. W. Hedrick as superintendent in direct charge of the work. The estimated total cost of bridge and approaches is $3,200,000.

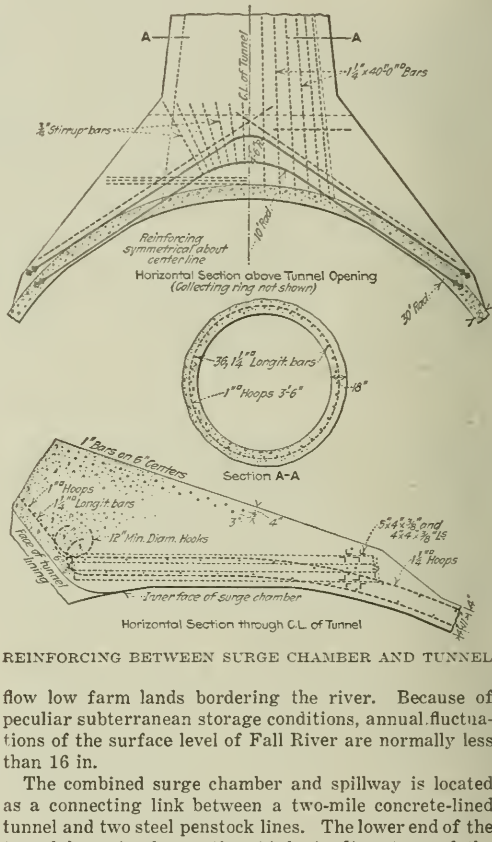
Demand a 30-Ft. Channel to the Sea at Wilmington, N. C.

As a result of the great industrial progress made in North Carolina, there has been an increasing demand for better port facilities at Wilmington, N. C. Along with the ambitious plans for the improvement of the port and the public ownership of the water front and its facilities has come a demand for a 30-ft. channel in the Cape Fear River from Wilmington to the sea. That proposal now is being studied by the Board of Engineers for Rivers and Harbors of the Corps of Engineers. At the present time the ruling depth between Wilmington and the ocean is 26 ft. It is estimated that it will cost $1,500,000 to provide a 30-ft. channel. While it is admitted by the proponents of the deeper channel that only a small percentage of the ships which likely would call at Wilmington would require more than 26 feet of water, it is pointed out that they must have at least a 30-ft. channel to compete successfully with Savannah, Charleston and Norfolk. Savannah and Charleston have 30-ft. channels. The ruling depth at Norfolk is 40 feet.

Surge Tank and Spillway Combined On Pit River Plant No. 1

Heavily Reinforced Cylinder 60 Ft. in Diameter Provides 1,800 Sec.-Ft. Spillway Capacity Between Tunnel and Penstock

THE SURGE chamber on the Pit River No. 1 development of the Pacific Gas & Electric Co. is designed so that it may also function as a spillway to discharge for short periods the full capacity of an 1,800-sec.-ft. pressure tunnel. This was made necessary by the exceedingly flat grade in Fall River whence this plant takes its water supply and in which raising the water surface a few inches at the diversion dam would back up the water for a mile or two upstream and over-

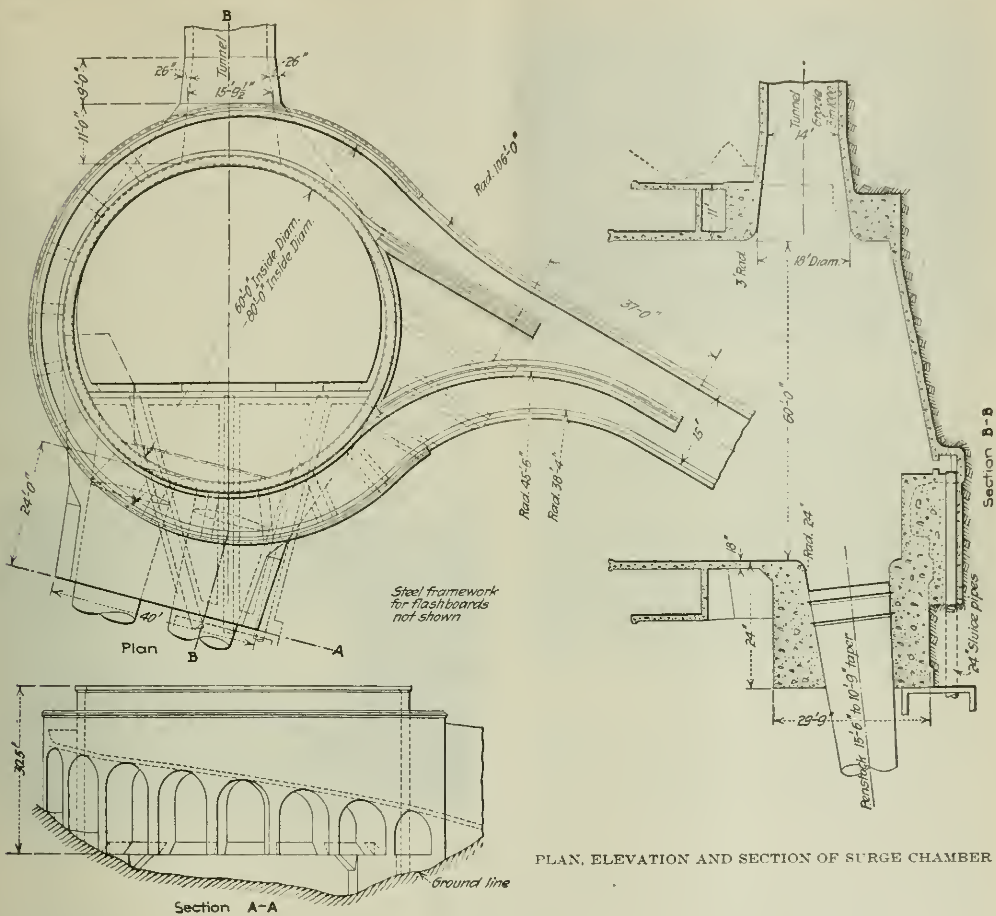


REINFORCING BETWEEN SURGE CHAMBER AND TUNNEL

flow low farm lands bordering the river. Because of peculiar subterranean storage conditions, annual fluctuations of the surface level of Fall River are normally less than 16 in.

The combined surge chamber and spillway is located as a connecting link between a two-mile concrete-lined tunnel and two steel penstock lines. The lower end of the tunnel is a circular section 14 ft. in diameter and the two steel penstocks are 10 ft. 9 in. in diameter at the upper end. These large openings into the surge chamber introduce complex structural problems in its design. The development of Pit River No. 1 project as a whole was described in *Engineering News-Record*, Oct. 5, 1922, p. 570.

The surge chamber is built of reinforced concrete; it has an inside diameter of 60 ft., a depth of 62 ft. and an external collecting chute or trough encircling the cylinder and leading to a concrete wasteway. The crest of the circular spillway is set at an elevation 6.17 ft.

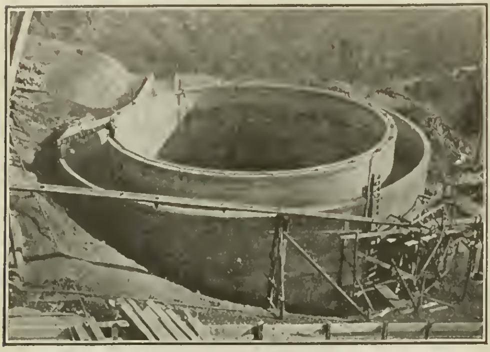


PLAN, ELEVATION AND SECTION OF SURGE CHAMBER

below that of the diversion weir in Fall River, and is provided with a steel frame about 10 ft. higher for such flashing as the operation of the plant may warrant. The encircling trough is of variable width and depth, designed to carry a flow of 1,800 sec.-ft. Baffle or guide walls are provided in the chute at the lower side to prevent excessive splashing and to keep the waves from jumping over the outer walls. This collecting trough delivers into a concrete chute 15 ft. wide by 8 ft. deep which in turn discharges over a precipitous cliff some 300 ft. above the bed of Pit River.

In drawing plans for the surge chamber and spillway consideration was given to the storage and head required to bring from no load to full load within a reasonable time the two 35,000-kva. generators in the plant served. Fall River is about 200 ft. wide and its flat gradient affords sufficient storage to permit of some desired peaking. It was deemed possible to draw from the river more rapidly while peak loads are being carried and to allow the storage to accumulate during the hours of low load. It was thought that a minimum flow through the plant of 900 sec.-ft. might obtain and the finished concrete crest of the surge chamber was established at an elevation 1 ft. above the computed hydraulic radiant under this condition of flow. After operating the plant for several months it was at times found possible to reduce the flow to considerably below this amount. Consequently flashboards have been added to permit of raising the water level in the surge tank 3 ft. above the original crest, in order not to waste water during low load hours.

In order to confirm opinions relative to the behavior in the collecting and spillway chutes and especially the height and shape of the various walls required, a small model was made of Spanish cedar to a scale of 1 to 60, the inside diameter of the model being 12 in. Various baffle walls or throat sections were made such that they could be readily inserted between the established surge chamber tank and spillway sections. Water was admitted at the bottom of the tank and allowed to flow over the crest at varying depths. There was a decided tendency for the water to crowd over the outer wall at and near the high points in the floor of the connecting trough, even though a split-water vane was provided. This wall was therefore raised about 3 ft. in working out the final design.



SURGE CHAMBER NEARING COMPLETION
Tunnel enters from left and penstock foundations are being placed at right. The chute discharge over the cliff appears in left background.

Baffle walls of various shapes and curves were tried, as was also a section with no baffle walls. The crest of the water surface under each condition was measured from the top of the outer walls at stated intervals and these measurements plotted. The combination which gave the smoothest results was adopted and constructed. While the full 1,800 sec.-ft. has at no time passed over the surge chamber, the results as noted from smaller flows are reported to be very gratifying and in close relation to those observed in the model.

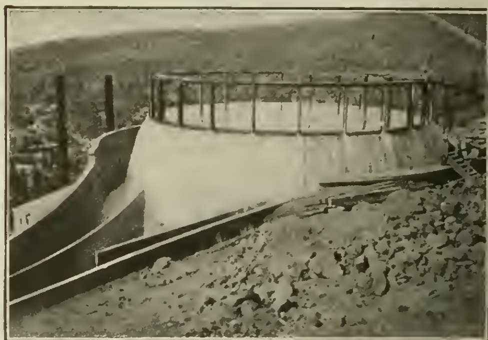
The shell of the surge chamber was designed to resist hydrostatic pressure in tension with a maximum stress in the steel of 12,000 lb. per square inch. The main reinforcement consists of hoops made of square corrugated bars; these hoops were made in two different diameters which were placed alternately so as to stagger the position of the bars with reference to inner and outer faces of the walls. The size of the bars in these hoops increases from 1 in. at the top to 1¼ in. at the bottom and the spacing between hoops, vertically, decreases from 8 in. at the top to 4 in. at the bottom. All laps were made not less than 40 diameters and were staggered vertically in the rows. The laps in the inner row were also kept staggered from those of the outer row. Vertical bars, ¾ in. in diameter, were spaced on 2-ft. centers.

The stresses concentrated in the shell of the surge chamber at the tunnel opening total about 1,000,000 lb. and are effective in a direction tangent to the cylindrical reinforcement. A structural steel bridle was designed to transmit the stresses above and below the opening, with an arrangement of reinforcing shown in the accompanying illustration. The vertical members at either side consist of four 5x4x⅜-in. angles, four 4x4x⅜-in. angles and four 1¼-in. square bars. All of this acts as tension reinforcement for a concrete beam about 7½-ft. deep into the compression side of which are hooked the 1¼-in. square bars used as hoop reinforcing. Two sets of six 1x6-in bars tied these members together at the top and bottom. The inward component of stress or pull was provided for by thoroughly tying the whole anchor block in which the bridle is built to the concrete lining in the tunnel. The tunnel lining is reinforced longitudinally for a distance of about 70 ft.

The penstock openings were handled in very much the same manner, except that advantage was taken of the weight in the top penstock anchor to resist the inward forces. This anchor was increased sufficiently in dimension to carry safely any and all combinations of forces that might act thereon.

The collecting chute was designed as a concrete "L" section with reinforcing tied into the main shell of the surge chamber and supported on wall piers carried down to bedrock. The downhill or front elevation was treated as a series of arches for architectural reasons only. The laying out of the supporting pier was made somewhat difficult due to the fact that the outside circle was not concentric with the surge chamber, the width of the trough being gradually increased from 5½ ft. at the high point to 10½ ft. at the junction with the tangents from the outer walls of the spillway chute.

The main section of the spillway chute is 15 ft. wide and 8 ft. deep and has a grade of 1 in 7. The side walls are 10 in. thick, designed as L-section retaining walls. The floor is 8 in. thick tied into the sides with reinforcing bars. The chute is located off center with respect to the surge chamber in order to fit the ground contour to best advantage. In order to prevent sloughing of the cliff below the chute from endangering the concrete structure, the lower 54 ft. of this chute is designed as a self-anchored cantilever resting on a substantial pier placed some 25 ft. back from the edge of the cliff. Although serious sloughing is not expected the lip was flattened to a horizontal grade and was extended some 5 ft. beyond the edge of the cliff in order to keep the drip well down on the bluff.



SURGE CHAMBER SPILLING
Supports for walkway, on which hand railing is not yet placed, will serve as ashboard guides.

The steel frame for flashboards was designed with vertical guide beams or posts at 8 ft. 1 in. centers, tied at the bottom with channels and at the top with angle bands or hoops located along the chords of the circle. No diagonal bracing of any kind was used.

The surge chamber structure was constructed by company forces and considerable difficulty was experienced from the fact that the tunnel operations were under contract and incomplete at the time this work was under way. This complicated the work at the portal entrance.

Concrete was of a 1:2:4 mix throughout. Crushed lava rock from the tunnel dump and a good quality of local sand were used. Hydrated lime in the proportion of 10 per cent by volume of cement was incorporated in the mix. Some leakage appeared immediately after the water was turned into the surge chamber but this soon disappeared and since that time the walls and the bottom are reported to be practically watertight.

Cold Storage Warehouse Has Unusual Design

Insulation Requirements Complicate the Design—Railway Track Enters at Third Floor Level—Asphalt and Plaster Wall-Coating Put On With Spray and Cement-Gun

By Stewart T. Smith
Architectural Engineer with Van R. H. Greene, New York City

A LARGE brick and reinforced-concrete warehouse of notable design is now being erected for the Terminal Refrigerating & Warehousing Co. in Washington, D. C. The building has a ground area of 29,000 sq.ft., and will include space for cold and dry storage and an ice-making plant of considerable size. The insulation requirements for the cold storage space have introduced some unusual features in the design. The building site is east of 4½ St. S.W. and between D St. and Virginia Ave., where the zoning restrictions allow a total height of only 85 ft. from top of curb to top of parapet wall. In order to secure the greatest amount of floor area, the stories are made 10 ft. high, the roof flat, and the parapet wall only 6 in. high. This arrangement allows the building to have eight stories and a basement.

The floor space of the building is divided as follows: 101,000 sq.ft. of dry storage, 50,000 sq. ft. of cold storage, where goods are kept at a temperature of from 32 to 40 deg.; and 25,000 ft. of space for freezers, where goods are kept at a temperature of from 14 to 32 deg. There is also an ice-making plant of a capacity of 150 tons per day, and storage space for 900 tons of ice. Refrigeration is provided by four compound motor-driven ammonia compressors which provide 450 tons of ice and require 2,000 electrical horsepower per day. The ammonia condensers are located on the roof of the building

Local truck service for the building is from the ground floor on D St. and railway service by a spur from the Pennsylvania R. R. which runs into the building at the third floor level. The present track has a capacity of six cars, and the structural frame of the building is so arranged that bays in the third and fourth floors south of the present track can be removed to provide space for a second track. Two elevators

FIG. 1—D ST. ELEVATION

9 x 17 ft. are provided for the dry storage side of the building, and two elevators 9 x 9 ft. for the cold storage side of the building. The cars of the latter elevators are provided with special rubber flaps around the edges

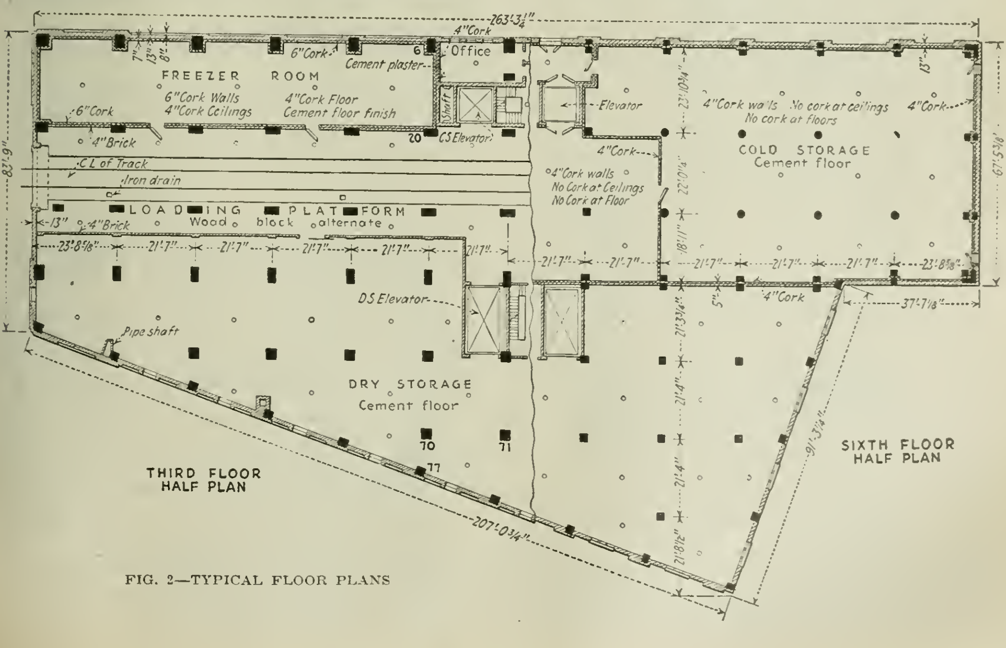


FIG. 2—TYPICAL FLOOR PLANS

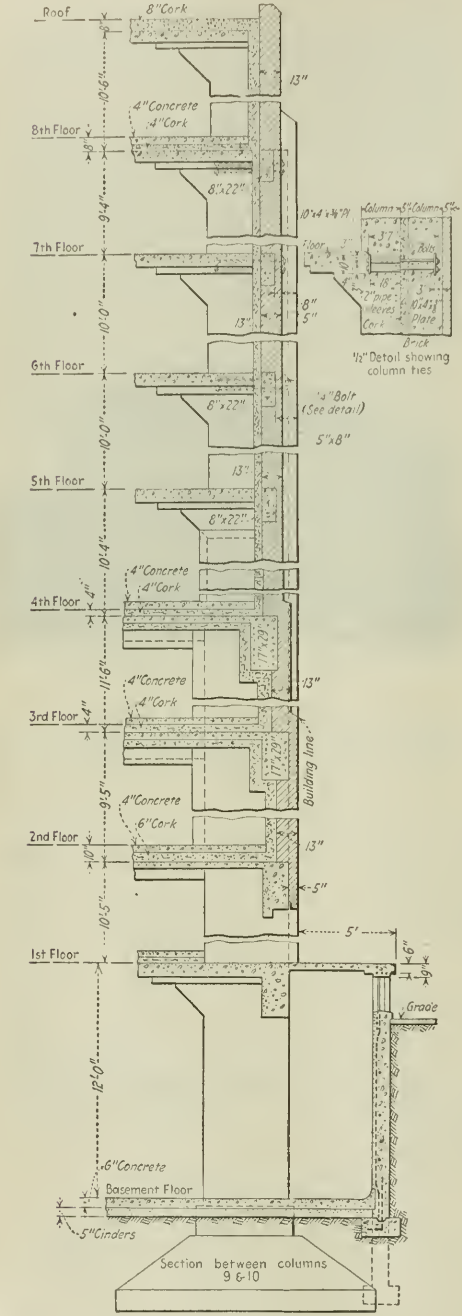


FIG. 3—DETAILS OF THE INSULATION

which fit between the car and the hatchway, preventing the escape of refrigeration from the room when the cars are at any landing and the doors of the room open.

Structural Features—The first four floors in the south half of the building are designed for a live-load of 300 lb. per square foot. All other floors are designed for a live-load of 200 lb. per square foot. This is in addition to the weight of the insulation and wearing surfaces, where insulation occurs on floors.

Beam and girder construction is used for the entire south half of the building and for the second, third, and fourth floors of the north half. The first, fifth, sixth, seventh, and eighth floors and the roof in the north half are all flat-slab construction with drop panels. For all flat-slab design the revised Chicago Code was used with the exception that a stress of 16,000 lb. per square inch for the steel was used to conform with the local code. The location of the columns in the north half of the building was fixed by the dimensions of the freezing tanks in the basement.

The footings rest on a hard formation of clay and gravel and were designed for a soil bearing capacity of 8,000 lb. per square foot.

The columns have a mix of 1:1:2 and rest on pedestals of 1:2:4 mix. A mat of steel is provided in the top of the pedestals to properly transmit the stress over the larger area of the pedestal.

Around the cold storage portion of the building the columns are solid up to a point approximately 7 ft. below the fifth floor. From this point up columns are split to provide for insulation, and wall beams are provided at alternate floors to carry the walls. The anchors which are used to anchor the wall columns to the framework of the building are made of 1¼-in. bolts set in pipe sleeves to allow for expansion and contraction.

The supports for the railroad tracks are designed to carry a Pennsylvania engine, total weight of engine and tender 158 tons, and a 126-ton hopper car, plus 50 per cent of live-load for impact. The columns between the present track and the future track, from the second to the fourth floors, were considered as one unit with an unsupported height of 25 ft.

The usual wall girder for flat-slab design was eliminated and no increase in the slab thickness was provided at the wall line. With the elimination of the weight of the wall on the structural frame of the building, it was considered best not to invite additional stress to the edge of the slab by placing a wall girder there.

Retaining walls were designed as slabs from column

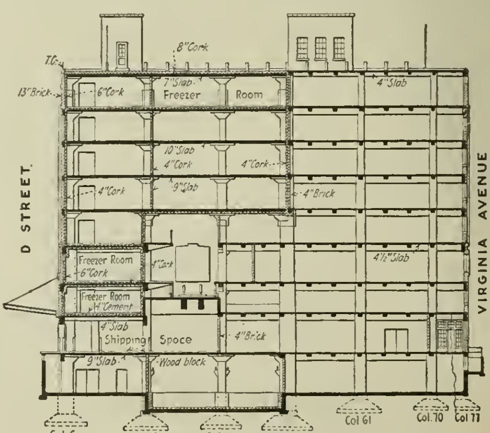


FIG. 4—VERTICAL SECTION OF THE BUILDING

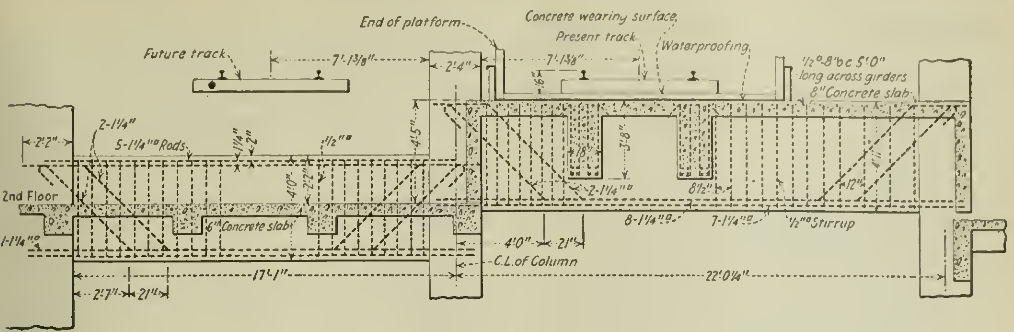


FIG. 5—DETAILS OF THE TRACK GIRDERS

to column with the exception of those along D Street, which were considered as slabs from floor to floor. All retaining walls and the entire basement floor are waterproofed with an integral waterproofing compound.

Insulation Details—All cold storage and freezer rooms are grouped together on the north side of the building and completely insulated with cork. Two layers of pure compressed corkboard in slabs 12 in. wide x 36 in. long and 2 or 3 in. thick, depending on whether the total thickness was to be 4 or 6 in., were used for this purpose. To make this insulation as continuous as possible the walls of the cold rooms were made separate from the structural framework of the building by providing a separate framework to support the walls around the cold storage section. This framework is anchored to that of the building at each floor level. The insulation between the north half and the south half of the building above the fifth floor virtually splits the building into separate units.

Where insulation was applied to the floors, the concrete slab was mopped with asphalt and the first layer of cork was set in this asphalt. This layer of cork then received a heavy mop coating of hot asphalt and the second layer of cork was laid in it while hot, breaking joints with the first layer in both directions. The top surface was mopped with asphalt and a one-ply waterproofing fabric was laid over the entire area, after which a 4-in. concrete wearing surface was applied.

At the roof the same method of construction was used as on the floors, with the exception that the concrete wearing surface was eliminated and the roofing took the place of the fabric.

Where walls were to be insulated, they were first cleaned of all loose particles and then two coats of hot asphalt were shot on with a special gun, filling all the surface pores of the walls and completely damp-proofing them. Two layers of cork were then set up in asphalt the same as on the floor except that the second layer is held in place by the use of wooden skewers. The exposed cork surface is plastered with a cement plaster containing 10 per cent of hydrated lime. The plaster was applied with a cement gun—a departure from the ordinary two-coat hand job for this class of work. The plaster is scored off into 4-ft. squares to prevent unsightly cracking.

Where cork is affixed to a ceiling the first layer was laid in the forms and the concrete poured over it. The second layer was set up in asphalt against the first after the forms had been removed and held in place by wooden skewers. The exposed cork surface received a plaster finish as on the walls.

Insulated partitions were made by the use of the two layers of corkboard, set together in cement plaster and both exposed cork surfaces plastered. Care was taken to get all rooms completely insulated, and where the corkboard could not be made continuous it was arranged in such a way that heat must travel about 4 ft. through masonry work before entering the cold rooms.

The architectural features of the building were designed by Appleton P. Clark, Jr., architect, of Washington, D. C. The writer had charge of the structural design of the building. All mechanical equipment and refrigerating details were designed by Van R. H. Greene, refrigerating engineer, New York City. The building is being built by the Consolidated Engineering Co., Inc., Baltimore, Md.

Effect of Oil-Well Water on Cements

A study of the effect of various oil-well waters on the setting of cement is being made by the Department of the Interior at the petroleum experiment station of the Bureau of Mines, Bartlesville, Okla. Petroleum engineers of the Bureau of Mines in the course of their investigations are frequently told by operators that the chemical characteristics of waters in their wells will prevent cement from setting. Where surface tests have been made at these wells, it has invariably been found that a good grade of cement properly mixed will set in water from the well. This indicates that conditions in the well such as movements of fluid, agitation by gas, or improper preparation of the hole for cementing are among the causes for the failure of the cement to set. The bureau's engineers are, however, not convinced that cement will set in all oil-field waters and therefore are striving to obtain samples of oil-field waters where difficulty has been experienced in securing a proper set. By collecting numerous samples of waters from various fields in the United States and making tests with cement it is hoped that useful information may be obtained regarding cement failures in wells. The bureau is therefore requesting oil operators to furnish samples of waters from wells where difficulty has been experienced in securing a proper set. Water samples should be sent to the petroleum experiment station, Bureau of Mines, Bartlesville, Okla., accompanied by a data sheet stating owner and well number, location and depth of well, and information regarding the method of obtaining the sample.

Through the Reclamation Country

By F. E. Schmitt
Associate Editor, *Engineering News-Record*

A SERIES OF ARTICLES on Federal Land Reclamation is to start in *Engineering News-Record* next week. It will give a history of the twenty-one years of government irrigation, state the many problems of operation—engineering, agricultural and financial—analyze the various complaints that are being so emphasized by those who are seeking a reform of the current law and methods and seek to present some views as to a constructive policy in the future. Through it all will run the evident theme that irrigation, from planning, through construction to operation, is a continuing engineering problem.

As a part of the preparation of the series Mr. Schmitt is now traveling through the West, visiting irrigation projects, studying developments and interviewing builders, operators and settlers. He will write a series of letters of running comment on the situation as he sees it on the ground. These are not the final result of his trip but they will serve to acquaint our readers with the actualities of reclamation as revealed to an unprejudiced investigator.

This is the third letter. The first appeared in the issue of October 4.—*Editor.*

Hermiston, Ore.

DIFFERENT farmers on reclamation projects take different attitudes when interviewed as to farming conditions and prospects. While generally they complain of low prices for farm products, high prices for all other commodities, and excessive freight rates, some farmers take a more hopeful view than others. On one point all agree: that their condition and the condition of the project would be entirely different, and that they would be doing nicely, if it were not for the effects of the war-time boom and the subsequent forced deflation—the worst in three or four decades. They pay 50 or 100 per cent more than they receive, and they resent it.

Farmers in other parts of the country also are having a hard time of it, and for the same reasons. The reclamation projects are in the same trouble as the farming regions east of the 100th meridian. Yet the condition of the reclamation farmer is blamed on the unbusinesslike and unsympathetic engineer, while the general farmer's condition isn't blamed on anyone in particular.

Unlike the general farmer, the reclamation farmer has ready-made grievances for his troubles, in the shape of the government's water and construction charges, and he can demand of his political representatives that they procure deferment of the charges. These charges are no greater than his taxes, and much less than the interest payment on his mortgage debts; but, though the government charge is theoretically a prior obligation, it can be deferred, while taxes and interest can not. In fact the government claim has pretty well ceased to be a prior lien at all.

Politics in Reclamation—Politics enters into the reclamation business, therefore. It does today and it seems to have done so from the early days on.

The Reclamation Service was not always free to select the most promising projects, and it had some very doubtful projects forced on it.

The reclamation law directed that the attempt should be made to expend in each state the money originating in that state (from sale of public lands), a concession to local jealousies. While the rule was not followed closely, one of its results is the Umatilla project, surrounding this town, which is not one of the most successful ones; it is hampered by poor soil and at present is only half settled, after a good part of its original area has been withdrawn from the project as not worth irrigating. The Service adopted this project originally because it thought itself obliged to develop a project in Oregon. Umatilla is not strictly a case of political interference, but several other projects are, such as the unfortunate Hondo project, in New Mexico.

Political pressure had the result that on some projects the beginning of repayment by the settler was deferred long after water was supplied; even though the construction charge had been announced and the first payment collected for, the call was withdrawn by the Secretary of the Interior and held up for a number of years, during which time the farmers received the full benefit of irrigation without paying anything but operating charges—a direct loan to them of government money not contemplated in the law. But these and similar special favors to the project settlers were probably less harmful than the demoralization of the relations between the settlers and the Reclamation Service which resulted from constant political agitation of reclamation matters. Public statements by a United States senator that the settlers need not worry about the repayment of the construction charges, and that they might not have to repay them in the end, did not improve the situation.

Several relief bills passed by Congress in recent years further deferred the construction charges. These bills were well-intentioned measures to relieve the hardships produced by deflation. But being blanket measures applying to the worthy and unworthy alike, their effect was neutral or bad rather than good, and they also represent a phase of political in place of business management.

Prominence of Political Influence—The element of political influence forces itself into notice in the present juncture for two reasons. First, it bears directly on the question of operating success of the reclamation projects. A project manager says, "It doesn't seem possible to make a single move without arousing the opposition of one or another interest." Second, the future possibilities of reclamation impregnated with politics appear very menacing with respect to new projects. All sorts of hands are stretched out for money from the revolving reclamation fund. Projects that from an outsider's viewpoint look darkly questionable are being promoted and investigated.

Politics via Washington is perhaps not so serious a matter as local politics, which on a reclamation project almost inevitably centers around reclamation. The men who seek leadership and preferment need issues, and naturally they agitate the farmers' grievances, and the Reclamation Service is the goat. Under private management this particular evil is absent. All that the water users could agitate about is to take over the operation of the system—and this they frequently do not want to do even when it becomes their obligation.

Inflation-Deflation Sequence—Referring to the effect of the price boom and the 1920 deflation, a project farmer said, "Most of the farmers here lost their heads when the war prices came. The wise ones paid their debts and kept the balance of their money; the others bought oil stocks and such like, and some of them even

mortgaged their farms to pay for the stock. Most of them lost their whole investment; and then they were hit by the low prices." Aside from this effect the inflation developed a fantastic rise in land prices and much speculation in land. Farms were sold to adjoining farmers or to outsiders, often on a shoestring. The added burden on the land made the farmers less fit to meet the price conditions later on, when their returns often were less than the cost of production and vast quantities of potatoes were left in the ground or were fed to hogs.

British Sanitary Engineering Practice

Extracts from an address by H. C. H. Shenton, President, Institution of Sanitary Engineers, London, England.

If it were not for the unceasing work of the engineer, life in our large cities would be impossible. If one follows the course of a drop of water from the time when it is extracted from the river Thames for the London water supply to the time when it again enters the river at Barking or Crossness from the outfall sewer, some idea of the engineers' work may be obtained. It is drawn from a river which receives the drainage of all the Thames Valley above; the sewage of such towns as Oxford and Reading, together with that of innumerable smaller places, houses, factories, etc., enters the Thames above the intake of the Metropolitan Water Board, yet such is the excellence of the work of the sanitary engineer that the water at the intake is practically as good in quality as if it were drawn from the river fifty-five miles higher up. Sir Alexander Houston has shown this. This water is purified by storage, it is filtered, sterilized and pumped, it flows into a system of 6,577 miles of water main, and is eventually delivered for the supply of a house or other building.

English and American House Sanitation—One of the matters most worthy of consideration at the present time is the difference which exists in the practice of English and American engineers. In this country we have for a long time past adopted the principle that all soil pipes shall be kept distinct from bath, sink and lavatory waste pipes. The Americans, on the other hand, appear to use one system of pipes for all purposes. It is obvious that the American system is much more economical than our own, because it saves a double system of pipes, and many branch drains, gullies and manholes otherwise required If a bath sink or lavatory basin is trapped suitably and if the pipes are ventilated, so that siphonage and air pressure are impossible, it seems that the American engineer sees no objection to the waste pipe being connected direct to the drain or soil pipe. Where this is done there is a saving, first of a separate waste pipe, or system of waste pipes, next of the gulley or gullies into which such waste pipes discharge, next of the branch drains running from the gullies to manholes, and lastly of the manholes themselves, in short about half the expense of the work is saved. Seeing that this applies to every new house built and that the present need for economy is great, the matter is at any rate worthy of our consideration.

The Intercepting Trap—Although it is generally admitted that the intercepting trap would be unnecessary in connection with a perfect sewerage system, it does not appear that the average system of sewers in this country is perfect enough to encourage engineers to use the house vent pipes as sewer ventilators. However, cases exist where the interceptor has been omitted wholesale, apparently with satisfactory results, and it seems as if the matter deserved more attention than it has recently received.

Sewer Pipe Joints—In the author's opinion, insufficient attention is given to the probability of expansion and contraction in concrete pipe lines. The extreme rigidity of the ordinary joints is certainly a drawback, seeing that any movement or settlement tends to cause fracture. The Stanton Hume pipe is made with a double socket, into which cement or lead can be calked. The lead joint no doubt possesses the advantage of slight flexibility. Recently these pipes have been made with ordinary sockets. Some years ago the author used the Brandram joint which consisted of a steel band drawn round the pipe and keyed, while it was covered with hot bitumen. Recently a joint which appears to be somewhat of the same character has been brought forward. The Victualic joint is used for iron and steel pipes. It has been approved by Lloyds for use on ships, and it is also interesting to note that it has been used on a 15-in. cast-iron sewer at Dartford and on a 3-in. steel sewage main at Bradford. The application of this valuable flexible joint to concrete and reinforced-concrete pipes is desirable, but apparently this is still a thing of the future. The cast-iron pipe lined with cement by the centrifugal process is also worthy of note in connection with sewerage work.

Sewage Sludge Utilization—The use of activated sludge as a fertilizer when it is applied to the land is evident. Good results have been obtained; and J. A. Coombs, in the discussion which followed the reading of his paper before this Institution, said, "the first big town which pumps activated sludge over a sufficient area of distribution will be a pioneer of a practice which will be copied everywhere." The problem of drying this material completely for use as a fertilizer will probably be solved in the near future. There are various possibilties. Dr. Hele Shaw's streamline filter is capable of dewatering activated sludge completely at a very moderate pressure and is certainly a very important factor in the case. Activated sludge has been referred to by Dr. Nasmith as if it were of a highly putrescible character. In the author's experience it does not differ greatly from ordinary humus derived from filters.

J. D. Watson, of Birmingham, A. J. Martin, and others have shown that it is possible to utilize profitably the sludge from ordinary digestion tanks. Some of our large towns, like Bradford, Huddersfield and Morley, extract grease from sludge and sell it; elsewhere, as at Kingston-on-Thames, artificial manure is produced. We have the word of Mr. Watson that utilization of sludge is a duty, and there can be no doubt about it, because Mr. Watson has dealt with the problem on a very large scale at Birmingham, and speaks with knowledge.

French Establish Masons' Apprentice School

Paris Correspondence

A novel movement towards the betterment of masons' apprentices is being carried out in France by the Chambre Syndicale des Entrepreneurs de Maçonnerie. A combined home and school has been established in Paris for mason's apprentices where they may perfect their themselves in the diverse specialties of their trade.

It is intended solely for orphans of workers in the building trades who lost their lives in the war and workers who are members of the masons' trade unions.

Pupils are taken from their fourteenth year onward and even if they have already been at work provision is made for those who may be needy to take up such higher branches of their trade as they may be fitted for. Obviously this is an effort to form quickly an added corps of masons in the building trades.

The cost of instruction, food and lodging is at the rate of 7 francs 50 centimes per day, the equivalent of $1.50 at the normal rate of dollar exchange. After passing technical and practical examinations, the pupil receives a diploma and is granted the grade of "companion," in all save point of age and extended experience a full fledged working mason.

This institution has attracted the attention of the French Under-Secretary for Technical Education and is to be closely associated with the Ecole Pratique d'Industrie which is under reorganization.

Pollution of Water Supplies by Coal Mine Drainage

Serious Character of Acid Mine Drainage Shown by Study in a Pennsylvania Bituminous Mining Area—Lime Treatment of Mine Drainage and Other Remedies Considered

By C. P. Collins
Consulting Engineer, Clarksburg Engineering Co., Inc., Clarksburg, W. Va.

POLLUTION of public water supplies by mine drainage has become a serious matter in some parts of the country, particularly in the bituminous districts of Pennsylvania. In 1920, the writer, together with a number of other engineers, was called upon to investigate this problem in Fayette County, Pa., where subsequently the Mountain Water Supply Co., with the Dunbar Water Co. and Pennsylvania R.R. Co. as co-plaintiffs, were pitted against the Sagamore Coal Co. and twenty-eight other coal companies in the most important case ever brought in the courts to restrain stream pollution caused by drainage from bituminous coal mines. (No. 1023 in Equity, 1921, Fayette County, Pa.; decided in favor of the coal companies Dec. 26, 1922.) Some of the data gathered by the writer for use in behalf of the water companies will be presented in this article.

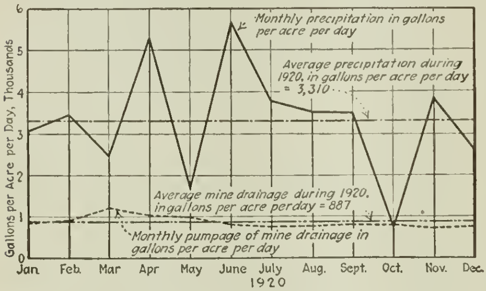


FIG. 1—RELATION BETWEEN COAL MINE DRAINAGE AND RAINFALL

In 1904, the plaintiffs built a 251-m.g. storage reservoir on Indian Creek, about 4½ miles above its junction with the Youghiogheney River, in Springfield Township. The reservoir had a drainage area of 109 square miles about 60 per cent of which is underlaid with Lower Measures coal. A 36-in. cast-iron pipe line, with two branches, conveys water from the reservoir to Pittsburgh, one branch via Greensburg and one via Brownsville. Water for railroad purposes is supplied along the pipe line, besides which a large volume of water for municipal purposes is delivered by the Westmoreland Water Co., in the County of Westmoreland. It was alleged that coal mine drainage injured the water for both industrial and commercial purposes. When the dam was constructed the waters from the streams in this area were unsurpassed in purity, with the drainage of only a few mines entering them, whereas at present they receive drainage from about 38 commercial mines. The object of the investigation in which the writer took part was to determine the probable life of the water-supply works if coal mining was to continue without check.

Geological Considerations—During the initial stages of coal mining, considerable water finds its way through the slates and shales immediately above the coal seam and thus enters the mine workings. After the room pillars have been drawn, the breaking of the roof and superincumbent strata disturbs the natural reservoirs above, and much more water is, therefore, encountered than in the initial stages of mining. The amount of water which may be expected from a given area of virgin coal, and from the area where pillars have been removed, is wholly dependent upon local conditions and cannot be estimated without a careful study of the flow from mines where like conditions obtain.

The height above the coal to which the disturbance reaches after the pillars are removed is dependent upon the condition and character of the strata above the coal. In some cases the height of the disturbance is very great. To the writer's personal knowledge, pronounced cracks have appeared on the surface where the cover over the seam was 475 ft. This is an unusual case but heights as great as 250 ft. have frequently come under his personal observation. It is evident, therefore, that the drawing of pillars may at times have a far-reaching effect and thus greatly increase the amount of water entering the mine workings.

Quantity of Mine Drainage—To ascertain the quantity of mine drainage that may be expected from a given area of coal, mined under the conditions that obtain in the bituminous coal region, investigations were made in Somerset, Cambria and Westmoreland counties in addition to those made in Fayette County, in Western Pennsylvania. About 30,500 acres of exhausted territory, exclusive of Fayette Co., were covered.

V-notch weirs were placed at various drainage outlets, and careful determinations were made of the area of coal mined out from which the drainage was collected. At all gaging stations, the depth of cover, the character of the overlying strata, and the thickness and quality of the coal were carefully noted. The investigation included all the mines on a given drainage area. After the total flow of mine drainage was determined, the flow of the main stream below the last point of outlet was measured by submerged floats, and under the same weather conditions as obtained during the gaging of the mine drainage. Care was exercised to obtain results indicative of average flows.

TABLE I—MONTHLY PUMPAGE OF COAL MINE DRAINAGE AT CENTRAL STATION, NEAR JOHNSTOWN, PA., AND RAINFALL AT JOHNSTOWN

Months (1920)	Pumpage, Million Gallons	Precipitation, Inches
January	114.1	3.49
February	111.7	3.57
March	166.5	2.83
April	135.1	5.86
May	131.5	1.94
June	106.4	6.26
July	107.3	4.32
August	104.3	4.02
September	104.5	3.86
October	108.8	0.87
November	94.5	4.27
December	101.5	3.00
Totals	1,386.2	44.29*
Monthly averages	115.5	3.69

* The total precipitation for the year 1920 was 3.07 in. below the yearly normal.

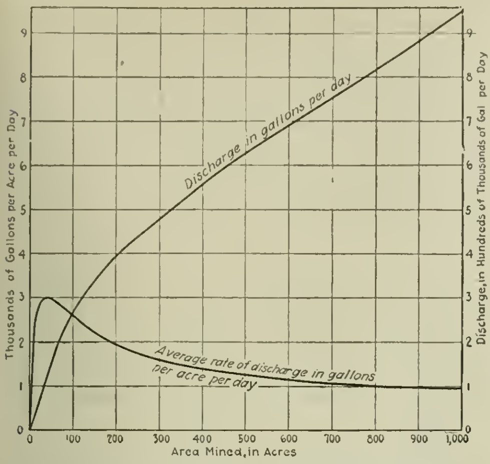


FIG. 2—AVERAGE RATE OF MINE DRAINAGE FLOW AND DISCHARGE FROM VARIOUS MINED-OUT AREAS

Mine Drainage Flow in Relation to Rainfall—To study the fluctuations in the flow of mine drainage and the relation of mine drainage flow to rainfall, the records of a large central pumping station near Johnstown, Pa., covering the year 1920, were used. This pumping station received the drainage from 4,282 acres of mine workings, the depth of cover averaging about 250 ft.

Table I shows the monthly pumpage in million gallons per day, and also the precipitation in inches at Johnstown, Pa., for the year 1920, as obtained from E. C. Lorentz, the observer for the U. S. Weather Bureau. The average mine drainage for the year 1920, as shown by the diagram (Fig. 1) was 887 gal. per acre per day, whereas the average precipitation for the same period amounted to 3,310 gal. per acre per day, making the mine drainage 26.8 per cent of the precipitation. This also represents the percentage of percolation through the strata. A study of the diagram clearly shows that the flow of mine drainage is comparatively constant, resembling closely the flow from permanent springs. The minimum mine drainage flow at the station for the year 1920 occurred in November, and was 736 gal. per acre per day, or 83 per cent of the average flow. In other words, we find the minimum flow to be only about 17 per cent less than the average. While precipitation is subject to daily and monthly variation, the mine drainage has only a seasonal variation, excepting where the workings are near the outcrop.

Conditions Governing the Rate of Mine Drainage—Mines operating under a light cover and near the outcrop have a much higher rate of flow than those under deep cover. After the pillars have been drawn, and the strata above the coal are broken, the rate of flow will be greatly increased. In the early stages of development, and even before the pillars have been drawn, we find a higher rate of flow than obtains after the workings are farther advanced.

Fig. 2 shows the average rate of flow in gallons per acre per day, together with the discharge for various areas mined out. The curves have been plotted from actual measurements, only average flows being considered. The areas mined out in every case were accurately determined, and included both large and small areas. The curve representing the average rate of flow in gallons per acre per day has been plotted from the results obtained in several counties of Western Pennsylvania, covering in the aggregate about 30,500 acres mined out. It is the opinion of the writer that the rate of flow shown by the curve is representative of what may be expected in the bituminous region, where the depth of covering ranges from the outcrop to that of an average of 250 ft. It will be seen that after about 800 acres have been mined out the rate of flow is quite constant.

Quality of Mine Drainage—Sulphur and iron appear in the coal in the form of pyrites, which, coming in contact with air and water, causes chemical changes which produce an acid drainage. The degree of acidity is largely influenced by the amount of sulphur and iron present in the coal seam, and the character of the roof. Under certain conditions, where the strata above the coal are of a basic nature, surcharging the percolating waters with basic constituents, which tend to neutralize the acid in the mine drainage, the drainage may for a time be slightly alkaline, but this condition is unusual. In the examination of the drainage from 160 mines operating in the Lower Measures of coal in Somerset and Cambria Counties in Western Pennsylvania, the writer found only four from which the drainage was slightly alkaline. Table II gives analyses of mine water collected during this investigation which may be considered as typical for mine drainage.

Coal in situ has no effect on the quality of the water in the streams on which it outcrops. It is the impurities, such as iron and sulphur, in the coal coming in contact with air and water after mining is started that produce chemical changes which result in the formation of acid drainage. This condition does not change after the mine is worked out and abandoned, but in general the drainage continues to be acid for several years, and comparable in quality to that from active mines. Before mining is started, the coal in place and undisturbed acts as a barrier to the percolating waters above and prevents the water and air from coming in contact with the impurities, and for this reason a virgin field of coal has no detrimental effect upon the purity of the streams.

TABLE II—ANALYSES OF COAL MINE DRAINAGE

	Grains per U.S. Gallon	
	Miller*	Central†
Total solids	266.01	146 42
Probable incrustants	190.15	96.26
Suspended matter	7.29	10.50
Iron oxide, (Fe_2O_3)	21.56	9 22
Aluminum oxide (Al_2O_3)	12.90	3.36
Calcium oxide (CaO)	30 55	16 47
Magnesium oxide (MgO)	9 05	9 77
Sulphuric anhydride (SO_4)	129.40	72 74
Sulphuric anhydride acid sulphate (SO_3)	20 82	10 04
Free sulphuric acid (H_2SO_4)	34.42	23.62
Chlorine (Cl)	0 70	0.47
Treatment required:	Pounds per 1000 Gal.	
Lime (90 per cent CaO)	7.30	5 31
Soda ash (95 per cent Na_2CO_3)	19 52	13 01

* Sample collected Aug. 10, 1920, at Miller Shaft, near Portage, Cambria County, Pa. Flow about 334,000 gal. per day at the time sample was taken.

† Sample collected Aug. 13, 1920, at Central Pumping Station, near Johnstown, Pa., Flow about 3,365,000 gal. per day at the time sample was taken.

Both analyses were made by E. C. Trax, chief chemist, McKeesport Water Co., McKeesport, Pa.

Many other samples were collected in Cambria and Somerset Counties. Those given above represent what might be termed average analyses of mine drainage in the bituminous region.

The beds of streams receiving mine drainage soon become coated with a typical deposit. This deposit protects the rocks of the stream-bed from the action of the acid in the mine drainage, from which it could otherwise obtain neutralizing elements. Therefore, although a stream in its course may become clarified to a certain extent, the acid is largely retained, and the water is not improved in its course, except in so far as the acid content may be reduced by the neutralizing effect of surface waters from tributary streams not contaminated with mine drainage.

Water Supplies for Domestic Use—The presence of mine drainage in a water supply renders it unfit for domestic use. It is impossible to maintain plumbing fixtures on account of the action of the acid. This trouble becomes specially apparent after the water is heated and deposits of ferric oxide are formed on the pipes. This produces a water totally unfit for laundry purposes.

Water Supplies for Industrial Use—Sulphuric acid in the strength encountered in mine drainage attacks iron and steel very readily, as evidenced by the rapid deterioration of pumps and pipe lines receiving such drainage. When water impregnated with sulphuric acid and its products, known as sulphates, is used for boiler purposes, it produces disastrous effects within the boiler, causing pitting rather than extending uniformly over the surface of the metal. The result of pitting is to produce failure much sooner than if the thickness were uniformly decreased. Locomotive boilers are operated under very high temperatures and pressures, thus making the pitting effect much more pronounced than in stationary boilers.

Disposal of Mine Drainage by Dilution—It is probably safe to say that so long as the flow of the stream is 120 times the flow of mine drainage no difficulty will be encountered in allowing the drainage from mines to enter the streams under the ordinary conditions that obtain in the bituminous coal region.

Treatment of Mine Drainage—The treatment of mine drainage so as to render it harmless to streams is in its infancy. The plant of the H. C. Frick Coke Co. at its Calumet mine in Mount Pleasant Township, Westmoreland County, Pa., marks one of the first attempts to treat mine water. (For details of this plant see article by L. D. Tracey, *Coal Age*, July 1, 1920, p. 12.)

Briefly, limestone pulverized to pass through a 200-mesh screen is thoroughly mixed with the mine water by means of a baffled tank and baffled flume, then settled for about four hours in a second tank, then drawn off over weirs and passed to a storage basin. It is estimated that about ⅘ ton of powdered limestone is used to remove one ton of ferric oxide. If the free sulphuric acid is neutralized, the ferric sulphate is changed to ferric hydrate and calcium sulphate, but the latter is in solution and thus ferric hydrate remains as a byproduct. This material, the settling tank sludge (about 75 per cent water), is reduced to a dry yellow powder by splashing the sludge against a steam heated drum. During the year 1920, the Calumet mine plant produced about six tons of ferric hydrate per day. This material is in demand by companies manufacturing artificial gas for the purpose of removing the hydrogen sulphide present in the gas. It is also one of the chief ingredients of a number of paints. The Calumet plant is still in the experimental stage but may be characterized as an encouraging step towards an ideal plant.

Suggested Simple Treatment of Mine Drainage—The writer believes that a simple plant could be constructed to treat mine water so that the effluent could be discharged into a stream without seriously injuring the water for water supply purposes. A sketch of such a plant is shown by Fig. 3.

Let us consider that it is required to provide for the treatment of mine drainage from an area of 200 acres of workings. From Fig. 2 is seen that from such an area we may expect an average flow of about 400,000 gal. per day. It has been proved from experiments in the process of sedimentation that very little advantage is gained by retaining the water in the tank for a longer period than two hours. With a flow of 400,000 gal. per day, a tank of the cross-sectional area shown by Fig. 3 and a length of 72 ft. will meet the requirements in this case.

In view of the fact that ordinary limestone contains only about 48 per cent of lime, whereas the calcined stone carries about 76 per cent, it is the opinion of the writer that it would be advisable to use calcium hydroxide (slaked lime) in place of the pulverized limestone, thus avoiding the construction of a pulverizer and mechanical conveyors, and getting more direct contact of the neutralizing element and the mine water. To treat 400,000 gal. per day of ordinary mine drainage would probably not require more than 400 lb. of quick-lime.

The sludge from the settling tank, if it cannot be disposed of on the lines suggested by the experiments at Calumet mine, could be deposited on drying beds, so constructed as to prevent the leachings from contaminating the stream. When dried, the material would be removed to a dry place and covered with earth.

Excluding Mine Drainage from Water Supplies—To the writer's knowledge, no laws have yet een enacted in the states where coal mining is prosecuted to protect water supplies from mine drainage. Moreover, such decisions as have been rendered have been in favor of the coal companies. There remain as alternative protective measures the construction of conduits to intercept mine drainage and the acquisition of mineral rights. Intercepting the mine drainage and discharging it below the reservoir of a given water supply has two very serious drawbacks: (1) If the drainage is carried in pipe lines it would require the use of pipes not affected by acid drainage. Terra cotta pipes would resist the acid but the writer has examined several drainage lines built of this material, and in every case great trouble was encountered by the deposits on the walls of the pipe. While wet, this deposit is very hard and can scarcely be picked off with a knife. When it becomes dry it can easily be reduced to a fine powder by rubbing it between the fingers. To prevent such deposits the mine water would first have to be collected in settling basins. This would make such drainage lines very expensive. (2) The amount of water cut off from use at the reservoir would present a very serious problem in dry weather.

Control of Mineral Rights—The only safe plan in the light of present conditions, and when no relief is offered by law, is for the water companies to gain control

of the minerals on the watersheds where they contemplate the construction of reservoirs for purposes of water supply. This would not only be a great burden to the public on account of the necessary increase in the rates for water service, but it would also be equally as great a blow to the domestic and industrial world by reason of the elimination of large areas of coal from which indispensable fuel must be obtained.

Sealing Abandoned Mines—As has been said, the drainage from abandoned mines is as injurious as that from active mines. The writer tested the drainage from mines that had been abandoned for as long a period as fifteen years and found it to be highly acid.

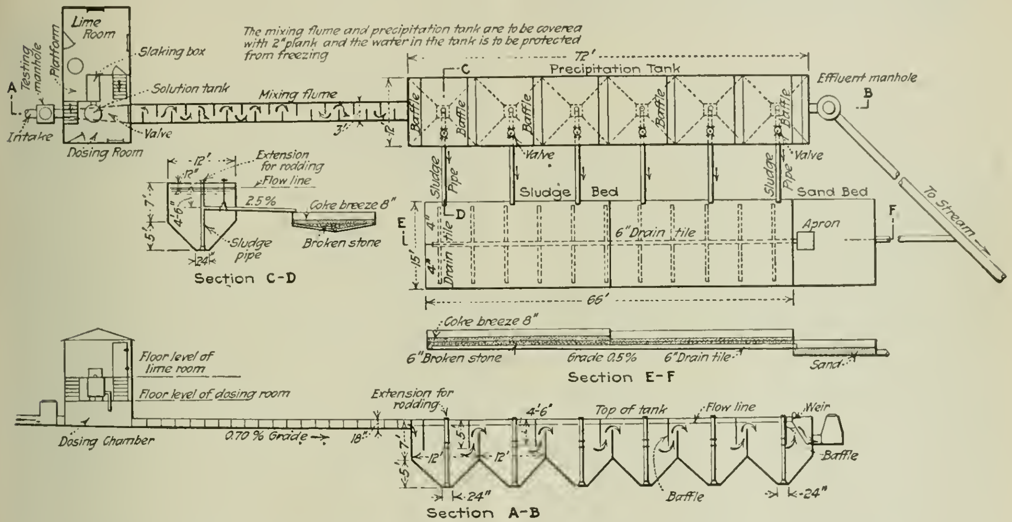


FIG. 3—SKETCH OF SUGGESTED PLANT FOR TREATING MINE DRAINAGE WITH SLAKED LIME

Designed for daily capacity of 400,000 gal. The object is to neutralize acid sufficiently so that, with stream dilution, it will not injuriously affect water supplies. The flume and tank to be covered with 2-in. plank as frost protection.

Under the present regulations of mining coal it would be very difficult to prevent the drainage from abandoned mines from entering the streams, for the reason that the surface is generally broken to the limits of the outcrop of the coal. However, under a strict regulation that no coal shall be disturbed beyond the limits of a 20-ft. cover, and that no openings shall be allowed to be made other than are absolutely necessary for mining purposes, it is the opinion of the writer that abandoned mines could be effectually sealed.

Considering that the coal between the outcrop and the line of about 12-ft. cover is of little value, and cannot be shipped under normal conditions, the loss of coal resulting from confining the mining to a limit of 20-ft. cover would not be large compared with the benefits derived from leaving such a solid barrier to prevent the seepage from abandoned mines from entering the streams.

Suggestions for the Future—There is no hope for relief until legislation is enacted and enforced to regulate the discharge of mine drainage into the streams of such states. However, we cannot expect that any state will pass such an act until an approved and efficient method of treating mine drainage is offered. In the opinion of the writer, the Department of Sanitation in the United States Bureau of Mines is the proper authority to make an exhaustive study of treating mine drainage so that it may be discharged into streams without dangerous results. This would be a much more efficient method of procedure than to have each state make investigations.

It is very evident that the expense of treating mine water would be no hardship to the operators, as it is an axiomatic principle that the consumer must always bear the burdens incident to coal production. However, if it can be shown that the added expense would not exceed 10c. per ton of coal produced under normal prices of labor and material (and the writer feels very confident that it would not exceed this) the local water-consuming public would no doubt gladly bear this extra expense, if it could be assured that supplies of pure water could be maintained during the operation of the mines and after they are abandoned. It would be a small price to pay in comparison with the benefits received, benefits so vital to the health and happiness of the people.

To obviate the necessity of treating the mine water from abandoned mines, or at least to have the volume of such drainage reduced to a minimum, it should be unlawful to mine any coal within the area included between the outcrop and the line of 20-ft. cover.

Engineers Should Control Street Traffic

According to C. Augustus Vollmer, of the Los Angeles police, traffic control should be divorced from police duty and given to engineers. Speaking before the Traffic Commission of Los Angeles, he said that traffic control has outgrown its status as part of the duty of a policeman and is now the work of expert engineers, for it has reached the point of a scientific problem involving street capacity and many other similar matters which are out of the scope of a police officer and more in the field of engineers.

Theory and Tests on Duty of Irrigation Water

Discussion of an Article on the "Economical Use of Irrigation Water Based on Tests" in *Engineering News-Record*, by Barry Dibble, B. A. Etcheverry, J. B. Lippincott, Lynn Crandall, A. Lincoln Fellows, and the Authors

Determination of the actual theoretical, ideal and practical duty of irrigation water has formed the main subject for most meetings of irrigation engineers, operators and users since the Mormons started irrigation in Utah. MESSRS. CLYDE, GARDNER *and* PROFESSOR ISRAELSEN *have made a heroic attempt to bring practice and actual need into consonance by means of a formula developed from carefully observed tests at widely distributed points. To develop the views on the value of the proposed methods a number of engineers were asked to comment on the article. Below are given the replies of five engineers together with answers by the authors. When understood the method seems to meet with approval, although cautions as to blind use are sounded and accepted by the authors as proper.*—EDITOR.

Soil Samples a Better Guide than Formulas

BY J. B. LIPPINCOTT
Consulting Engineer, Los Angeles, Calif.

THE AUTHORS have gone into higher mathematics in order to work out the duty of water curves for different crops. Their article impresses me as an unusually complete demonstration of the manner in which the theorist is likely to attack a problem of this kind. I do not consider their mathematical demonstration of any value whatever because there are so many local conditions that enter into this problem of the growing of plants. For instance, adjacent to our coast where we have frequent fogs, we raise crops without any irrigation at all, and these same crops, fifty miles inland, would scarcely germinate. Again, the soil conditions completely modify the amounts of water required for all our crops.

In addition to my engineering work I am interested in three farms. We watch the condition of the leaves on the plants closely and when they begin showing any wilt we know that it is time to serve them with additional water. We also have soil augers and take samples of the soil at different depths from time to time and are guided largely by our observations of the soil samples. I have a superintendent who is a university graduate in citrus culture and these are the methods that he uses. They strike me as being unusually practical and far superior to those proposed in your article.

* * *

Farmers' Handicaps Must Not be Discounted

BY LYNN CRANDALL
Water Commissioner for Big Lost River, Mackay, Idaho

THIS PAPER is a commendable attempt to find a rational basis for solving the perplexing problem of determining the proper "duty of water" under certain specified conditions.

In applying it to large projects, however, the results of experiments on small plots of ground, judgment and discretion must be used. On the experimental lots the ground is well prepared, adequate help is available, soil moisture conditions are under control so that water can be quickly applied to the entire plot when so needed, and the average experimenter is usually — unconsciously, perhaps — interested in establishing the fact that large yields can be secured with small or moderate amounts of water. The average irrigation farmer, on the other hand, labors under many handicaps. He has to start irrigating his fields before the soil moisture has been fully utilized by the crops as otherwise the crops will suffer before irrigation is completed; he suffers at times from interruptions and fluctuations in the water supply. His available help is often insufficient to see that the water is changed at proper intervals, especially during the night; his ground is often poorly prepared on account of lack of resources, and in many instances he is a tenant with but slight interest in making any permanent improvements. The net result of these various factors is that in practical operation a greater amount of water must be supplied to the farmers than the amount determined from the irrigation of experimental plots.

If all irrigation projects were settled by ideal farmers, men of practical ability, energy and good judgment, who owned their places free from debt, then indeed might the experimental *y-w* curves be approached in actual practice. The "expectancy curve" of such an event ever happening, however, is one the determination of whose co-ordinates defies mathematical analysis.

Even when allowance has been made for the amount of water to be delivered to the average farmer to irrigate some particular crop, in addition to the amount determined from experimental plots, the first step only has been taken in the solution of the problem of determining the acreage that can be irrigated from some stream of measured runoff. The water requirements for crops like alfalfa are nearly twice as great as those for grain, so that obviously the proportion of the project to be devoted to particular crops will have an important bearing on the water requirements for the project as a whole. It often happens during the early years of settlement of an irrigation project that large areas are devoted to grain. Later the development of the daily industry, for example, leads to the seeding of considerable areas of pasture, alfalfa, etc., requiring greater quantities of water than the grain which they displaced on the land.

The losses in the canal system from the point of river diversion to the settler's land must be estimated and in the case of large canal systems these losses may consume nearly as much water as the net amount used by the plants. When the requirements at the point of river diversion are thus determined, there still remains the problem of correlating this demand with the records of available river runoff. If a sufficient supply is provided by storage or from the natural flow to supply the demand during the years of average runoff, what will the supply be during the lean or dry years, and how often will they occur? A project cannot achieve a substantial success that furnishes an adequate water supply during three out of five years, with a severe shortage during the other two years.

A large irrigation project with earth canals, where the soil conditions, crops, climate, etc., are such as result in a net duty of water of say 2.25 acre-ft. per acre, for the season, on the land, will generally require not less than 3 acre-ft. per acre delivered at the settler's headgate and from 4.5 to 5 acre-ft. per acre, or perhaps more, at the point of river diversion.

Engineers must share with the promoters the responsibility for many poorly conceived irrigation schemes—largely because of a too ready use of experimental data on "duty of water" without a full appreciation of the necessary allowances that must be made to cover the points mentioned by the writer. In studying the irrigated areas of the western United States, those sections that are prosperous, productive, with good roads and schools, with established land values and permanent and attractive homes, are invariably those which have an ample water supply, generally considerably in excess of the amounts that most irrigation engineers would consider necessary.

Some of the factors that enter into the "duty of water" question can be reduced to a mathematical basis, as has

been done by the authors; the determination of others must rest upon judgment and experience. In general, however, engineers should recognize that the results of experimental "duty of water" tests must be applied to large acreages with caution and with proper allowances, and that the successful productive, irrigated areas are using more water and will continue to use and require more water than the amounts that have been generally considered necessary by most "duty of water" investigators.

* * *

Warn Against Waterlogging, Alkali and Leaching

By B. A. Etcheverry
Department of Irrigation, University of California, Berkeley, Calif.

The method of solving the problem is interesting and is based on the application of economic principles to the results obtained from tests. It is, however, important that the results of these tests be not given undue weight and that the different values obtained for the economic number of acre-inches applied per acre for the different conditions and crops be considered only as illustrative and not the proper values to use in practice. The importance of this is obvious when it is realized that the economic depths derived from these tests are generally considerably in excess of what is required under reasonably good practice and in excess of the quantities which have caused large areas of irrigated lands to be damaged or rendered worthless by waterlogging and accumulation of alkali.

The limited water supply in many parts of our arid states is not sufficient to serve all of the best lands. The economic use of water is therefore of primary importance. It is unfortunate that much of the water used for irrigation is controlled in a large measure by vested rights or sold on the acreage basis independently of the quantity of water used. It is only where water is costly or charged for in accordance with the quantity of water used that there is an incentive for the careful use of water.

Results obtained from tests may be very misleading unless the conditions affecting the use of water are fully considered and the limitations appreciated. Many of the tests have been made on small tracts where the water table is deep down and where the surplus water added to the land passes down beyond the reach of plant roots and is carried away by natural underdrainage without raising the water table. These tests often give larger yields than are generally obtained over a large area of irrigated land. The larger yields and the relatively free subsoil drainage naturally cause a greater use of water than that required in practice.

In a large area of irrigated lands the deep percolation loss or surplus irrigation water gradually causes a rise in the water table. A condition of equilibrium is obtained when the surplus water is balanced by the underground drainage and the increased soil moisture evaporation due to the high water table. Unfortunately in many cases this condition of equilibrium is only reached when the water table is so near the surface that much waterlogging and accumulation of alkali result.

A large part of the water applied on the test tracts may be surplus irrigation water, passing down beyond the reach of plant roots. For instance, the experiments made at Davis, Calif., show that with 36-in. depth of water a yield of more than 9 tons of alfalfa was obtained, while the Utah experiments show a yield of about 4¾ tons per acre with 48-in. depth of irrigation water. Evidently the Utah tests show a less efficient use of water with probably considerable deep percolatory loss. The yield of over 9 tons per acre on the Davis tract is much larger than that generally obtained in practice. On large irrigated areas in the San Joaquin Valley the yield of alfalfa is not over 5 tons per acre. This is in part due to the effect on the root system of a high and fluctuating water table, which results from more water being delivered to the areas than the quantity necessary to produce the crops.

The yield water curve for wheat from the Utah experiments shows about 46 bushels of wheat with zero acre-in. of water applied and about 57 bushels with about 36 acre-in. of water applied. Evidently the larger part of the 36 acre-in. applied was lost by deep percolation. With this quantity of water added to a large area of irrigated lands, unless unusual natural underground drainage existed, waterlogging would soon occur.

The economic depth of irrigation water to use for the different crops for the conditions and values assumed by the authors of the paper may be justifiable if it will not produce damages of waterlogging, accumulation of alkali and leaching of fertility from the higher lands. If these damages do result, the cost of these damages or of drainage works to prevent waterlogging should be an additional factor to consider in arriving at the economic depth.

* * *

Amount Applied in Single Irrigation a Factor

By Barry Dibble
Project Manager, Minidoka Project, U. S. Reclamation Service, American Falls, Idaho

An excellent work has been accomplished at Logan, Utah, in determining the effect that modification in the application of water has upon the production of various crops. From the standpoint of the irrigation engineer this study is important as showing the factors that affect the water supply which it is economical to provide in a given case. In much of the arid West there is more good land than there is water available with which to irrigate it. Nearly all future irrigation projects will require a heavy initial investment to get water onto the land. Promotors are tempted to spread the water thinly over a large acreage to make the cost per acre low. When the farmer's turn comes he wants a liberal supply of water so that he may get the maximum crop per acre and avoid part of the work necessary in distributing water efficiently. Somewhere between the two extremes lies the economic mean which the authors are endeavoring to find.

When it comes to the practical application of experiments and formulas for determining the duty of water, there is a factor not considered in this paper which is of great importance; that is, the amount of water which is applied to the soil in a single irrigation. It is well established that the amount of water which the soil will retain within reach of the plant roots is very limited. If the application exceeds this amount, as is usually the case in current irrigation practice, the excess water percolates beyond the depth of the plant roots and ultimately reaches the ground water plane. The soil depth penetrated by the roots, of course, varies greatly with different plants.

Don Bark, in some of his experiments in Idaho, built a concrete cistern 6 ft. under the ground surface in which he caught the water that passed out of the test bed. S. T. Harding by other methods reached similar results on different soils. Both showed that twenty-four hours after irrigation the upper 6 ft. of soil retained an amount of available water equal to only 4 cu.in. per square inch of ground surface, even though a depth of 12 in. or more had been applied. At the end of twenty-four hours the water, particularly on the coarser soils, was still passing rather rapidly downward. In irrigating a field it is common practice to over-irrigate the part near the headgate in order to get sufficient water to the lower end of the field. It is possible for the farmer with some extra expense, care and labor largely to avoid these losses and thus reduce the quantity of water applied to the soil.

The question of the proper duty of water has frequently been before the courts in the West and its determination has often rested upon the testimony of the "practical farmer." With the development of irrigation and the increase in the acreage of lands that must be irrigated from the available water supply, it is becoming more and more important to adopt operating and farming methods which will result in greater economy in the use of water. Because of the great number of variables there is room for much analytical study such as Professor Irsaelsen and his assistants are giving this subject.

Decision as to Constants Difficult

By A. Lincoln Fellows
Senior Irrigation Engineer, U. S. Department of Agriculture, Denver, Colo.

THE ARTICLE is a notable step in the direction of a more definite knowledge regarding the most profitable use of water n irrigation. It is particularly valuable in calling the attention of irrigation engineers and managers to the fact that the most profitable use of water in irrigation may depend upon the application of a smaller, sometimes materially smaller, amount of water than is required for a maximum crop production, a fact that is too often ignored. This fact has been previously commented upon by various writers but this is the first deliberate attempt that I know of to present a method that may be used to insure the greatest profits in irrigated agriculture, and I have already made some use of it in trying to arrive at the proper amounts to be used in estimating the probable duty of water in certain regions.

The greatest difficulty lies in the fact that it is hard to decide upon the values for the constants of the formulas that will be of general or even local application, since the cost figures and also the values of agricultural products vary so greatly from year to year that any conclusions reached must be used with considerable caution. It is believed, also, that the discussion might be simplified to advantage by using profit-water curves based on the governing conditions of cases 1, 2 and 3, eliminating the calculus involved, which, though comparatively simple, nevertheless conveys an unnecessary impression of abstruseness to many practicing engineers.

Furthermore, the use of water studies involving calculations with respect to large areas is complicated by the fact that the water will be applied not to a single variety of crop, as in the authors' illustrations, but to a great variety of lands and crops giving different yields with respect to both quantity and value, and requiring different amounts of water. For these reasons I fear that the application of the formulas will in general be limited to more or less academic discussions of the duty of water rather than to determinations of the amounts to be provided by canal systems or for the irrigation of specific tracts of land. Nevertheless, I am of the opinion that the publication of the article will prove to be beneficial to irrigation. The same method has already been used to determine the proper amount of fertilizer to apply to land.

The comments made herein result from discussions held with a number of irrigation engineers and constitute, therefore, a consensus of opinion rather than my own individual thoughts. I am under especial obligations to Julian Hinds, engineer, U. S. Reclamation Service, for a letter regarding the article, some of which letter is quoted herein.

* * *

Authors' Replies to Comments and Criticisms

By Willard Gardner
Associate Physicist, Utah Agricultural College, Logan, Utah

FROM THE nature of Mr. Lippincott's premises it would be difficult to make a reply that would be satisfactory to him. He should note, however, that the determination of the empirical y-w curve is an important feature of the proposed method and that the authors have not overlooked the importance of local conditions. A careful record of measured quantities of water applied in accordance with the observations noted in his last paragraph, together with careful records of crop yields, is just the kind of information we would desire for the establishment of this function. By all means, it should not be overlooked that notwithstanding all apparent demand for water as indicated by the condition of the plant and the condition of the soil, it is frequently impossible to apply even a fractional part of the additional water needed without a very careful method of handling a limited supply.

It might be wisely contended that a precise analytical treatment of approximate and uncertain experimental magnitudes is unscientific. Does it not seem probable, however, that the experimental methods of modern science are adequate for the determination of such functions as the representative y-w function for a given locality with a fair degree of precision, parameters involving the time and also such parameters as are characteristic of sub-divisions of a given locality entering the function only implicitly through the average value?

On the other hand, an eagerness to abandon hope because of inherent difficulties in the analytical treatment is in many cases perhaps the principal obstacle in the way of the solution of some very practical problems.

The statements of Messrs. Crandall, Dibble and Etcheverry indicate that they have given the paper careful consideration and it is reassuring to note that their criticisms are constructive. We are aware of the importance of Mr. Crandall's distinction between the amount of water necessary at the farmer's headgate and the amount to be delivered from the river.

To regard the water and the land as a sort of perpetual annuity from which present and future generations must benefit is no doubt the proper point of view, and, as Mr. Etcheverry suggests, an attempt to secure a maximum profit per acre or per acre-inch for any one harvest might under certain conditions be like killing the goose for the golden eggs. To introduce the time explicitly, however, obviously increases the analytical difficulties, and experimental data available at present are wholly inadequate to determine how the time should be introduced in any given case. Even were it possible to do this, the rather subtle question may then arise, just what is the maximum for which we are seeking? Are we looking for a maximum value of the time integral or the profits function? If so, what is our upper time limit? Or are we looking for a maximum value of the "present worth" of the "annuity?" In either case we must decide upon the upper limit of a definite integral. It is to be hoped, however, that methods of irrigation, coupled with methods of tillage and methods of cropping, may be adopted which will insure permanent maximum annual profits.

Concerning the "expectancy curve" mentioned by Mr. Crandall, if by careful experimentation the y-w curve is established for a given locality, from this curve we ascertain the amount of water which we would recommend and the question of primary importance is this: Can a careless farmer use economically amounts of water in excess of this amount? The immediate answer to this question is that if his farm is of the average type for the locality he can do so only by using wasteful methods for the water which he first applies and careful methods for that which he applies subsequently. The careful farmer will use the amount recommended as a matter of choice because he will discover himself that this is the proper amount if he is not disposed to adopt it because of our recommendation. If his farm is of the average type he does not need to worry about a y-w curve of his own, his principal concern being to ascertain the appropriate amount of water he should use for his own benefit. Of course if the water costs him nothing he is concerned only with securing a maximum yield.

It is perhaps unnecessary to discuss these various questions that arise in further detail at this time. If we succeed in stimulating an interest in the subject we shall regard it well worth while and shall of course have no objection to any appropriate modification of the proposed method of attack.

* * *

By O. W. Israelsen
Professor of Irrigation and Drainage, Utah Agricultural College, Logan, Utah

IT IS gratifying to note the substantially correct interpretation of the purpose of the paper. Mr. Crandall has properly emphasized the need for judgment and discretion in the application of our methods of interpretation. Likewise Professor Etcheverry urges the need for caution, not so much in the use of any methods of analysis, as in the assurance that the experimental tests are dependable and applicable to the particular conditions confronting the engineer in a given case. It is noteworthy that Messrs.

Crandall and Etcheverry urge caution for precisely opposite reasons: First, that the tests being conducted under ideal conditions indicate a need for amounts of water far below actual necessities and second, that because of the free drainage under many test plats, the experiments frequently show a necessity for amounts of water far in excess of those most economical for large projects with a water table near the soil surface. Since the purpose of our paper is to present a rational basis for the interpretation and application of the results of thoroughly dependable duty-of-water experiments we consider it inadvisable here further to consider the difference presented in the comments of Messrs. Crandall and Etcheverry. Suffice it to say that in our opinion a few of the many duty-of-water tests heretofore conducted are dependable if properly interpreted, and that it is yet feasible in many western valleys by further experiments to establish the *y-w* or duty-of-water curve with sufficient precision to be of real value, despite the admittedly large number of independently variable influencing factors. To one of the variable factors, namely, the water capacity of soil and the amount of water applied in a single irrigation, Mr. Dibble gives particular attention. We agree that this factor is vital in the correct experimental establishment of the *y-w* curve, and we have treated it in some detail in a different publication. (Israelsen, Orson W. and West, Frank L., 1922—Water-Holding Capacity of Irrigated Soils. Utah Agr. Exp. Sta., Bul. 183, pp. 1-24.)

We regret that our paper failed to make clear to Mr. Lippincott even the elements of its purpose. His statement that "the authors have gone into higher mathematics in order to work out the duty of water curves for different crops" is manifestly erroneous. We do not claim that our analysis looking toward the establishment of rational methods of interpretation of duty-of-water experiments is of any value in determining the time to irrigate. On the contrary we agree that an examination of the leaves and of the moisture conditions of the soil by means of borings with a soil auger are very good methods of determining when water is needed. For this purpose we use these methods on our own farms.

In order to use its limited water supply most economically the West must clearly have vastly more information. We agree with Mr. Crandall in the assertion that "engineers must share with the promoters the responsibility for many poorly conceived irrigation schemes" not so much because of a too ready use of experimental data as because of un unintelligent use of these data. Moreover, courts, water commissions, state engineers and other public organizations confronted with the problem of adjudicating water rights have had presented to them widely different interpretations of experimental data by authoritative men whose motives are genuine. These differences have resulted in part from the necessity of forming opinions upon the basis of insufficient analysis of the rather perplexing problem. It therefore seems reasonable to believe that a comprehensive analysis of the results of dependable duty-of-water experiments, in which consideration is given to the cost of the water and the land, the labor cost of producing the crop together with its sale value for a period of years and other closely related practical questions, may reduce to some extent the difficulty of approaching a correct solution of the problem.

Rapid Transit Railway at Sydney, Australia

Active work on the combined city underground and elevated line of the New South Wales Government Railways at Sydney, Australia, is outlined in the report of the Railway Commissioners for the year ending June 30, 1923. Part of the underground lines is cut-and-cover work, built in a trench made with an American dragline excavator and steam shovels. The remainder consists of double-track tunnels and twin tunnels, all with concrete lining. Part of the elevated line will be a six-track structure. Extensive works are required for stations and for connections with existing lines.

Again the English Channel Tunnel

A STATEMENT as to the project on a 27-mile English-French submarine tunnel under the Straits of Dover has been issued recently by Sir Percy Tempest, chief engineer of the tunnel company and also general manager of the Southern Ry., whose lines would connect with the tunnel. This project, of many years' standing, is kept alive by its promoters, although the British government persists in refusing to grant the necessary authority, largely for national and strategic reasons. According to the present statement, the material to be encountered for the entire distance is very favorable, being a deep bed of chalk marl, or chalk infiltrated with clay. That this material does not swell on exposure and is impervious is shown by the trial heading built in 1880-1881 and extending about a mile under the sea. With the boring machine designed for this work, and used experimentally, a heading 12 ft. in diameter can be driven at the rate of 120 ft. per day, and two machines started at opposite ends should meet in less than three years. It is proposed to complete this pilot tunnel or heading and then its enlargement to full section could be started at various points, so that the time for the completion of the concrete-lined tunnel is estimated at 4½ years. Instead of the usual mucking operations, the excavated material would be mixed with water to form a grout and then pumped to the surface. With present prices the cost is estimated at $145,000,000. The annual revenue, based on existing traffic, would be more than 5 per cent of the cost, but it is expected that the tunnel communication would cause a great increase in traffic. A suggestion that a concrete caisson might be sunk in mid-channel for a working shaft with two additional headings is rejected by the engineer, partly on account of the extreme difficulty of sinking such a caisson in an open sea, subject to heavy storms, and with the danger of being struck by ships. Furthermore, with permeable strata and a hydrostatic pressure of 5½ tons per square foot there would be danger of water breaking through the seal at the bottom of the caisson and pouring through into the shaft.

Railway Relinquishes Water Supply Business

A water system operated by the Boston & Maine R.R. to serve its own water stations and a municipality has been sold to the latter, but under a contract which insures a supply to the railroad. This company had an investment of about $15,000 in the Woodsville Aqueduct Co., which furnished water to the railroad at Woodsville and Wells River, N. H., and also to the village of Woodsville. The situation is stated as follows in the annual report of the Boston & Maine R.R.:

"Some dissatisfaction existed in the village because the water, although well suited for railroad purposes, was thought not to be suited for drinking water, and it was felt that it would be wise for the railroad to go out of the business of furnishing water and electricity. At the same time, it was necessary that the railroad should be assured of a sufficient supply of both at this point. The Aqueduct Company was formed in 1885 and had developed into a property of considerable value. Negotiations had been going on for some time, and early in 1922 the Woodsville Fire District voted to purchase the water-works system and plant of the Woodsville Aqueduct Co. The district further voted to contract to furnish the Boston & Maine R.R. with water and electricity for a term of twenty years,

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Relativity for Laymen

Reviewed By George Paaswell
Specialist in Mathematical Engineering Problems, New York City

FOUR LECTURES ON RELATIVITY AND SPACE—By Charles Proteus Steinmetz, A.M., Ph.D., Past-President, American Institute of Electrical Engineers. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 126; 32 line cuts and halftones on cards in pocket. $2.

Dr. Steinmetz has evidently joined the throng of those, who, having accepted Relativity, become fired with a holy zeal to make all laymen converts to the theory. It is a very ambitious task to render a popular account of Relativity and it is surprising to note how convincing many of the explanations appear in the course of the lectures. However, it is only just to state that the author meets far greater success in demonstrating the significance of relativity than in exhibiting its plausibility.

There has arisen a classic method of explaining the new doctrine, founded upon its historical development. Starting with the failure of the Michaelson-Morley experiment to demonstrate motion with respect to the ether, the unique postulate of the shortening of time and space measures made its appearance. Then came the theorem of special relativity, that it is impossible to determine uniform motion with respect to the ether. There followed the fundamental law that the velocity of light is the same to all observers regardless of their reference system of co-ordinates. This is true merely because its converse would permit determination of motion with respect to the ether.

In contrast the author starts with two simple premises: (1) All phenomena of space, time and motion are relative, and (2) All laws of nature are universal. On their face, these two statements are easily acceptable, but, as a matter of fact, there is not enough in the two to premise the relativity theory upon, and the fundamental statement following these two premises, that the velocity of light is everywhere constant, appears rather as a contradiction than as a consequence of the premises. Relativity is founded upon an entirely novel conception of physical law and little is gained by attempting to reconcile Newtonian mechanics or our slightly ramified conceptions of space with the new theory. That the velocity of light is constant, regardless of the reference frame used, is a unique assumption not met with anywhere in the domain of physical law heretofore, and it seems unfair to the reader to attempt to slip such a law by him without, at least, pointing out such uniqueness.

It is all very well to give the usual examples of the bullet and the moving train and the observer fixed upon the earth but one should frankly admit that these simple analogies do not lead to an acceptable explanation of relativity. Such relative motion has always been accepted and completely understood. However, the author has really given a brilliant demonstration of the equivalence hypothesis—the equivalence of the gravitational field with a simple transformation of acceleration axes—and his examples there are exceedingly well chosen. As a general conclusion, drawn by the reviewer after having read a number of attempts to explain in a popular sense what relativity is, it seems far better to cling to a simple mathematical statement of the space of relativity and then to convince the reader that, due to the soundness of the mathematical demonstrations and to the experimental confirmation of the fundamental premise, the conclusions of relativity are correct.

Lectures 3 and 4, on Space Properties, are of exceeding interest and the geometry and other characteristics of the space described should certainly arouse sufficient interest in the reader to make him want to learn more of non-Euclidean geometry. As one notes the almost universal acceptance of the demonstration of the curvature of the high space by simply stepping up the formulas from two dimensions onward, there is an uneasy feeling that the mathematicians are justly irritated in the forced analogy between the space geodesics of Euclidean geometry and the properties of the world lines in the new space. In the long run it may be that the analogy will confuse rather than illuminate the properties of these new space "invariants."

On the whole one feels that the new book is a very stimulating contribution to the so-called popular treatises on Relativity and it is hoped that when the reader has finished it he will take up some of the more serious texts—Eddington's first report, Weyl (as translated into Engish), Silberstein, Cunningham, Robb and others.

Co-operation Instead of Conflict

INDUSTRIAL DEMOCRACY: A Plan for Its Achievement—By Glenn E. Plumb and William G. Roylance. New York: B. W. Huebsch, Inc. Cloth; 6x8 in.; pp. 359; frontispiece portrait of senior author. $2.

Some two years ago the late Glenn E. Plumb attracted country-wide attention by his plan for the nationalization of our railways. The plan was heartily approved by the various railway brotherhoods and received a warm welcome from organized labor generally and more or less endorsement by advocates of public ownership of all utility monopolies. Opposition, as was to be expected, came from representatives of the railways and of capital as well as from that part of the general public which was ready to protest that government operation of the railways, express, telegraph and telephone services during the war had been unsatisfactory.

Full of confidence in the underlying principles of his plan for the railways, Mr. Plumb went on with an elaboration of the application of those principles to all industry. In this he had the co-operation of W. G. Roylance. The result is this book on Industrial Democracy, the text of which, as the foreword states, "was in a finished state at the time of Mr. Plumb's death." The foreword adds: "The form and content of the book, arrangement of material and general philosophy resulted from earnest collaboration. The known familiarity of Mr. Roylance with the problems of agriculture, public finance, banking, currency, credit, and their relation to industrialism gives authentic value to their treatment."

Regardless of one's opinion as to the causes and remedies for the industrial conflicts, cycles of prosperity and depression, this book deserves wide and careful reading. It is no wild-eyed or wild-minded vision of a mere dreamer; nor of a man bent on bringing all capital and industry within the control of any one class, large or small. Instead, it is a carefully reasoned argument for applying what the author conceives to be the fundamental principles of democracy, as set forth in the Constitution of the United States, to the production and distribution of all goods and the conduct of all services required to satisfy human needs, including, particularly, financing these enterprises.

The substitution of a thoroughly democratic co-operation of all contributing in any way through labor, managerial ability, or accumulated capital in money or other form for the present endless conflicts between the respective contributors, each for his own gain, regardless of the interests of the rest, is the basic idea of the book. Organized industry is now conducted for profit rather than for production to meet human needs, the book holds. Moreover, the control of industry, it is maintained, is vested largely and almost overwhelmingly and increasingly in capital which operates from without instead of from within the industry and without any specific knowledge of the industries controlled. The mass of the producers has no part whatever in the control of industry, except as gained through strikes, actual or threatened.

Profits, the book holds, are abstracted from industry to pyramid capital on which the whole effort is to earn more and more profit. If a larger and due part of these profits went to the mass of producers, the book holds, then their consuming capacity would be increased and with it the market for commodities. Instead, the argument runs, capital demands absorb the purchasing power of the mass of producers so that from time to time goods pile up, wages are cut or employees let go, and the purchasing power of the mass of producers so curtailed results in the stagnation of industry.

Under Mr. Plumb's conception of industrial democracy, co-operation in production would be secured, not by abolishing private corporations and attempting any sort of communism, but through corporations organized on a thoroughly democratic basis. Under this plan every one engaged in production would share in both the control and the profits of industry in direct proportion to what each individual and each class contribute. The consuming public would be a partner in benefit but not in management. The returns to money capital would be some established percentage of the amount of money contributed to the enterprise. Voting for corporate management control would be proportioned upon the dividends paid to capital on the one hand and on the other upon the salaries and the wages paid to management and to labor. A part of the profits would go to the reduction of capital loans and a part into the business. Eventually outside capital loans might all be paid off. When profits exceeded all charges, including an established rate of return on the investment, prices for goods produced would be cut, thus making the consuming public a partner in the enterprise. By such means, the authors believe, the great waste in industry through the struggle between the present conflicting interests would be eliminated and economic and industrial efficiency obtained, together with individual and social justice.

The book contains a plan for operating the coal industry and plans for the benefit of agriculture, for market, for credit, for foreign trade—the latter also to be based on the principles of industrial democracy.

As might be expected from a book of propaganda, the book contains many dicta and allegations with little or no supporting data or documentary references. A wide reading of the book is to be hoped for, as it is full of food for thought. Whatever the fate of the plan so well presented may be, many of its underlying principles and supporting arguments are incontrovertible and are bound to be accepted in some part as the years go by.

Railway Maintenance

Reviewed by S. B. McConnell
District Engineer, Canadian Pacific Ry., North Bay, Ont.

PRACTICAL RAILWAY MAINTENANCE—By Charles Weiss, C.E. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 343; many line cuts. $3.50.

The author appears to have attempted to produce a volume suitable both for the student and the man of experience in railway maintenance. Although a great deal of information is presented much of it is of doubtful value to the man of experience. As for the student, while the book might be interesting it would, in some instances, prove misleading inasmuch as it evidently cites practices which, although suitable under certain conditions would be considered of questionable merit under others. A guide to beginners, who cannot be expected to have the knowledge at their disposal to enable them to discriminate between the conditions under which the rules laid down should or should not be followed, should state, where rules are not universally suitable or even suitable throughout this continent, under what conditions—as of climate or traffic—they should apply.

To cover railway maintenance in a manner to be of material value to those outside a limited area, the author's viewpoint should be based not only on a wide and varied personal experience, but also on a study of the experience of others under conditions beyond his own experience. In the case of this book one is forced to the conclusion that the viewpoint of the author is limited and the book of value only to those confronted with the same conditions. The following extract from page 11 is an example to support this conclusion: "Use the fall for final surfacing, lining, tie renewals and similar work, leaving the gaging for winter." This program may and no doubt does meet the requirements where the author has received his experience, but where winter means continuous frozen ground from November to May, as well as a heavy covering of snow throughout the most of this period, it would obviously be bad practice to leave the tie renewals until fall, as there would then be no opportunity to do the final surfacing before the freeze up; and as for the gaging, if left for the winter, there would be the added expense of removing the snow when every hour of labor available is required for shimming, bracing and other work resulting from the frost action. Under such conditions shimming could not be carried out as suggested on page 70.

The value or correctness of many other statements is open to question, but a single illustration will serve to show that this work is not based on a broad knowledge of railway maintenance.

English and the Engineer

ENGLISH FOR ENGINEERS—By S. A. Harbarger, Dept. of English, Ohio State University, Member, Committee on English, Society for the Promotion of Engineering Education. New York: McGraw-Hill Book Co., Inc. Cloth; 5 x 8 in.; pp. 266. $2.

The importance of the correct use of English in the success of the engineer is clearly set forth in this book, directed mainly to the undergraduate engineer and written purposely as a textbook. Properly studied, it should be most valuable to the embryo engineer, particularly if he takes to heart the author's true words: "A man's language is taken by most to indicate not only his literacy but also his background, the grade of society in which he has placed himself, his tastes, his aspirations, his diligence and his appreciation."

The letter, the wire communication, the explanation —of a design, a process, a piece of construction—the abstract, the report, and also conversation are the means whereby the engineer may sell his professional knowledge and ideas. The aim of this book is to develop in engineering students, who frequently pay too little attention to English while in college and regret it when they come to practical work, the ability to have something definite to say and to say it concisely and clearly.

While there are no exercises in the book, specifically for classroom study in engineering schools, there are plenty of references to sources for such material. The volume is also well supplied with examples and models for all the forms of writing discussed, the models being taken from books and from the leading technical journals of the day. Emphasis is laid throughout the book on the value of correct expression, even in the paper and envelope transmitting a letter, and on the importance of self-analysis to be sure that one has something the recipient will want to hear before he sets himself to letter or engineering report, article or editorial.

One feature that is interesting is the stress laid on oral discussion in society meetings, undergraduate as well as later professional. Too little attention is usually given in English work to oral expression, and to insist on attention at and participation in engineering society meetings as a means of developing proficiency in speaking while not a novel idea is one well worth emphasizing to the undergraduate.

The Writing of Briefs

BRIEF DRAWING—By Ralph Curtis Ringwalt, A.B., LL.B.; Member of the New York Bar. New York and London: Longmans, Green & Co. Cloth; 6x8 in.; pp. 214. $1.50.

In the logical marshaling of the main facts bearing on an engineering project, the engineer may often profitably follow the same general theory and practice as is followed by the lawyer in preparing a brief. This little book presents in small compass the fundamentals of brief drawing, as they appear to a lawyer who has both taught and practiced law. Emphasis is laid on one essential which every novice, whether in law or in engineering, must realize if he is to succeed: A brief, argument, or report must be drawn to convince the class of person to whom it is addressed.

After defining a brief, the author considers library research, reading and note taking, argumentation, the audience, and various phases of proof and evidence. He then analyzes brief drawing, including among other things the various classes of paragraphs, the introduction, the argument, the conclusion. A model brief closes the book.

The volume should be suggestive to professors in engineering schools and useful both to students of engineering and to many a practicing engineer.

Kent's Handbook Largely Rewritten

KENT'S MECHANICAL ENGINEERS' HANDBOOK — By the late William Kent, M.E., Sc.D. Tenth Edition, Rewritten, by Robert Thurston Kent, M.E., editor-in-chief, and staff of specialists. London: Chapman & Hall, Ltd. New York: John Wiley & Sons. 4¼x7 in.; pp. 1,247; line cuts. Flexible binding, $6.00 net; leather, $7.00 net.

The tenth edition of Kent's well-known Handbook has been largely rewritten. It contains much new text and many new tables. There is considerable new information on heat and heat insulation, fuels and combustion, air compressors and condensing equipment, power transmission and electrical engineering; considerable information in regard to railroad engineering with special reference to train resistance and locomotive design; and much new material in the section on machine design. The sections on fans and blowers, hydraulic turbines, pumps and pumping engines, steam engines and steam turbines, oil engines and gas producers, hoisting and conveying equipment, refrigeration and ice-making, and heating and ventilation have been entirely rewritten. New sections include gas turbines, automotive vehicles, aeronautics, fusion welding and cutting, malleable casting, reinforced concrete, and safety engineering.

Publications Received

ILLUSTRATIONS and some text have been added to the second edition of Special Assessments, a Means of Financing Municipal Improvements, by the Committee on Sources of Revenue, National Municipal League, 261 Broadway, New York City. (Technical Pamphlet No. 15; pp. 21; 25c. cach or $15 a hundred.)

THE INCREASING ACTIVITIES of state health departments in the field of applied sanitation, particularly in the South, is illustrated by a 45-p. pamphlet on The Operation of Water Filtration Plants of the Mechnical Gravity Type prepared by the Bureau of Engineering and Inspection of the North Carolina Board of Health (Raleigh). Half of the space is occupied by plain directions for filter operation, plant records, etc., and half by a description of chemical and physical tests for general filter, chlorine, bacteria and hydrogen-ion control.

THREE CONTRIBUTIONS to the June *Monthly Weather Review* (issued in September) will appeal to engineers: (1) Robert E. Horton, consulting hydraulic engineer, Voorheesville, N. Y., fills 15 pp. with a discussion of Rainfall Interpolation, accompanied by tables and diagrams; (2) Prof. Peter Philipovitch Gorbatcher, Rostov on Don, Russia, has some 4 pp. Concerning the Relation Between the Duration, Intensity, and the Periodicity of Rainfall; and there is a short paper on City Planning and the Prevailing Winds, by Clarence J. Root, meteorologist, Weather Bureau Office, Springfield, Ill.

A NATIONAL PLAN STUDY BRIEF, consisting of brief text and a number of striking diagram-maps of the United States, has been reprinted and is available in the form of a 24-p. Supplement to *Landscape Architect* (Cambridge, Mass.) for July, 1923. The author is Warren H. Manning, landscape and city planning consultant, Boston, Mass. The text deals chiefly with the natural resources and other opportunities afforded by the United States and the need of a national plan for their fullest and wisest utilization. The map-diagrams show our river and mountain systems; crop regions; original and present forest areas; rainfall totals by districts, with arid, semi-arid, irrigable and humid areas; lands improved and unimproved; soil in relation to

agriculture; factory centers; coal and lignite and also peat deposits; minimum potential water power by states; railroads; commercial and recreation areas and connecting ways; rural population per square mile, and national and state reservations—all of which may be characterized as a grand preliminary survey.

TRIBUTES TO THE LATE DR. HERMANN M. BIGGS, for several years health commissioner of New York State, are found in *Health News* for July, recently issued. Among the contributors outside of his one-time associates in the New York City and State health services are Prof. C.-E. A. Winslow, Yale University; Dr. Hugh S. Cumming, Surgeon-General, U.S.P.H.S.; Dr. Charles V. Chapin, superintendent of health, Providence, R. I.; Prof. George C. Whipple, Harvard University, and Dr. E. C. Levy, president, A.P.H.A. (Albany, N. Y.: State Department of Health.)

USEFUL INFORMATION designed "chiefly for the practical miner or small operator" is given in Timbering of Metal Mines, by E. A. Holbrook, Richard V. Ageton, and Harry E. Tufft. One or more methods for each timbering operation are given. (Washington D. C.; Bureau of Mines; one copy free.)

PUBLIC HEALTH BULLETIN No. 135 on Railroad Malaria Surveys, 1922, the Missouri Pacific Railroad, by A. W. Fuchs, associate sanitary engineer, U. S. Public Health Service, reviews malaria presence among employees and the effect of malaria on operating costs and railroad revenue, and presents a malaria control program. (Washington, D. C.; Public Health Service; one copy free.)

HIGHWAY INSTRUCTION IN ELEMENTARY SCHOOLS, designed to give also instruction in science, geography, civics, history and literature, is outlined in a 42-p. illustrated pamphlet, Main Streets of the Nation, by Florence C. Fox, specialist in educational systems, Bureau of Education (Washington, D. C.).

THE TWENTY-FIFTH SPECIAL REPORT of the National Industrial Conference Board (10 E. 39th St., New York City), on Engineering Education and American Industry, has sections on (1) the need for trained leadership in industry; (2) the educational problem and (3) the responsibility of industry. Under (2) there are discussed: the engineering school, tendencies in engineering courses, suggestions from industrialists, training in fundamentals, and selection and classification of students.

UNDER THE TITLE "Some Compressive Tests of Hollow-Tile Wall," by H. L. Whittemore and B. D. Hathcock, the Bureau of Standards (Washington, D.C.) has issued Technologic Paper No. 338, describing strength tests on tile walls 6, 8, and 12 in. thick, and 4 ft. long by 12 ft. high. It contains some excellent detailed information on this type of construction.

THE AMERICAN WELDING MILL CO., of Middletown, Ohio, has issued a little book entitled "River Shipping in Industry," which is a compilation of historical and river shipping data on the Ohio River and its tributaries. It is frankly in advocacy of waterways transportation, but it seems to be valuable as a directory of the Ohio River district.

Foreign Papers and Reports

THE ADDITIONAL WATER SUPPLY for Johannesburg and five other "magisterial districts" in the Transvaal, South Africa, comprising a total population of about 600,000, is described in a Souvenir of the Opening of the Vaal River Scheme—an illustrated pamphlet written chiefly by W. Ingham, chief engineer, Rand Water Board, Johannesburg. The works described include an impounding reservoir of over 16 billion U. S. gallons capacity, a low-lift pumping plant, settling basins, mechanical filters with a capacity of 6.4 m.g.d. (Imp.), a clear-water reservoir and high-service pumps delivering water under a 480-ft. head through a 26½-mile force main. After the water thus delivered has been mixed with an underground supply in a reservoir it is again pumped, part under an 820- and part under an 1,100-ft. head, a further distance of 14 miles to high-service reservoirs.

ANOTHER OCCASIONAL DESCRIPTION of the Works of the Birmingham, Tame and Rea District Drainage Board, by John D. Watson, chief engineer (Birmingham, England), has appeared. Altogether three plants treat the sewage of a little over a million people, chiefly from Birmingham. The main sewage-works, dealing with the sewage from a population of about 900,000, is and long has been one of the most interesting plants in the world. It includes detritus, storm-water, sedimentation, balancing, silt, separate sludge digestion, and final sedimentation tanks, together with bacteria beds (percolating filters, which receive the clarified sewage) and sludge drying beds. Besides describing all three of the plants Mr. Watson devotes a few pages to two activated-sludge units and a percolating filter, each of 12,000 U. S. gal. daily capacity. One of the activated-sludge plants depends on compressed air and the other on mechanical agitation for activation, and each treats tank-settled sewage. The tests thus far made indicate, Mr Watson says in effect, that either method of activation may be used successfully on Birmingham sewage; that tank liquor is better than crude sewage for activation; that one hour of "efficient flocculation" removes 60 per cent of "the impurity" and all "objectionable smell" from the tank effluent and "produces a liquor which may be oxidized at more than double the present rate on a percolating filter."

New Books and Revised Editions

BLUEPRINT READING: For the Machine Shop and Related Trades—By Joseph Brahdy, B.S., C.E., Brooklyn Vocational School, and Brooklyn Evening Technical and Trade School. New York: D. Van Nostrand Co. Cloth; 11 x 8 in.; pp. 18; 134 halftones and line cuts on blue. $2.50.

ELASTICITY AND STRENGTH OF MATERIALS USED IN ENGINEERING CONSTRUCTION: Section III, Theory of Torsion in Shafting, and Double Bending of Plates—By C. A. P. Turner, Consulting Engineer, M.Am.Soc.M.E., M.A.S.T.M., M.S.P.E.E., M.Am.Soc.C.E. Minneapolis, Minn.: Published by the Author. Cloth; 6 x 9 in.; pp. 122; 132 line cuts. $5.

THE ELEMENTARY PRINCIPLES OF LIGHTING AND PHOTOMETRY—By John W. T. Walsh, M.A. (Oxon), M.Sc. (London), A.M.I.E.E., F. Inst. P., Member of International Illumination Committee of Great Britain, General Secretary of International Commission on Illumination, Senior Assistant in Photometric Division of the National Physical Laboratory: with a Foreword by Sir J. E. Petavel, K.B.E., F.R.S., D.Sc. Cloth; 6 x 9 in.; 85 diagrams by G. H. Lewis. $4.50.

FIRE LOSSES: LOCOMOTIVE SPARKS—By L. W. Wallace, M.Am.Soc.M.E., M.Soc. Industrial Engs.; Executive Secretary, American Engineering Council of the Federated American Engineering Societies; former Professor, Railway Mechanical Engineer, Purdue University. New York: Barr-Erhardt Press, Inc. Flexible; 6 x 9 in.; pp. 203; 111 halftones and line cuts. $3.

Gives the result of five years' study of the relation of locomotive sparks to fires occurring along railroad rights-of-way. Covers the fundamentals of locomotive construction and operation from the standpoint of spark control, the effect of various types of spark-arresters, the distribution and character of sparks, and their ability to ignite combustible material.

HYDRAULICS APPLIED TO SEWER DESIGN—By G. S. Coleman, D.Sc. Eng. (London), Assoc. M.Inst.C.E., Associate Member of the Institution of Municipal and County Engineers, Senior Lecturer in Municipal and Sanitary Engineering in the Municipal College of Technology, Manchester, England, and Assistant Lecturer in the same subjects in the Victoria University of Manchester. London: Crosby Lockwood and Son. New York: D. Van Nostrand Co. Cloth; 5½ x 8½ in.; pp. 150; 70 line cuts. $4.

MEMOIRS: With a Full Account of the Great Malaria Problem and Its Solution—By Ronald Ross. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; 11 plates. $9.

MOVABLE AND LONG-SPAN STEEL BRIDGES—Compiled by a Staff of Specialists: Editors-in-Chief, George A. Hool, S.B., Consulting Engineer, Professor of Structural Engineering, University of Wisconsin; and W. S. Kinne, B.S., Professor of Structural Engineering, University of Wisconsin. New York: McGraw-Hill Book Co., Inc. Cloth; 6 x 9 in.; many halftones and line cuts. $5.

SOUTHERN YELLOW PINE: A Manual of Standard Wood Construction. Ninth Edition. New Orleans, La.: Southern Pine Association. Flexible; 5x7 in.; pp. 186; line cuts. $1.50.

Material added in this edition "includes timber working stresses based on recent extensive tests, new matter affecting the design of latticed wood trusses, and the calculation of nailed and bolted timber construction." Municipal and state building codes have been omitted because of the difficulty of keeping these revised to date, to keep the Manual of convenient size, and because the Southern Pine Association looks forward to a national building code. The volume contains many tables and diagrams and much other material of value to southern pine users.

A TEXT BOOK OF FILTRATION: Industrial Filtration and the Various Types of Filters Used—By Charles L. Bryden, E.M., B.S.; and George D. Dickey, B.S. Easton, Pa.: The Chemical Publishing Co. Cloth; 6 x 9 in.; 264 halftones and line cuts. $5.50.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Bates Road Tests and City Streets

Sir—There appeared, in *Engineering News-Record*, Sept. 6, 1923, p. 399, under the heading, "Bates Road Tests Do Not Apply to City Streets," an article by Ivan Houk, criticising the reports on the Bates test road. They have not, he said, made clear that the conclusions drawn do not apply 100 per cent to city pavements.

The Bates road tests having been made under certain conditions, we would not dream of supposing the conclusions drawn to apply to other conditions. It is the engineer's job to know the conditions he has to contend with. The conclusions drawn from one set of conditions and results must be modified before being applied to a different set of conditions.

The impression that the design of slab adopted by Illinois was intended to strengthen the edges of the pavement more than the middle, is wrong. Reports clearly state that it was intended to make them *as strong*. Whether the bulk of heavy traffic runs at the side or on the middle little affects the design. Remembering that it was the last straw which broke the camel's back, we design to prevent, as far as possible, a broken pavement, by making the slab uniform in strength throughout—strong enough to take care of stray loads as well as the more frequent ones. This condition is obtained, in our state roads, by thickening the edges until they are as strong as the middle.

One method suggested, in the Bates road reports, to protect the edges of pavement was to use curbs. These are used with city pavements, and although constructed for other reasons, they still may have this further use. But we cannot guarantee that heavy traffic will not run to the side of the street, and we would feel inclined to make the sides, as well as the middle of the street, strong enough to carry it.

There are however many features in city streets which call for more particular design. Slabs of uniform thickness are weakest at the corners and in city streets we may at times encounter corners which unquestionably will be subjected to maximum loads and maximum stresses. For example when a street-car track runs out a spur line, forming a terminus, there will be several pavement corners in the middle of the street.

The support of the subgrade in city streets would normally be better than in state roads, but the Bates road tests showed that owing to temperature changes causing the slab to warp, the pavement lifted clear of the subgrade. The amount of warping varies considerably with different types of pavement. How much this takes place in city streets should be ascertained by tests; it may be responsible for failures on a well prepared subgrade. In state highways, it is an important factor in design.

In short, the subject of city paving was not specifically within the scope of the Bates road tests, and the reports were not intended to discuss or compass it. Each pavement must be designed to meet its own peculiar requirements, and however much these individual requirements may vary, there will still be many properties in common to all pavements, and the designer of city streets may still benefit from the tests conducted at the Bates experimental road.

HADDON C. ADAMS,
Assistant Highway Engineer, Illinois
State Highway Commission.

Springfield, Ill.,
Oct. 1, 1923.

Further Discussion of Low-Head Pumps

Sir—I was, naturally, much interested in the letter by M. C. Steuber appearing in your issue of Sept. 20, p. 486, which I take occasion to answer because certain statements by Mr. Steuber are misleading and should be cleared up both to him and to your readers. I wish it to be understood that my statements herein are made only in the spirit of friendly criticism and are meant to bring out the facts clearly.

It is to be noted that in my article in the Aug. 9 issue, p. 230, I drew comparison with other pumps of the same size as my model, operating at equal capacities against equal heads. To those who understand the subject it is unfair to draw comparisons without taking account of all these factors. However as Mr. Steuber has drawn a direct comparison I shall take him up without any apology for size and make a direct comparison myself, as a very important feature was overlooked.

A very little study discloses the fact that the Malde pump described never gave a discharge velocity of over 5.1 sec.-ft. (usually called spouting velocity) and only gave this at 1-ft. lift and at 650 r.p.m., which I judge means a peripheral speed of 45.5 ft. per sec. of the impeller. The velocity head of the water only once reached .403.

The Malde pump showed 40 per cent at 3-ft. lift with a spouting velocity of 3.16 sec.-ft. whereas the rotary flow for the same conditions of lift and efficiency gave a spouting velocity of 7.6 sec.-ft. or 2.4 times as much as the Malde. At 5-ft. lift the Malde shows 39 per cent efficiency with a spouting velocity of only 3.5 sec.-ft., whereas the rotary flow shows 36 per cent with a spouting velocity of 9.7 sec.-ft. This is 2.77 times great as the Malde. At 6-ft. lift the rotary flow shows 39 per cent efficiency with a discharge spouting velocity of 9.2 sec.-ft., whereas the Malde with 38 per cent efficiency shows only 3.25 sec.-ft. Again, the rotary flow, for equal conditions of efficiency and head, gives a rate of discharge (spouting velocity) 2.84 times as great as the Malde.

This proves conclusively the superiority of the rotary flow without reference to the difference in size which I will now take up.

From a comparison of the friction losses in 4-in. and 16-in. pipe, using the figures for 100-ft. lengths in a standard table, it would appear that a 4-in. casing with a spouting velocity of 9.5 sec.-ft. should lose 31.6 times as much head due to friction as a 16-in. casing of equal length. Due allowance should be made for this in making comparisons.

A 16-in. pump at a 6-ft. lift and a spouting velocity less than 6 sec.-ft. should give not less than 80 per cent. It has been done. If the rotary flow under this low condition of capacity did not do as well I would be greatly disappointed.

The fault in the Malde pump, unfortunately, is inherent in the design; and, short of radical changes in this, it cannot be expected to give much higher efficiencies, especially if the rate of discharge is increased, in which case it would be expected to fall off.

With regard to the test curves, I will say for Mr. Steuber's benefit that though only two tests were shown, these are typical of twenty run under widely varying conditons.

The discharge characteritics were predicted, and so were the efficiencies and high speed and the horsepower curves and furnished no surprise on test. What did furnish a little surprise was the ability of the pump to operate with a pipe velocity of only 1.5 ft. per sec. on the higher lifts at a very high peripheral speed without cavitation.

While the Malde was not run at over 45.5 ft. per sec. peripheral speed, one incomplete test was run at 72 ft. per sec. peripheral speed with the rotary flow with an increased discharge but no other difference from other tests. This test was not finished because the writer lost his nerve at the sight of a 650 r.p.m. motor running 2,500 r.p.m.

I believe that the above covers all of Mr. Steuber's questions and I thank him for his interest in this subject.

EUGENE F. DELÉRY,
Design Engineer

New Orleans, La.,
Sept. 30, 1923.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Am. Soc. C. E. Board Acts on Davis' Dismissal

Special Committee Report Accepted Recommending Protest Letter Be Sent Dr. Work

Engineering News-Record Staff Report

Preceding the fall meeting of the American Society of Civil Engineers at Richmond, Va., Oct. 17-20, twenty-six of the twenty-eight members of the Board of Direction of that society on Oct. 16 took decisive action in the matter of the dismissal of A. P. Davis from the Reclamation Service. The Board accepted the report of a special committee composed of John F. Stevens and George S. Webster, recommending that a letter be sent to Secretary of the Interior Work protesting against his contention that an engineer is not competent to conduct administrative positions, and citing examples wherein engineers have become famous through their executive abilities. The letter will also demand from Secretary Work specific citations of the failure of engineers in reclamation work. It will probably also demand congressional action looking toward the assurance that an engineer will be responsible for government irrigation.

The Board of Direction may attempt, it was brought out, to bring about Congressional action looking toward the appointment of a many-sided technical commission to investigate and report upon the whole question of the development of the St. Lawrence River for power and navigation uses.

Earthquake Committee Formed

A committee to investigate the earthquake in Japan was appointed, to be headed by the following California members of the society: J. D. Galloway as chairman, C. H. Snyder, and C. B. Wing. It is probable that Japanese members will be added.

Definite action regarding the formation and activities of the proposed committee on cement was put over until the January meeting of the society. The report of the licensing committee was received but has not yet been adopted or made public. However, without indorsing the principles of registration, the Board recommended that in view of the many state laws the profession should indorse a uniform law, and the standing committee was authorized to prepare such a law.

New procedure decided upon for the professional conduct committee will be for the secretary of the society to prepare an unbiased brief in the matter of any professional dereliction brought to the attention of the society. The committee will then study the case and report confidentially to the Board, which shall then decide whether or not the case is to be made public.

Prizes for the past year were awarded as follows: Norman medal, D. B. Steinman, for paper on "Locomotive Loading for Railway Bridges"; James J. R. Croes medal, James F. Sanborn, for paper on "Engineering Geology of the Catskill Water Supply" (this was a joint paper written by Dr. C. P. Berkey and Mr. Sanborn, but as Dr. Berkey is not a member of the society, the award was made to Mr. Sanborn); Thomas Fitch Rowland prize, S. W. Peek, Jr., for paper on "High-Voltage Power Transmission"; James Laurie prize, R. W. Gausman and C. M. Madden, for paper on "Experiments with Models of the Gilboa Dam and Spillway"; Arthur M. Wellington prize (first award, the prize having been established in 1921 by *Engineering News-Record*), J. P. Newell, for paper on "Analysis of Cost of Freight Service, Grand Trunk Railway Co. of Canada"; Collingwood prize for juniors, Jacob Fels, for paper on "Accurate Experimental Determination of the Lateral Earth Pressure Together with a Resume of Previous Experiments."

Two honorary members were elected to the society, though neither has made formal acceptance of the election. They are Onward Bates and Desmond FitzGerald, both past presidents of the society.

Coming meetings of the society were arranged as follows:

1924: spring meeting, Atlanta, Ga.; summer meeting, Pasadena, Calif.; fall meeting, Detroit, Mich.

1925: spring meeting, Cincinnati, Ohio; summer meeting, Salt Lake City, Utah; and fall meeting Montreal, Que.

Flood Cuts Embankment of Oklahoma Reservoir

A flood of greater volume than the one which swept down the North Canadian River in Oklahoma last June and overtopped the dam of the reservoir of Oklahoma City has again overtopped the dam and embankments and has cut a channel 350 ft. wide through the embankment at the west side of the reservoir.

The Oklahoma City reservoir is located in the valley of the North Canadian River about eleven miles above the city. (For a description of the dam and of the flood of June, 1923, see *Engineering News-Record*, March 4, 1920, p. 478 and Aug. 23, 1923, p. 292.) The reservoir is formed by a reinforced-concrete dam and spillway and an earth fill dam with a concrete core-wall across the main channels of the river. A bypass channel and emergency spillways were provided to take care of floods. Beyond the west end of the earth fill dam is a low embankment protected along part of its length by a gunite mat. According to a report from C. E. Bretz, superintendent of the city waterworks department the crest of the flood was 27 in. above the top of the dam when the river started cutting through the embankment at the west end of the dam. A futile attempt was made to save the embankment by the use of sand bags.

The flood followed a rainfall of nearly 6 in. which started on Oct. 12. The embankment failed at 12:25 a.m. Oct. 16, 1923.

Army Camp Builders Demur to Fraud Indictments

Defendants Ask Cases Be Thrown Out Contending Indictments Charge No Crime

A demurrer to the indictments of Benedict Crowell, W. A. Starrett, C. W. Lundoff, Morton C. Tuttle, Clair Foster, James A. Mears and John H. McGibbons, charging conspiracy to defraud the government in connection with building army cantonments, was argued before Judge Hoehling, of the District of Columbia Supreme Court, during the first two weeks in October. The principal counsel for Mr. Crowell and his associates were Frank J. Hogan, of Washington, and Col. Henry L. Stimson, formerly Secretary of War under the Taft Administration. The government was represented by ex-Congressman McCullough of Ohio and W. T. Chantland, both of whom have been connected with the Department of Justice in the preparation of the indictments, and by U. S. District Attorney Peyton Gordon.

Ask Dismissal

The defendants combined in asking that the indictment be dismissed on the ground that it charged no crime, but based an allegation of fraud solely on the opinion of the present Department of Justice regarding the wisdom of a governmental policy; that is, the making of cost-plus contracts for the construction of the army training camps. Counsel defied the Department of Justice to indict Woodrow Wilson and Newton T. Baker, ex-President and ex-Secretary of War respectively, although quite obviously the crime charged against the defendants was equally chargeable against the heads of the administration. Col. Stimson, although a Republican, said that the indictment was obviously an attempt on the part of the present administration to transform a political difference of opinion into a criminal prosecution. He insisted that were the indictment of Mr. Crowell and his associates upheld no President would ever be free to exercise his function as Commander-in-Chief of the Army and Navy. If confronted with the emergency of war and the imperative necessity of prompt action, the executive would be compelled to appeal to Congress for specific authority for his every important act, to await debates and enactment, or else to act with the knowledge that a criminal indictment would hang over his head.

Ex-Congressman McCullough said that the crime consisted in the deceit of the responsible officers of the government, misrepresentation of material facts, resort to coercion, and finally the control and domination of the whole construction activities of the government during the war. The waste and delay due to the methods adopted might have been vitally contended had the nation been forced to exert its every effort to win the war.

Ford Muscle Shoals Offer Still Stands

Appeal to Farmers in Attack on Sale of Gorgas Steam Plant—Weeks Replies

In an attack on the Secretary of War for the sale of the Gorgas steam plant to the Alabama Power Co., Henry Ford stated that his offer to buy the Muscle Shoals development still stands. He accused the Secretary of War of favoring interests who opposed the use of Muscle Shoals for the manufacture of fertilizer when he sold the steam plant. He said in part as follows:

"Long ago Mr. Weeks matured in his mind the plan to break up Muscle Shoals and dispose of it piecemeal. When he sold the steam plant at Gorgas he pulled the first stitch in unraveling the greatest prospect ever held out to the American farmer and manufacturer.

"The next steps are so plain that a child can see them. It only remains to sell the gigantic nitrate plant No. 1, and then nitrate plant No. 2, and finally the Wilson Dam itself, and that is the end of Muscle Shoals as a possible demonstration of the cheapness with which power and fertilizer can be produced.

* * *

"The Ford Motor Co. never has needed Muscle Shoals. We have water-power sufficient for all our purposes. The only thing I could do at Muscle Shoals which I am not able to do elsewhere would be to make fertilizer for the farmer. And that is the sole reason why John W. Weeks and scores of corporation lawyers have exerted their cunning to prevent me. The same influences that prevented a vote in the House last Spring are responsible for the sale of the Gorgas plant to prevent a vote on Gorgas."

In repeating his offer to buy the whole development Mr. Ford made a statement regarding the use of the power which he has not made before, i.e., that power would be sold to the surrounding community. He said:

"My offer is still before Congress. I shall not withdraw it. There is nothing whatever for me to explain. There is nothing that John W. Weeks can explain, though he should talk from now until he leaves public life, but I want to say this: If I get Muscle Shoals we shall run power lines 200 miles in every direction from Muscle Shoals. We have been working and have learned how to send power long distances without losses by leakage. I say this now for the benefit of the international financiers, who, with the Alabama Power Company, have Muscle Shoals almost hopelessly in their grasp."

Secretary Weeks Replies

In reply to Mr. Ford the Secretary of War said:

"Muscle Shoals was a development for nitrate purposes in the war, which included the construction of a large dam on the Tennessee River, and the construction of two air-fixing nitrate plants, with large quarries, and as an adjunct to these plants, in order to supply power ending the completion of the water power dam, a steam plant was erected ninety miles away on the Warrior River, known as the Gorgas plant.

"The total expenditure on these properties was about $102,000,000 of which less than $5,000,000 was spent upon this isolated and temporary steam plant. The steam plant was erected on the property of the Alabama Power Company, which reserved title to the land on agreed conditions which gave to them the right to purchase the Gorgas steam plant.

"The proposals made by Mr. Ford for the purchase of this entire equipment involved the payment by him of $5,000,000 for the entire plant, including the above isolated and temporary steam plant. They also involved many other conditions with regard to the completion of the water power, etc. No disposal of government property can rightfully be made by any administrative officer without the approval of Congress, and I, as the responsible official in this matter, referred Mr. Ford's offer to Congress, which has so far not acted upon it.

"In the meantime the Alabama Power Company, under its rights in the old contract, notified the government that the lands must be vacated on or before Oct. 15 this year. They offered to pay $3,500,000 for this comparatively small item of the whole equipment. The government had an option to accept this offer, which was the highest made, or to salvage this plant as second-hand machinery, and from which they could not have realized more than $1,000,000. On the other hand, it must be borne in mind that for this single item in the entire equipment the government has secured $3,500,000 as against the $5,000,000 offered by Mr. Ford for the entire plant and equipment.

"At the time of the sale, in a desire not to disturb the *status quo*, the administration stated to Mr. Ford that this amount could be credited on his original offer of $5,000,000 if it was so wished.

"Mr. Ford's declared purpose in purchasing the Muscle Shoals is the manufacture of nitrates for fertilization purposes. I have never opposed Mr. Ford's securing the use of this water power or any other equipment we have, provided he is able to give such assurance of its being devoted to this particular purpose as will satisfy Congress and properly protect the public interest. That he could ever economically make nitrates by the use of steam power is denied by every expert adviser.

"The fact that he says his offer is still open would seem to indicate that he does not regard the Gorgas steam plant as necessary to him in the carrying out of his plan to purchase and develop Muscle Shoals water power."

Texas Plans Water-Works Course

A short course of instruction for water-works operators and engineers will be given at Waco, Texas, Jan. 21-26, 1924, covering waste water, water control, boiler room economy, filter plant operation, geology of underground waters and legal responsibilities. The course, of which this is the sixth year, is given under the auspices of the Texas Water Works Association, the Southwest Water Works Association, the Texas State Board of Health, the University of Texas, and Baylor University. Dr. W. T. Gooch, of the last named school, is director of the course.

Frederick L. Cranford Nominated to Head A.G.C.

Resolutions opposing "outside" inspection of work, declaring against extension of public ownership of utilities, opposing changes in the Transportation Act and endorsing the objects of the National Transportation Institute, and appointment of a committee to formulate a safety policy with the National Safety Council to be reported to the next annual convention, were among outstanding accomplishments of the quarterly meeting of the Executive Board of the Associated General Contractors of America at St. Louis, Oct. 4, 5 and 6.

Frederick L. Cranford, of Frederick L. Cranford, Inc., Brooklyn, was nominated by the Board for election as president at the next annual meeting. A. S. Downey, of Seattle, Wash., one of the partners of the A. W. Quist Co., was nominated for election as vice-president at large. Other nominations to fill offices in the association, secured by referendum among the member chapters, are to be announced later.

The time and place for the next convention were referred to a committee composed of President J. W. Cowper, General Manager R. C. Marshall, Jr., H. H. Wilson, A. S. Downey, H. W. Baum, Frederick L. Cranford and Sumner Sollitt. Some date in January probably will be selected and the choice of location apparently rests between Chicago and Washington.

Tylor Field, of Cincinnati, was named to succeed Col. J. R. Wiggins, of Philadelphia, as the Association's member of the Joint Board of Jurisdictional Awards in the Building Industry, Col. Wiggins having resigned owing to pressure of private business.

The Board voted $500 to assist the work of the Committee on Seasonal Operations. This committee, organized a few weeks ago at Atlantic City, will hold a meeting in Washington, early in November, at the Department of Commerce.

Connecticut to Spend $15,000,000 on Roads in Next Two Years

Close to $15,000,000 will be available during the next two years to carry on the work of the Connecticut State Highway Department, according to an estimate made public recently by the Department. This sum includes direct appropriations from the state and fees which the motor vehicle department receives from registrations, licenses and fines, in addition to the state tax on gasoline. The law requires that all fees from the motor vehicle department be used for the reconstruction and maintenance of trunk line highways.

The amount appropriated by the General Assembly for the highway department for the current two-year fiscal period aggregates $4,200,000. The remaining $10,000,000 it is estimated, will be received through the motor vehicle department.

Heretofore, receipts from the gasoline tax have been turned into the State Treasury direct by the motor vehicle department, but the recent session of the General Assembly, however, directed that this money be devoted exclusively to the betterment of the state's roads. It is estimated that the gasoline tax will produce $2,000,000 in revenue during the next two years.

Work's Friends Justify Davis' Removal

Again Charge Evils of Reclamation to Engineering Control—"Business Administration" Needed

A new flare-up in the controversy over the removal of A. P. Davis, as Director of the Reclamation Service, has followed the publication of articles in the Washington *Herald* attacking the Secretary of the Interior for his course in that connection, and in particular revealing the fact that on Aug. 17 an executive order was signed by President Coolidge only a day or two after he came to Washington as president exempting Director David Davis from the regulations of the Civil Service Act. This order was signed in opposition to the recommendation of the Civil Service Commission and was kept secret until the *Herald* uncovered it.

This has had the effect of stimulating friends of Secretary Work to take a more active stand in his defense. In substance this is what they contend:

"The full responsibility of making reclamation a decided success rests upon the Secretary of the Interior, a situation very distinct from that of a technical bureau having an organic act of its own. Secretary Work had been advised from so many quarters and from such reliable sources that the agricultural and business problems of the service were not being met, that he was convinced a radical change in policy had to be put into immediate effect if the service were to be saved from collapse. He had abundant proof that most of the projects were in a bad way. He realized that Director Davis could not be in full sympathy and could not give the maximum of co-operation in putting into effect policies substantially different from his own. Moreover Secretary Work had learned that a substantial number of those on projects had been antagonized to the point by Director Davis where all hope was gone of inducing them to pool together with him.

Employment of Engineers

"In his zeal to show the capacity of the engineering professions, Director Davis had carried the employment of engineers to a ridiculous extreme. Every important post in the service was held by an engineer as well as many of the minor positions. Even the ditch-riders were engineers. The business problems and the solution of the intricate questions of a non-engineering character long had been neglected. The reclamation projects had reached a point where they were experiencing the full effect of that neglect.

"There was no intention on the part of Secretary Work, however, to disparage the engineering work that had been done, under Director Davis' direction. He was particularly anxious that reclamation continue to have the advantage of Mr. Davis' engineering ability and knowledge of its engineering problems. For that reason, he tendered him the position of consulting engineer.

"When the matter of change of policy was taken up with Director Davis by Secretary Work, the entire conversation was an amicable one. Mr. Davis even remarked that there would be less trouble getting rid of him than was the case with Dr. Newell. A second conference took place over the form the resignation should take. Secretary Work had objected to the featuring of the fact that the resignation was tendered at his request. He felt if they were to continue to work hand-in-hand in the interest of the service, a better way of phrasing the letter could be devised. This conversation apparently was on the same friendly basis as the former one, but shortly thereafter he seemed to have developed a brainstorm which led to the final stormy interview with Secretary Work.

"The engineering end of reclamation work is not being neglected. F. E. Weymouth, whose ability is universally admitted, now is chief engineer in fact as well as in name. There will be no interference with his free exercise of authority over engineering matters.

"It is no more necessary to have an engineer in charge of all reclamation activities than it is necessary to have a surveyor as the Commissioner of the General Land Office. The chief activity of the Bureau of Indian Affairs is the conduct of schools, yet it is not regarded as essential that only school teachers be eligible to the post of commissioner.

"The much discussed executive order of Aug. 17 is simply a presidential appointment to harmonize the appointment of D. W. Davis with the appointments of his predecessors. The activities of the National Civil Service Reform League smacks of first aid for the Democratic Party. All of its representatives who have called on Dr. Work have admitted affiliation with that party. A. P. Davis was not killed. He committed suicide."

Latin-American Road Engineers May Visit U. S.

Before calling the Pan-American Road Congress, authorized at the Santiago meeting of the Pan American Union, it would be desirable, in the opinion of some of those interested in the matter, to bring to the United States a road building engineer from each of the Latin-American countries. This was developed at a conference at the Department of Commerce October 5, attended by Assistant Secretary of Commerce Drake; Director General Rowe of the Pan American Union; Secretary General Sherwell, of the Inter American High Commission; Thomas H. McDonald, Chief of the Bureau of Public Roads; Pike Johnson, president of the National Automobile Chamber of Commerce, and Eugene S. Gregg, chief of the division of Transportation and Communication, Department of Commerce.

Since the motor vehicle industry was the only outside activity represented at this conference, a further meeting is to be held early in November at which it is expected others concerned will be present.

The thought was expressed that impetus would be given the congress idea in the various countries, were their principal engineers dealing with highway matters brought to the United States and acquainted with the progress of highway work here. They then would be in a better position to organize the participation of their respective countries in a congress which would be held at a later date, probably in some Latin-American city.

Secretary Hoover Calls Super-Power Conference

The New England and Middle Atlantic States to Co-operate — Should Develop St. Lawrence Power

At a conference of the chairmen of the various public service commissions of the New England and Middle Atlantic States, and the Secretary of Commerce held in New York City on Oct. 13, the Secretary said that the conference was called for a preliminary discussion of the co-operative steps which federal and state authorities should take to promote what is called the super-power development in the New England and the Middle Atlantic States; that the conference was not conceived with the idea of putting more government into business, but to stimulate the public authorities and industries toward co-operation in the development of a great service to the public. The Secretary said that engineering science has brought us to the threshold of a new era in the development of electric power. This new stage in progress is due to the perfection of high voltage transmission over long distances and the more perfect mechanical developments in generation of power whereby we can now undertake to develop the cheaper sources of power farther afield, such as the St. Lawrence River, and the cheaper generation from coal through larger and more favorably placed generation plants.

Three Problems

In summing up his remarks Mr. Hoover said that there were three outstanding problems which called for solution before a great super-power system could be set up in the New England and Middle Atlantic States. These problems were (1) The legal relation such as the inhibitions against the import or export of power across the boundaries of certain states; (2) the engineering features such as the changes in frequencies necessary to make such a free flow of power possible; and (3) the promotion of co-operation between the federal government and the states over the development of interstate power or power on navigable streams and over the means of developing the St. Lawrence River, which power Mr. Hoover thinks should be developed and poured into the common pool.

After the delegates to the conference had expressed their general sympathy with the aims of the conference and their willingness to co-operate with Mr. Hoover, he proposed that a second conference be called in about a month or six weeks at which time the public utilities and chambers of commerce throughout the territory should be asked to send representatives. In the meantime, in order that the next conference might be in a position to take more definite action, the Secretary stated that he would, through conference with the various members, prepare a program and appoint sub-committees to handle the various questions; that his office would send out the program to the members of the conference for such additions or changes as they thought desirable in order that much of the routine might be cleared away before the conference met. Mr. Hoover hopes these conferences will arouse public interest in super-power systems.

Public Health Association Holds Annual Meeting

Fifty-Second Session Well Attended—Nine Technical Sections Convene—Dr. Park New President

Engineering News-Record Staff Report

A large attendance and a well ordered program were features of the fifty-second annual meeting of the American Public Health Association at Boston, Oct. 8-11. Besides the two general meetings on Monday and Wednesday evenings, the nine technical sections held from one to three meetings each. In general, the afternoons were left free for visits of inspection to sanitary engineering services and works in and about Boston. The Sanitary Engineering Section, for instance, devoted one afternoon to a trip to plants for the treatment of paper mill and tannery wastes on the Neponset River, and another afternoon to a visit to the old and new sewage-works of Worcester, automobiles having been provided for the party in each case.

The newly chosen president of the association is Dr. William H. Park, of the Health Department of New York City, and the first vice-president is Dr. F. H. Mahoney, health officer of Boston. The new chairman of the Sanitary Engineering Section is H. A. Whittaker, director, Division of Sanitation, Minnesota State Board of Health, Minneapolis, and the new vice-chairman is Langdon Pearse, sanitary engineer of the Sanitary District of Chicago. G. W. Simonds, Jr., director of the Bureau of Sanitary Engineering of the Florida State Board of Health, Jacksonville, Fla., continues to serve as secretary of this section.

Committee Reports—The Committee on Air, Dr. George A. Soper, New York City, chairman, secured the general approval of the section subject to availability of funds and authorization of the governing authority of the association, for the preparation of a comprehensive report, estimated to run about 130 pp., dealing with the air both inside and outside of buildings, including garbage- and sewage-works and other plants that may disseminate offensive odors. The report of the Committee on Mosquito Control, together with discussions from various viewpoints, reviewed progress of work in this field. Emphasis was laid on the need of better machinery for digging the 10-in. trenches common to meadow drainage for mosquito control. It was stated that a ditcher is needed that is self-contained and that will be able to break up the sod so that it will not be washed about over hay lands at high water. The Committee on Bathing Places, through George W. Simonds, Jr., chairman, reported that several states have already adopted the tentative standards set up by the committee. The committee strongly believes that methods of analysis suitable for potable water are not well suited for the control of bathing places, but advises for the present the continued use of the A.P.H.A. standard of water analysis.

Garbage and Refuse Disposal—M. N. Baker, chairman of the committee on garbage collection and disposal, laid stress on the unsatisfactory condition of garbage disposal, which he considered to be the least satisfactory of any of the municipal public services today. This he attributed largely to the fact that garbage and refuse disposal is not generally regarded by city authorities as an engineering matter. A paper on the Beccari system of garbage disposal was presented by J. Waldo Smith, consulting engineer, Board of Water Supply, New York City, who is also president of the American Beccari Corp. Information was presented regarding several Beccari plants in Italy (see *Engineering News-Record* of Feb. 15, p. 324). Briefly, this is a fermentation system of garbage disposal, the garbage being deposited in cells of about 25 cu.yd. capacity, four cells comprising a unit. In the colder parts of the United States it would be necessary to provide not only a cover for the cells but also a roof over the cells as a whole. A Beccari installation of two units is being installed at Scarsdale, N. Y., and will be in operation the latter part of this month. In discussing this paper, George W. Fuller remarked that he had recently seen the Beccari plant at Florence, Italy, which plant seemed to be operating satisfactorily. Mr. Fuller stated that the process seemed to him to be a most interesting development of a rotting process similar to that applied to barnyard manure. He is somewhat skeptical as to the amount of oxidation that would result from the entrance of air through the openings provided for that purpose. The refuse being treated at Florence seemed to be mixed material, including manure. Apparently the process at least for some days was due to anaerobic action. Besides taking part in this discussion, Mr. Fuller presented a paper on "European Observations on Refuse Disposal," an abstract of which will appear in a later issue.

For the Committee on Water Supply and Purification, George W. Fuller presented a general survey of the field, in the course of which he called attention to new filters or extensions to old filters under construction at Philadelphia, Baltimore, Richmond, Grand Rapids, Minneapolis, Milwaukee, Detroit, Cleveland, Buffalo, Montreal and numerous smaller cities. Because "superchlorination seems likely to come into wider use," said Mr. Fuller, "especially for unfiltered supplies and for supplies which are filtered under conditions permitting plankton growths to exert an influence on the water as it reaches the consumer, it is well to bear in mind that the excess of chlorine may be removed by reducing agents, such as sulphur dioxide, thiosulphate, etc."

Sewage Sludge Committee—The report of the sludge committee, by Langdon Pearse, Chicago, reviewed progress and practice in sludge utilization at Milwaukee, Chicago, and elsewhere. The Milwaukee Sewerage Commission reports that T. Chalkley Hatton, chief engineer, has appointed a fellow to the agricultural college of the University of Wisconsin, who is devoting his entire time to the use of sludge in agriculture. The value of activated-sludge in comparison with various mixes of commercial fertilizers is being studied on a number of different crops at various experimental farms, on golf greens, etc., in Wisconsin. The co-operation of the National Fertilizer Association in the study of this general subject has been obtained. The Sanitary District of Chicago, stated Mr. Pearse, has interested a number of agricultural experiment stations in making tests of the fertilizing value of sludge. Work is now under way on cotton in Mississippi and on garden plants at the University of Illinois. From Baltimore, it is reported by Milton J. Ruark, division engineer of sewers, that the entire sludge production for the year 1922, which was about 5,400 tons on a dry basis, was either dried by heat in a contractor's plant or on drying beds, air drying on the beds being used exclusively the latter part of the year. The farmers take away all the air dried sludge but for more than a year no charge for it has been made by the city. In co-operation with the Agricultural Experiment Station of Baltimore nine acres of land have been laid out in six sections of one-half acres each, and each section divided into six plots of one-fourth acre each, for comparative studies of liquid digested sludge, air dried sand bed sludge, commercial fertilizer, commercial fertilizer and dry sludge and manure, while as a control one plot has been given no treatment. During the year 1922 the preparation of air dried sludge cost 66⅔c. per ton. Sludge utilization at Rochester, N. Y., and Houston, Texas, was also reported by Mr. Pearse.

A review of "Thirty Years of Sewage Treatment at Worcester, Mass.," was presented by Roy S. Lanphear, supervising chemist of the Sewer Department. Chemical precipitation has been used since March, 1890, supplemented by slow sand filters since 1893, the acreage of the latter having finally been extended to about seventy-five. Imhoff tanks and sprinkling filters are now under construction.

Under the title "Observations on the Pollution and Natural Purification of the Ohio and Illinois Rivers," W. H. Frost, surgeon, U. S. Public Health Service, Baltimore, Md., reviewed studies begun in 1913, interrupted in 1917 by the war, and again carried on during the past two years. Besides their local application the object of the studies "has been to investigate the possibility of establishing closer, more general and more fundamental correlations between the degree of pollution in streams as shown by laboratory tests and such obvious contributing factors as are readily determinable by field surveys."

Treasury Water Standards — The standards for water supply to trains and steamships in interstate commerce, commonly known as the Treasury Standards, were discussed at length by representatives of the United States Public Health Service and members of the Sanitary Engineering Section. George W. Fuller raised a question as to whether there would be taken into account, in addition to the proposed B. Coli index, all the antecedents of the supply. He suggested setting up a standard higher than the present one with the understanding or hope that it might be attained within the next ten years. He also noted that abroad standards are set up with the understanding that exceptions will be made for certain places to suit local conditions.

Speaking for the Field Survey Sub-Committee of the Public Health Service's Advisory Committee on Water Standards, Prof. George C. Whipple said that much time had been spent trying to meet the ideas of some to the

effect that a scoring system for water supply should be devised. This has been given up. The committee is now considering five classes or ratings of water supply: Excellent, good, fair, poor and bad. Professor Whipple stated that his idea is that no water supply should be approved unless a sanitary survey shows it to be satisfactory. If the supply passes the sanitary survey, then bacterial and chemical data should be considered and the supply accepted or rejected after consideration of all three classes of evidence. There should be for every supply either satisfactory means of purification or else purification should not be needed. No supply should be approved if the sanitary survey shows any one of a number of major deficiencies, including such things as interconnection with possible polluted supplies, overloaded filters or by-passes around filters.

A progress report was made for the sub-committee on Chemical and Physical Standards, the report being presented by Jack Hinman of Iowa in the absence of Edward Bartow, chairman, who holds that satisfactory supply should be clear, colorless, odorless, tasteless, have certain specified chemical limitations, particularly as to lead, zinc and magnesium. Dr. H. A. McLaughlin of the Public Health Service expressed the opinion that many of the chemical and physical standards proposed by the committee were beyond the scope of the Treasury Standards.

In the course of the discussion Harry Jordan, sanitary engineer, Indianapolis Water Co., urged that there was danger of the new standards being put so high as to embarrass many water-works plants and Abel Wolman reviewed objections along this line made by representatives of a number of water-works. Mr. Wolman's conclusions seem to be that a very considerable percentage of the water-works of this country could readily meet the proposed new standards. Dr. William H. Park of New York City expressed the belief that in the New York City supply there was present a large margin of safety—this supply being one of these that have not been complying with the existing or Treasury Standards. Dr. M. J. Rosenau of Harvard University called attention to the fact that the old chemical standards as well as the present bacterial standards are based only on index of pollution.

Dr. McLaughlin said that it is hard to get down in words any directions for correlating bacterial and field surveys, but expressed the belief that as a matter of administration there would be no difficulty in such correlation.

Pacific Highway Links Completed

Good roads enthusiasts of the state of Washington will celebrate on Oct. 23-25 at Olympia completion and official opening of the last links in a 700-mile paved highway which stretches from British Columbia to the California-Oregon state line. When California completes a 114-mile gap, the Pacific Highway will be hard-surfaced from Vancouver, B. C. to Tia Juana, Mexico, and will be the longest international paved road in the world. Officials and good roads advocates from British Columbia, Oregon and Washington will take part in the exercises.

Random Lines

We Nominate Dr. Work for Dean of the College

Young men complain that the learned professions are overcrowded. We shall endeavor to earn their gratitude by suggesting to them a new avenue for their energies.

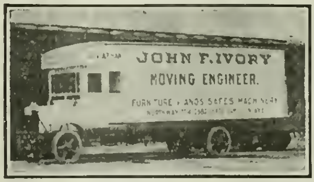
We believe there is a large field and rich rewards for the college graduate who will take up the profession of *political engineering*, which will lead to the universities conferring the degree of Bachelor and Master and result in qualified graduates only being retained as the advisers of political condidates. We must do in politics what we have done in architecture, mechanics, chemistry, all the various activities of life, to the advantage of all concerned. Our present methods are inefficient, wasteful, unscientific; we would put the business in the hands of experts, men trained in their profession, and save the candidates money and the people much trouble.—From the political correspondence column of the New York *World*, "The Looker on in Washington."

* * *

A New Batch

—Rose Brothers Co., *Wrecking Engineers*, Fort Humphreys, Va.

—*The Life Saving Engineer;* another name for the "safety engineer."



—*Motion Picture Engineer*—The Society of M. P. E. meets in convention in Ottawa.

—*Police Signaling Engineer*—A new highly specialized branch.

* * *

Concrete vs. Masonry; An International Analogy

From the speech of David Lloyd George, at Montreal.

"I have just come from your great neighbor. Their problem is a different one from ours. Their problem is to weld all those races into one common pattern. Their business is to do what you see those great machines do when they are making concrete—crush the rocks into the same size, the same pattern, weld it together by some substance that attaches and makes cohesion. There you have got to make the concrete, attach it by a common nationhood so as to make one solid nation of an infinite variety of types. That is the problem of the United States.

"Our problem is a problem of hewing rocks of granite or marble out of different quarries; of fashioning them, shaping them, putting them into the building—each separate block contributing its strength to the building, each contributing its color, its beauty, so that the whole will be a fabric of infinite strength and exquisite beauty—that is the British Empire."

Philadelphia Authorizes Huge Municipal Loan

People Will Vote November 6 on Bill Providing for Expenditure by City of $71,000,000

At a recent meeting of the Philadelphia City Council a municipal loan of $71,000,000 was approved to be submitted to vote of the people at the election on Nov. 6. The loan is provided in two bills, one for a loan of $3,000,000 to be made in 15-year bonds to cover short-life works, and the other for $68,000,000 to be made in 50-year bonds and to provide for works of permanent character. Items provided in the fifteen year loan are: Street and road paving and repairing, $2,400,000; extension of police signal system, etc., $440,000; refund of money appropriated from current funds for improvement to the Institution for the Feeble Minded, $160,000.

Chief among municipal improvements provided for by the 50-year loan are the construction of the first step in the recently approved high-speed transit system for the city, and the completion of the Delaware River Bridge. The complete list of items in the loan follows:

Completion of Delaware River Bridge...	$5,623,000
Broad Street subway, with Ridge Avenue, Eighth, Walnut, and Chestnut St. subway, and Woodland Ave. elevated........	15,000,000
Surface car subway in Chestnut St., connecting to Delaware River Bridge....	10,000,000
Surface car line from Frankford "L" terminal........	750,000
Harbor improvements........	2,000,000
Sewage disposal plant........	9,000,000
Water supply system........	6,000,000
Street improvements........	500,000
Free library buildings........	1,000,000
Construction of sewers........	3,300,000
Construction of city bridges........	500,000
Construction of City Hall annex........	2,000,000
High-pressure fire service extensions.....	200,000
Art museum construction........	2,000,000
Street damages, etc........	5,077,000

The bills for these loans had been passed by City Council at a previous meeting and submitted for action of the Mayor. The Mayor returned them to Council unsigned, stating that he considered the provisions for city transit to be unduly favorable to the Philadelphia Rapid Transit Company, and that he did not approve of the provisions made for the City Hall Annex because another site is already owned by the city on which it had been contemplated to erect such a structure. The bills were repassed by City Council without action by the Mayor and were ordered to be submitted to vote of the people at the general election on November 6, 1923.

Sir Henry Maybury Invited to U. S. by Highway Officials

Sir Henry Maybury, the British road authority, has been invited by the American Association of State Highway Officials, the Highway Education Board, the American Road Builders' Association, and the Highway Research Council, to come to the United States to discuss plans for the proposed English-speaking road congress, which it is hoped to hold in the United States in 1926. Some of those who attended the Congress in Seville this year were convinced that more headway could be made at an assemblage of that character when a common language can be used.

Dean Cooley Resigns as Federation Head

Ill Health Cause—Executive Board Authorizes Action in Dismissal of Former Reclamation Head

Announcement of the resignation as president of the Federation of Dean Mortimer E. Cooley, authorization of a protest letter to be sent Secretary Work for his dismissal of A. P. Davis from the Reclamation Service, and reports and action upon licensing and government reorganization, were features of the session of the executive board of American Engineering Council of the Federated American Engineering Societies held at Rochester, N. Y., Oct. 11. Dean Cooley is retiring because of ill health. He has been granted a leave of absence from the University of Michigan for the second half of the 1923-1924 academic year. As his term as president of the Federation does not expire for another year it is probable that action will be taken whereby the beginning of the two-year tenure of the new president will begin in 1924, thereby making it unnecessary to select a president to fill the unexpired term.

REPORT ON DAVIS DISMISSAL

Chief among committee reports was that of the Committee on Public Affairs, details of which outlined herein were authorized. It recommended that "a strong and dignified letter be addressed to Secretary Work commenting upon his letter of Aug. 14" which should bring out the following points:

1. That "an engineer and business man are not necessarily two distinct individuals, that a man with engineering training can be an excellent business man, and that, particularly in operations where engineering plays a large part, the executive or business man is more capable of filling the position if he has an engineering training."

2. That Secretary Work is "wrong in assuming that as soon as a project is finished, or supposed to be finished, its engineering aspect ends, and that then it is purely a business proposition." The letter should also state, the committee recommended, that reclamation is an ever continuing engineering matter.

3. That objection should be registered against the dismissal of any engineer or technical employee occupying "an important and responsible position" arbitrarily and "without a hearing at which charges may be brought against him and which he may have an opportunity of refuting."

In addition to this letter the committee recommended that a congressional investigation be made of the Davis-Davis matter and that it would probably be advisable for all constituent members of the Federation to acquaint members of congress in their respective communities with the underlying facts. The committee refrained from approving or disapproving the fact-finding commission which Secretary Work has appointed to get reclamation facts, inasmuch as members might have to appear as witnesses before the Work commission, or that the dismissal of Mr. Davis might not be considered at all by the commission.

In connection with the Davis matter, the Public Affairs Committee which had met a few days previous to its report in joint session with a special committee from the American Society of Civil Engineers, reported upon information given on reclamation and irrigation matters by Frank C. Wight, managing editor of *Engineering News-Record*, who explained the scope and broad content of the series of articles which this journal starts next week on reclamation.

The committee on Public Affairs also recommended that no action be taken at this time relative to the trial of so-called war-fraud contractors and engineers. Discussion of action on the Public Health Service led to the conclusion that it would be inadvisable to take action, owing to the strong belief among committee members that investigation of public health was not an engineering matter.

DEPARTMENT OF PUBLIC WORKS

The Executive Board of the Council passed a resolution urging that the president of the Federation be authorized to appoint a special committee to "draft and have introduced into Congress a bill carrying into effect the portion of the reorganization plan" now before that body and prepared by the Joint Committee of the House and Senate. This action is in line with previous action on the part of certain engineering societies for the establishment of a national Department of Public Works, which should include all the engineering functions of the reorganized Department of the Interior, as contemplated in pending legislation. The Council, however, expressed regret at the delay in pushing the legislation, so put into resolution form its desire to consolidate engineering backing of a public works department.

The Publication Committee reported that wide publication had been secured in the public prints for the activities of the Federation, and that it was impossible to get advertising for the Federation's bulletin with its limited circulation.

Calvert Townley reported for the special committee on Revision of the Constitution that it was considering a simplification of the name by leaving out the word Federated, making it American Engineering Societies, and calling the American Engineering Council simply the Council of the American Engineering Societies. There was a lengthy discussion as to the possibility of considering affiliation of local societies at a reduced cost per capita through state representation at the January meeting of the Council, but it was finally decided that a more deliberate course would be preferable.

LICENSING OF ENGINEERS

The report of the committee on Registration of Engineers occasioned a long debate. The model law drawn up by the committee, of which Gardner S. Williams is chairman, and submitted at the St. Paul meeting, is still being circulated for suggestion and comment. The mining and the chemical engineers object to any model law, urging that even if the expressed attitude of the F.A.E.S. is against registration the attempt to insure sanity and uniformity in states where it is inevitable by offering a law which is least objectionable will be misunderstood.

The next meeting of the Council of the Federation is set for Jan. 10 and 11 at Washington.

Recommends Safety Provisions in Federal Activities

That safety conditions in the federal service are behind the times was stated in a letter to President Coolidge made public by the Federated American Engineering Societies, the writer being M. G. Lloyd, chief of the Safety Section of the U. S. Bureau of Standards, and acting president of the American Society of Safety Engineers. The Executive Board of the Engineering Foundation, of which Mr. Lloyd is a member, has sanctioned a program for safety provisions in the activities of the government. Mr. Lloyd in calling attention to the recent disaster at the Bureau of Standards states that the American Society of Safety Engineers took cognizance two years ago of the lack of safety provisions and passed a resolution at that time. Also, a resolution was recently passed by the American Engineering Council of the Federated American Engineering Societies. Mr. Lloyd asks President Coolidge to include in his next message to Congress a recommendation for legislation which will establish in the federal departments adequate accident-prevention measures such as have been already recommended by the Congressional Joint Committee on Reclassification.

Engineers to Aid Seattle Chamber

The Seattle Chamber of Commerce has appointed a board of engineers to co-operate with and advise the industrial committee of the chamber, and compile information relative to the expansion of industry in the city. James E. Blackwell, city engineer of Seattle, is chairman of the board, and other members include: A. M. Young, structural engineer; E. L. Webber, consulting engineer; George Jamme, mining engineer; A. A. Miller, electrical engineer; A. L. Knisely, chemical engineer; and Joseph Jacobs, consulting engineer.

An important activity of the board will be to compile information relative to indutries for which Seattle offers particular advantages. Heretofore, this information has been compiled at intervals by specialists hired by the chamber, and such information, while satisfactory at the time, soon became out of date. The new board will be at the service of the committee to provide any character of industrial or engineering information required.

Iowa Water Works Men to Meet

The Iowa Section, American Water Works Association, will meet Oct. 21, 25 and 26 at Ames and Boone, Iowa. Nebraska, Missouri and South Dakota are included in this section. Fifteen papers, a round-table discussion, a joint session with the Ames Engineering Society and Ames Chamber of Commerce and an inspection of the water plants of Ames and Boone are scheduled. The papers will cover bacterial content, well water, geology of water supply, records, supervision, publicity, finance and fire insurance in addition to a description of four Iowa supplies. A sewage disposal conference of Iowa operators Oct. 22 and 23 will precede the water-works meeting.

St. Louis Zoning Ordinance Held Invalid by State Court

The Supreme Court of Missouri in a four-to-three decision handed down on Oct. 6 held that the St. Louis zoning ordinance is invalid on the ground that it is not an authorized exercise of the police powers granted the city by the state. The main opinion, written by Judge Robert F. Walker, was in the case of the Penrose Investment Co., which sued to compel James N. McKelvey, director of public safety, to issue a permit for the erection of an ice-making plant. Other suits included in the decision were brought by parties who had been refused permits for a junk shop and for an apartment house, the latter to face on Forest Park. If the city fails to get a re-hearing it will appeal the suit to the United States Supreme Court.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga., Nov. 12-16.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Meeting, Washington, D. C., Nov. 13-15.

AMERICAN ROADBUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 14-18.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich. Annual meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

The California Section of the American Water Works Association will hold its fourth annual convention in Fresno, Oct. 25-27. Interesting features will be an automobile trip to the Kerckhoff dam and power house of the San Joaquin Light & Power Corp., and, on invitation of the Bureau of Sanitary Engineering of the State Board of Health, a visit of inspection to several sewage-disposal plants in the vicinity of Fresno.

The Engineers' Club of Trenton, N. J., at its meeting Oct. 11 enjoyed an illustrated talk on "The New York and New Jersey Vehicular Tunnel" by Colonel Frederick A. Snyder, assistant engineer of construction on the tunnel.

The Texas Section of the American Society of Civil Engineers recently held its fall meeting, electing officers as follows: President, H. A. McKenzie, of the McKenzie Construction Co., San Antonio; vice-presidents: John A. Morris, State Board of Water Engineers, Austin, and J. C. McVea, city engineer, Houston; and secretary-treasurer, E. N. Noyes, Myers & Noyes, construction engineers, Dallas.

Harvard Engineering Society, Undergraduate Section, was addressed Oct. 13 by Frank C. Wight, managing editor of *Engineering News-Record*, on "The Imperfect Art of Engineering."

The Iowa Section of the American Water Works Association will have its annual meeting Oct. 24-26 at Ames and Boone, Iowa, with meetings at Iowa State College at Ames and inspection of the water works at the two towns. Members of other state sections will be made welcome.

The Colorado Scientific Society had as a recent speaker D. W. Brunton, chairman of the board of consulting engineers for the Moffat tunnel, who spoke on the problems contemplated or likely to arise in the boring of the tunnel. He also pointed out that when the Moffat tunnel is completed, if the Denver & Rio Grande Western R.R. will build the "Dotsero cutoff," about 42 miles of track, the distance from Denver to Salt Lake can be shortened by 174 miles.

Personal Notes

L. F. SCOTT, who is now assistant highway engineer with the U. S. bureau of public roads with headquarters at Chicago, was formerly division engineer with the Kansas Highway Commission at Fort Scott, Kan.

D. D. MICKEY has resigned as resident engineer of federal-aid projects in Linn County, Kan., and has entered the employ of the U. S. Bureau of public roads with headquarters at Omaha, Neb.

A. V. MILLAR, professor of engineering at the University of Wisconsin, Madison, has been appointed assistant dean of the college of engineering, University of Wisconsin.

EINAR G. ALMQUIST, lieutenant of the Royal Corps of Engineers of Sweden, is making a tour of the United States with a view to gaining practical experience about engineering construction in this country, particularly with reference to road and bridge construction. He has spent several weeks in Philadelphia working as carpenter's helper on the construction of the anchorages of the Delaware River Bridge.

W. A. MACLEAN, deputy minister of highways for Ontario, has resigned and is succeeded by S. L. SQUIRE, who has been prominent in connection with the good roads movement.

LLOYD ALDRICH, who had charge of the concrete test highway at Pittsburg, Calif., has opened an office as consulting highway engineer in Los Angeles.

HORNADAY CONSTRUCTION CO., municipal contractors and engineers, Memphis, Tenn., announce a local change of address from 1261 Central Ave. to 388 Shrine Bldg., Memphis.

R. H. HOWARD, chief engineer of maintenance-of-way, Wabash R.R., has been appointed chief engineer, succeeding A. O. Cunningham, appointed consulting engineer. The two former positions have been consolidated.

M. F. LONGWILL and J. J. BAXTER, division engineers of the Wabash R.R., have been appointed assistant chief engineers in charge of the eastern and western districts respectively.

S. W. FREESE, associated with John B. Hawley, Ft. Worth, Tex., a hydraulic engineer, has been given a year's leave of absence to take a master's degree in engineering at Trinity College, Cambridge University, England. Mr. Freese is a graduate in civil engineering from Massachusetts Institute of Technology and had previously attended Southern Methodist University at Dallas.

GEORGE O. BUTLER, C. A. BARNETT, and ALEX O. TAYLOR have formed a partnership, known as Butler, Barnett & Taylor, in West Palm Beach, Fla., for the practice of engineering. All three were recently on the W. J. Conners Highway as chief engineer and division engineers, respectively.

W. F. HUPP, Massena, N. Y., formerly assistant superintendent on highway construction for the Shepherd Construction Co., has accepted a similar position with the Henry P. Burgard Co., Buffalo, N. Y.

LEWIS BERRY, Herington, Kan., has severed his connection with the Moreno-Burkham Construction Co. of St. Louis to become filtration plant superintendent with Burt & Tripp Construction Co.

H. S. ANDREWS, formerly bridge designer for the Long Island R.R. and residing at Jamaica, N. Y., has been appointed commissioner of public works at Fulton, N. Y.

G. F. HATCH, formerly assistant engineer of the city of Portland, Maine, has been made assistant engineer of the Pitometer Co., New York City, for work on water-waste surveys.

Obituary

HAROLD W. YOUNG, 36 years of age, assistant engineer on the Southern Pacific R.R. Natron cutoff project near Klamath Falls, Ore., came in from the project Oct. 9 and later was found dead in a hotel in Klamath Falls, shot through the head, with every indication of suicide.

J. H. PATTON, assistant division engineer of the Union Pacific R.R., with headquarters at Salt Lake City, Utah, was killed Oct. 11 near Medicine Bow, Wyo. With a companion he was riding on a "speeder" making an inspection. A freight train caught them, crushing the car, killing Mr. Patton and seriously injuring G. R. McDougal, his assistant. Mr. Patton was 24 years of age.

RALPH PETERS, president of the Long Island R.R. since 1905, died suddenly of heart disease Oct. 9 at his home at Garden City, L. I. On Nov. 19 he would have reached his 70th birthday and retired. Mr. Peters was born in Atlanta, Ga., a son of Richard Peters, pioneer railroad builder, and was a graduate of the University of Georgia, class of 1872.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Japan Places Large Orders for American Lumber

At least a full month earlier than had been expected by Northwest lumbermen, Japan has placed initial orders for 80,000,000 ft. of North Pacific Coast lumber for reconstruction purposes. The order is largely for squares and "baby" squares, indicating that Japanese saw mills are not all out of commission. A quantity of the order was for lumber of ordinary mill stock sizes which, until next April, can be sent into Japan duty free under an emergency tariff suspension rule. The effect of the Japanese orders will undoubtedly be to strengthen a market already strong and to stimulate production by the mills. Labor supply is reported adequate for the increasing demands and at present there is no log shortage.

Report of the Pacific Northwest Lumber Inspection Bureau for the first six months of 1923 shows that cargo shipments of lumber from Pacific Northwest ports have exceeded those of the same period of 1922 by more than 11 per cent and have set a new record.

Electrical Equipment Orders for Japan Exceed $1,000,000

The Westinghouse Electric International Co. has received orders for electrical apparatus to be used in reconstruction work in Japan totaling well over $1,000,000. Other orders are in course of negotiation which will bring the total amount to approximately $2,000,000. It is understood that the power plants in the quake zone were not seriously damaged but that the distribution systems were practically destroyed.

Portland Cement Association Sends Investigator to Japan

Homer M. Hadley, district engineer in charge of the Seattle office of the Portland Cement Association, sailed Oct. 5 for Japan to investigate results of the earthquake on Sept. 1 upon modern structures, particularly those consisting largely of reinforced concrete. Mr. Hadley will probably be absent three months at least, although it is expected he will be able to cable a condensed preliminary report soon after his arrival.

Mr. Hadley's structural experience was gained with a number of the foremost Pacific Coast engineering firms.

American Motor Trucks Shipped to Aid Japanese Restoration

Shortly after wire communications had been established, following the Japanese earthquake, cabled instructions were received in this country for the shipment of American motor trucks. The first consignment of Pierce-Arrow machines has already been made and a second shipment is about to leave.

Asphalt Simplification Effective Jan. 1

Commerce Department Announces Endorsement of 10 Varieties by Consumers and Producers to Reduce Waste

After January 1, 1924, "Too many asphalt grades" no longer will be the complaint of public highway officials, engineers, contractors, and producers, the Department of Commerce having announced that upon that date the recommendations adopted at its recent asphalt paving conference will become effective and asphalt grades for use in

(I) For construction of Sheet Asphalt, Asphaltic Concrete, and Asphalt Macadam Pavements, and also for Surface Treatment.

Penetration Limits

25 to 30	50 to 60	100 to 120
30 to 40	60 to 70	120 to 150
40 to 50	85 to 100	150 to 200

(II) For Joint Filler for Various Types of Construction.

Penetration Limits

30 — 50	60 — 70
50 — 60	85 — 100

The first is used primarily for brick pavements, and does not require the admixture of sand, whereas the latter three which are identical with three of the grades adopted for asphalt pavement construction, are those which would ordinarily be used in admixture with sand to produce an asphalt grout.

(III) In adopting these limits, it is understood that the producer will furnish asphalts with penetration equal to the mid-point in each range, a plus and minus tolerance from that mid-point being acceptable to all parties, but in no case shall the deviation exceed the limits of the grade specified.

the construction of sheet asphalt, asphaltic concrete, asphalt macadam, and surface-treated pavements will be reduced from 88 to 9. The number of asphalt grades used as joint filler in the construction of brick and block pavements and various other types has likewise been reduced from 14 to 4 [of which 3 are included in the foregoing 9 grades for roads and streets, bringing the total of approved grades for all paving purposes to 10].

A complete report of the conference at which the reduction in the number of asphalt varieties was adopted is in process of printing and will be published about Dec. 1 by the Department of Commerce as one of its series on "Elimination of Waste in Industry." It will be entitled "Simplified Practice Recommendation No. 4—Asphalt" and can be obtained from the Superintendent of Documents, Government Printing Office at Washington at 5c. per copy.

The endless multiplicity and non-uniformity of specifications having reached a point which demanded nation-wide co-operative action on the part of engineers, contractors and producers, at the suggestion of Secretary Hoover a systematic approach to a solution was made during the spring and summer by all parties interested and a constructive reduction of varieties was effected.

Nine definite penetration limits for the construction of sheet asphalt, asphaltic concrete, asphaltic macadam pavements and for surface treatment, and four penetration limits for joint filler for various other types of construction, including brick and granite block pavements, were unanimously adopted at a general conference held at the Department of Commerce on May 28, 1923, and have been officially accepted as the standard of practice by the highway engineers of 30 states, the American Society for Testing Materials, the Society for Municipal Improvements, the American Society of Civil Engineers, the United States Bureau of Public Roads, the Asphalt Association, and 5 manufacturers not members of the Asphalt Association. It was the sense of the conferees that the recommendations should become effective on all deliveries of material after Jan. 1, 1924, and that they should be subject thereafter to annual review and such revision as the industry may desire.

The accompanying table gives the penetration limits as adopted.

Committees Named for Road Show and Convention at Chicago

Chairmen of committees for the Good Roads Show and convention of the American Road Builders' Association, to be held in Chicago, Jan. 14-19, have been named as follows:

PUBLICITY, S. T. Henry, Allied Machinery Co. of America, New York; RECEPTION AND HOTEL, G. W. Craig, Asphalt Association, Chicago; REGISTRATION, L. S. Louer, *Engineering & Contracting*, Chicago; PROGRAM, C. S. Hill, *Engineering News-Record*, New York; ENTERTAINMENT, A. Cronkrite, Universal Portland Cement Co., Chicago; BANQUET, J. F. McGurk, Camden Petroleum Co., Chicago.

All of these committees will report to the convention and show manager, Charles M. Upham, State Highway Engineer, Raleigh, N. C.

Production of Lumber, Lath and Shingles: 1922 and 1921

The Department of Commerce announces that the total production of lumber during 1922 in the United States was 31,426,922,000 ft., an increase of 16.5 per cent when compared with the cut reported for 1921, but a decrease of 9 per cent compared with the cut for 1919.

The production of lath was reported as 2,905,595,000 in 1922 and 1,970,696,000 in 1921, and the production of shingles 8,068,585,000 in 1922 and 6,843,187,000 in 1921.

Comparing the statistics for 1922 with those for 1921 the greatest changes are shown for the western states, the states in that region apparently having recovered from the severe depression of 1921.

In 1922 yellow pine contributed 36.6 per cent of the total cut for all kinds of wood, Douglas fir 21.4 per cent, and western yellow pine 6.6 per cent.

The figures for 1921 and 1922 are not strictly comparable. In 1922 the output of mills cutting under 50 M ft. each was omitted and in 1921 the cut of custom mills was omitted. The cut of neither class, however, materially affected the totals.

Advertisers Urged to Use Complete Street Address

Advertisers in newspapers and magazines are causing a great deal of trouble to the United States Post Office by failing to use a complete street address in their printed matter. In the larger cities particularly the manufacturer's name followed by the name of the town and state is not always sufficient identification for the rapid distribution of mail. Postmaster E. M. Morgan, of New York City, has just sent out a statement calling upon advertisers to help the Post Office Department by using street addresses in all of their printed literature and other advertising. In New York, according to Mr. Morgan, 80,000 pieces of mail, exclusive of those addressed to the largest and best known firms, are received at the New York post office every day without street address. The delivery of the bulk of this mail is delayed from 8 to 24 hr. and every day 10,000 pieces of mail remain undelivered for want of a complete address.

Postmaster Morgan says in part: "If advertisers do not include in their advertisements the complete address that will insure delivery of mail sent as the result of such advertisements, not only will the burden of disposing of this mail continue but the advertiser will lose the business which he is seeking by reason of delay or non-delivery of the replies."

Name Members of Japan's Reconstruction Board

The Metropolitan Reconstruction Board in Japan, which is to have charge of all reconstruction work throughout the devastated area, has been enlarged and will consist of eleven members, according to a cablegram to the U. S. Department of Commerce from the commercial attache at Tokyo. K. Inaba, formerly chief of the Engineering Bureau of Hokkaido, has been named chief of the Land Adjustment Bureau in place of S. Miyao who was originally selected for that post. E. Ota, formerly counsellor for the government railways, has been designated chief of the Engineering Bureau in place of R. Naoki, who will serve as chief engineer. The office of executive secretary has been assigned to K. Kanai.

Business Notes

CAL CHEMICAL CO., INC., Hagerstown, Md., manufacturer of concrete accelerator and curing compound, announces the recent opening of sales offices and warehouse facilities in Chicago and New York. The Chicago office is in charge of A. S. Harrison, who is also vice-president and Chicago manager of the Minwax Co. The New York office is in charge of M. F. Cavallon, formerly New York representative of the A. T. Malmed Co. and the Hy-Test Cement Co.

GIBB INSTRUMENT CO., Bay City, Mich., manufacturer of electric welding equipment, announces the appointment of H. A. Wilson as manager of its Detroit branch, in place of F. M. Luchs, resigned. Mr. Wilson was formerly district manager in New York for A. P. Munning & Co.

Last Call for Exhibit Space at Good Roads Show

Applications for space at the Road Show to be held by the American Road Builders' Association in the Coliseum, Chicago, Jan. 14-18, 1924, are being received in even greater volume than was the case a year ago. Allotment of space will be made Nov. 1, and prospective exhibitors who wish their applications to be considered must have them in the hands of Charles M. Upham, the association's convention and show manager, not later than Oct. 27. The application blanks were sent out some time ago, but additional blanks may be obtained by writing to Mr. Upham, care of American Road Builders' Association, Raleigh, N. C.

The meeting in Chicago on Nov. 1, at which exhibit space will be allotted, will be confined to the members of the executive committee of the American Road Builders' Association, the executive committee and representatives of the Highway Industries Exhibitors' Association and the advisory committee of the Exhibitors' Committee. On account of the large number of applications and the limited space available, it has been found necessary to restrict the attendance at this meeting to the committees named above.

Equipment and Materials

Large Tackle Blocks Hand Made

For handling 68-ton plate girders on the new Straus building in Chicago, described in *Engineering News-Record* of Sept. 27, p. 523, exceptionally large tackle blocks were supplied to the contractors, the Thompson-Starrett Co., by the W. W. Patterson Co. of Pittsburgh, for use on two large guy derricks. There were two five-sheave blocks and six six-sheave blocks, which are shown in the accompanying illustration. The former weighed 628 lb each and the latter 720 lb. each.

These blocks were hand-made throughout. They had shackles forged from solid 5 x 5-in. billets hammered down to 3 in. round and bolts 2 in. in diameter. The diameter of the sheave pins was 2 in. The straps were 5 x $\frac{5}{8}$ in. and all plates were $\frac{3}{8}$ in. thick. The edges of the plates were ground and filed to prevent cutting of the cable. The sheaves were 16 in. in diameter and were grooved for $\frac{3}{4}$-in. cable.

Portable Wood Working Machine Cuts Cost of Forms

To reduce the cost of labor in making wooden forms for concreting and for other forms of millwork, including sawing, mortising, drilling and planing, the P. L. Billingsley Co., 425 Elm St., Cincinnati, Ohio, has developed the portable, electrically operated woodworking machine illustrated in the accompanying photograph. The machine, called the Flexway, is mounted on a four-wheel carriage with roller bearings and the swivel post is carried on ball bearings. The sawing head is adjustable to cut any angle up to 55 deg., a feature adapting it particularly to the cutting of jack rafters, in addition to joists, studding, bridging, siding and

flooring. In the cutting of circular holes for column head forms a radius rod, adjustable to different size circles, guides the tool around a perfect circumference.

Five of these machines are now in use by the Ferro-Concrete Construction Co., Cincinnati, Ohio, whose president, W. P. Anderson, makes the following comments on the operation of the equipment:

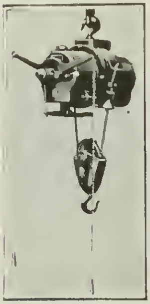
"One of the great advantages of the machine is that it is portable and can easily be taken to any job where electric current is available or moved around to any point on the job. The illustration herewith shows the machine in use for cutting a round hole for a column cap; with it one man can cut five holes where only one could be cut by hand.

"The other principal use we make of the machine is in cutting panels and this can be done on the bench where panels are made. The machine cuts, measures and squares the ends of the form, and is so flexible and evenly balanced that only one motion of the arm is necessary to get either square or beveled ends. This enables us to increase our output 25 to 30 per cent with the same amount of labor as was formerly used when the panel had to be cut by hand. In fact, the form ends

can be cut off in less time than it formerly took to mark the lines for handsawing. The use of this machine with our company is confined principally to form-making but I believe it will effect a greater saving to house-builders than it does to us, as it could practically do all millwork in house construction."

Compact Air Motor Hoist for 500-Lb. Loads

For lifting and handling loads up to 500 lb. in repair or assembly shops the Ingersoll-Rand Co., New York, has placed upon the market a new air motor hoist for loads too heavy for one man. This hoist operates on air pressures from 60 to 100 lb., has a lifting speed of 50 ft. per minute, a maximum lift of 15 ft., uses ¼-in. wire rope and weighs 150 lb.



A feature of this equipment is an automatic brake which holds the load even if the air supply be disconnected or fail. A balanced three-cylinder motor operates in either direction, without vibration, and is geared through a mechanical train to the hoisting drum. A graduated throttle permits close regulation of both lifting and lowering speeds. Motor and gears are inclosed, the former operating in a bath of oil and the latter in heavy grease. In place of the top hook shown in the accompanying illustration a roller-bearing, monorail trolley can be supplied.

Publications from the Construction Industry

Truck-Mounted Crane—BYERS MACHINE Co., Ravenna, Ohio, illustrates a variety of uses of its Truckrane in a 16-p. pamphlet. The crane, which can be mounted on the chassis of any 5-ton motor truck, has a 25-ft. latticed steel boom designed to handle a ½-yd. clamshell bucket. Among the operations on which the use of the mobile crane is shown are the handling of batch boxes from truck to paver on road work, transferring sand or crushed stone from railway cars to trucks, stock piling sand, excavating in a gravel pit, unloading coal cars, earth excavation for building foundations.

Concrete Mixers—JAEGER MACHINE Co., Columbus, Ohio, has published a 48-p. illustrated booklet on its tilting-drum type of concrete mixer with capacities of 3, 4, 7, and 14 cu.ft. Most of the mixers illustrated are equipped with power loaders and a new tip-over water tank. A feature of the mixer equipment is the company's new vibrating distributor in the form of a chute which is subjected to a jarring movement in order to distribute semi-dry mixed concrete which would not otherwise flow down to the trough from the discharge end of the mixer. A portion of the text is devoted to the Jaeger concrete placing plant which includes an inclined track, skip, hopper and chutes.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Japan Will Require Three Billion Feet of Lumber

Output Is Equal To Demand Provided Japanese Will Accept Ordinary Building Sizes and Grades

The Douglas Fir Exploitation and Export Co. will send a commission to Japan early in November. The object of the mission according to the National Lumber Manufacturers' Association is "to provide technical assistance in rebuilding the devastated region and to encourage the Japanese to modify the sizes and specifications of lumber which they have required for their use, so that a large proportion of the products of the American logs can be utilized in meeting the needs of Japan.

"It is estimated that it will require over a thousand shiploads of three million feet each to rebuild the devastated areas, and America is the only country that can quickly respond and whose output is equal to such a demand."

The Japanese trade, according to the Association, formerly called for squares, ranging in size from 4 x 4 in. (10 to 20 ft. lengths) to 24 x 24 in. (24 to 40 ft. lengths) all in merchantable grade.

The combined resources of British Columbia, Washington and Oregon cannot furnish over a billion ft. of these sizes and grades in a year, says a prominent lumberman of the West Coast, and if the demand is as great as estimated, lower grades and sizes must be used.

"The large squares," states the report, "especially must be produced from the cream of the log, leaving a large proportion of side lumber not suitable for the demands of the Japanese. This is not in the interest of conservation, nor is it in accordance with the standardization program. If the Japanese will use ordinary building sizes of lumber they can secure more lumber at lower price, and this will tend to prevent a more or less acute situation in the domestic market."

Reports to the U. S. Department of Commerce place the destruction of buildings at 316,000 in Tokio and 70,000 in Yokohama. At the time of the disaster, large reserve stocks of lumber were stored in Kobe, Osaka, Tokio and other cities. With the destruction of stocks in Yokohama and Tokio, there would still be a fairly good supply left in the other cities for immediate emergency purposes. The real demand, according to the lumber manufacturers, will come when the permanent construction of the devastated areas commences.

Advices received from the Consulate General of Japan at New York, and made public by the U. S. Department of Commerce, state that by an Imperial ordinance, building materials and necessities of life will be exempted from import duty until March 31, 1924.

Next week — Essential data on fifty large contracts awarded since March—Total value $157,460,646.

5,967 contracts reported by Engineering News-Record

for seven months, Mar. 1 to Oct. 1

14	at	$5,000,000
174	at	1,000,000
184	at	500,000
310	at	200,000
2,044	at	100,000
341	at	50,000
2,771	at	25,000
129	at	10.000
5,967	averaging	$220,000

Total Value:
$1,324,642,000

Foreign Projects of Interest to Americans

A number of foreign construction projects which should be of interest to American engineers, contractors and manufacturers has just been reported by the United States Department of Commerce. They are merely noted here, further information being available at the Bureau of Foreign and Domestic Commerce or its district of co-operative offices, when a reference number is given.

A Spanish city, through its governing council, has appropriated $1,500,000 for the construction of low-price houses. The appropriation is for subsidizing concessionaires in order to relieve the housing shortage among the laboring classes. Subsidies of from $30,000 to $300,000, representing 30 per cent of the total estimated cost of the houses, have been granted to six companies.

Plans have been approved by the Minister of Public Works for a pontoon bridge to connect two Danish cities. The cost is estimated at $2,412,000, at present exchange. Reference No. 35x-1.

A Lithuanian city has approved plans for a water and sewerage system to cost $2,000,000, and it is proposed to grant a concession to some foreign construction company. Reference No. 106,546.

In a city in India extensive hydro-electric plans are underway. One of the projects is a dam 190 ft. high and more than a mile in length. It is stated that this dam will exceed the Assuan dam by 3,000,000 cu.ft. of masonry.

The Indian Stores Department is calling for bids on equipment for two large hydro-electric projects. Reference No. 106,908.

Bids Wanted on Chinese Bridge

The Hai Ho Conservancy Commission, Tientsen, North China, will receive tenders until May 1, 1924, for the construction of a bascule or other type of opening bridge over the Hai Ho River. The new bridge will be 306 ft. long, with a 40 ft. roadway with 9 ft. sidewalks on either side. The moveable span is to be of such design that when the bridge is opened the fairway will be 140 ft. The estimated cost is $550,000. Specifications are filed with the Bureau of Foreign and Domestic Commerce.

Many More Projects This Year Than Last

Reports published in Construction News in the first half of 1923 numbered 2,263 more than in the first half of 1922 for the United States alone. This is an increase of 16 per cent. Detailed figures are given in two tables on p. 207 of last week's Construction News.

Every section of the country reflects this greater activity, with the exception of the South. Southern projects totaled 1,763 in the first six months of 1923, against 1,787 last year. On the other hand the 412 contracts awarded there this year averaged $230,000, whereas last year's 411 awards averaged $219,000.

In the entire United States the 4,362 awards reported by *Engineering News-Record* aggregated $1,047,230,000, an average of $240,000. In the same period last year the 3,895 contracts totaled $779,767,000, an average of $200,000.

Minimum costs of these projects are as follows: Water-works, $15,000; other public works, $25,000; industrial construction, $40,000; commercial buildings, $150,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 215 to 226, are the following:

Subway, Brooklyn, N. Y., to T. A. Gillespie, New York City, $1,725,884.

(*Continued on p. 662*)

Building Equipment Required for News-Record Contracts

For the $868,529,000 worth of industrial and building contracts noted in *Engineering News-Record* from Jan. 1 to Oct. 1, plumbing, heating and lighting equipment, paint and elevators to the value of $118,000,000 has been or will be purchased. This year's large contracts for industrial expansion have exceeded $200,000,000. Commercial building awards amounting to $150,000 or larger, aggregate $667,136,000. The money value of the painting and equipment required for both the industrial works and the large building contracts published in Construction News during the last nine months is estimated as follows:

	Industrial Works	Buildings
Plumbing	$1,040,000	$13,340,000
Heating	7,200,000	33,350,000
Lighting	5,540,000	23,345,000
Elevators	1,000,000	13,340,000
Painting	6,320,000	13,340,000
	$21,100,000	$96,715,000

Bids wanted on big water-works job at Denver, Colo., by Board of Water Commissioners. Work involves 96 tons of special castings. Total value, $327,000. B. Lowther, engineer.

Car Loadings Break All Records

Freight loadings for the week ended Sept. 29, totaled 1,097,274 cars, the greatest number for any one week in the history of American railroads. This exceeds by 4,707 cars, the previous record which was established for the week of Sept. 1, when the total was 1,092,567 cars. Seasonal crop and coal movements are responsible for the increase.

Public Bond Sales Dull During Last Three Months

The month of September did not show any more activity in the sale of state and municipal bonds than the months of July and August. The *Commercial and Financial Chronicle* reports the total of long term bonds for September to be $50,216,404 against $51,345,526 for last month and $99,776,656 for September a year ago. The largest issues of the last month were the $5,000,000 North Carolina, 5½ per cent, 2-yr. notes; the several bonds of the City of Buffalo, N. Y., totaling $3,510,000 at 4¼ per cent; and the waterworks bonds of Cleveland, O., for $3,360,000 at 4¾ per cent.

During September $11,102,000 United States municipal bonds were offered without success.

Of the 40 representative bond issues included in the accompanying table, six were sold at par, three below and the remainder above. The yields ranged from 4 to 5.99 and the rate of interest from 4 to 6 per cent.

REPRESENTATIVE BOND SALES DURING SEPTEMBER

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Dated	Maturity	Purchased By
North Dakota	Real Estate	$1,000,000	5½	105	5	Apr. 1, 1923	Due serially	Wells-Dickey Co., Stacy & Brown
Rhode Island	Penal & Charitable Inst. Loan.......	50,000	4	100	4	Sept. 1, 1923	Sept. 1, 1973	Natl. Exch. Bank, Providence
County								
Akron School Dist., Ohio........	School	1,000,000	5¼	101.97	5.03	Oct. 1, 1923	1924–1944	W. A. Harriman & Co., New York
Bedford School Dist., Ohio......	School	74,192	5½	100.02	5.49	Sept. 1, 1923	1924–1931	Seasongood & Mayer, Cincinnati
Live Oak Drainage Dist., La.....	Drainage	75,000	5½	100	5	Apr. 1, 1923	Apr. 1, 1925 due serially	Canal-Commercial Trust & Savings Bank, New Orleans
Essex, N. J....	Sewer	117,000	5	103.11	4.76	Oct. 1, 1923	1924–1962	J. S. Rippel & Co., Newark, N. J.
Duval, Fla.	Roads	1,050,000	5	98.28	5.15	July 1, 1923	1928–1953	Stacy & Brown & A. B. Leach & Co., Inc., New York and others
Duval, Fla.	Bridges	450,000	5	98.28	5.15	July 1, 1923	1928–1953	Sidney Spitzer & Co., Toledo, O., and others.
Shoshone, Ida..................	Highway	{ 160,000 140,000	5¼	100.001	5.24	July 1, 1923	1933–1942	Union Trust Co., Spokane
Black Hawk, Ia.............	Roads	150,000	5	100	5	Sept. 10, 1923	....	White-Phillips Co., Davenport, Ia.
Webb., Tex.............	Roads	250,000	5½	101.53	5.36	Oct. 10, 1923	1924–1953	Ryan, Bowan & Co., Toledo, O.
Kenosha, Wis.	Courthouse and Jail	500,000	5	101.415	4.83	Oct. 1, 1923	1924–1943	R. M. Grant & Co., Kenosha
Stanislaus, Calif..............	Irrigation	135,000	5	100.0007	4.99	Oct. 1, 1923	1934–1953	First Natl. Bank, Modesto
Orange, Ind.	Roads	33,000	5	100.34	4.92	Oct. 1, 1923	1924–1933	Paoli State Bank, Paoli, Ind.
East Chicago, Ind.	School	200,000	5	102.025	4.84	Sept. 1, 1923	Sept. 1, 1943	Fletcher Savings & Trust Co., Indianapolis
Gary, Ind.	School	346,000	5	100.06	4.98	Oct. 1, 1923	Oct. 1, 1943	C. W. McNear & Co., Chicago
Long Island Drainage Dist., La...	Drainage	225,000	5½	100	5½	Apr. 1, 1923	1925–1950	Canal-Commercial Trust & Savings Bank, New Orleans
Municipality								
Fredonia, N. Y..............	Street Improvement	90,000	4¾	100.01	4.74	Oct. 1, 1933	1924–1933	Citizens Trust Co., Fredonia
Goshen, Ind..........	Water, heat, light and power	50,000	5	100.11	4.98	Sept. 26, 1923	1925–1934	Union Trust Co., Indianapolis
Greece, N. Y.............	Lake Shore Water Dist.	180,000	4.8	100.11	4.78	Oct. 1, 1923	1926–1943	Sherwood & Merrifield, New York
Leavenworth, Kan.	City Hall	250,000	5	101.35	4.933	Oct. 1, 1923	1934–1953	Branch-Middlekauf Co., Wichita, Kan.
Louisville, Ky.	Sewer	952,000	4½	100.59	4.45	Oct. 3, 1923	Feb. 1, 1960	Eldredge & Co., New York and others
Menominee, Mich.	Waterworks	50,000	5	101.91	4.87	Oct. 1, 1923	1947–1950	Harris, Small & Co., Detroit
Moorhead, Minn..........	Paving	50,000	5¼	101.50	5.172	July 1, 1923	1925–1945	Minnesota Loan & Trust Co., Minneapolis.
Nanticoke, Pa.	Borough	130,000	5	101.72	4.64	Sept. 15, 1923	1924–1930	M. M. Freeman & Co., Philadelphia
New Orleans, La.	Belt R. R.	600,000	5	100	5	Sept. 24, 1923	....	Hibernia Securities Co., New Orleans and others
Rome, N. Y.	Paving	45,515	6	100.08	5.99	Oct. 1, 1923	1924–1927	Sherwood & Merrifield, New York
Jamestown, N. Y.	Bridge	22,000	4.6	100.08	4.58	Oct. 1, 1923	1924–1933	Sherwood & Merrifield, New York
North Providence, R. I.	School	100,000	4¾	99.805	4.77	Nov. 1, 1923	Annual	R. M. Grant & Co., Boston
Schenectady, N. Y.	Public Improvements	280,000	4½	100.51	4.42	Sept. 1, 1923	1924–1933	....
	Sewer	120,000	4½	100.51	4.42	Sept. 1, 1923	1924–1943	G. B. Gibbons & Co., New York
Tekamah, Neb.	Paving	40,000	5	100	5	Sept. 15, 1923	Sept. 15, 1933	State of Nebraska
Terre Haute, Ind.	Fire Alarm System	104,000	5	101.67	4.74	July 1, 1923	1924–1939	Harris Trust & Savings Bank, Chicago
Newark, N. J.	Sewer	1,000,000	4½	100	4½	Oct. 1, 1923	1924–1963	Ironbound Trust Co., Newark
	Water	500,000	4½	100.072	4.49	Oct. 1, 1923	1924–1963	West Side Trust Co., Newark
	Improvements	500,000	4½	100.072	4.49	Oct. 1, 1923	1924–1963	Wide Side Trust Co., Newark
	Public Buildings	100,000	4½	100.013	4.49	Oct. 1, 1923	1924–1963	Clinton Trust Co., Newark
	Street Cleaning	100,000	4½	100.412	4.36	Oct. 1, 1923	1924–1928	Natl. State Bank, Newark
	School	1,099,000	4½	100.03	4.49	Oct. 1, 1923	1925–1958	Clinton Trust Co., Newark
Township								
Noble School Twp., Ind.........	School	30,000	5	100.88	4.85	Oct. 1, 1923	1925–1936	Mier State Bank, Ligonier

Large Contracts Let During Week

(*Continued from p. 661*)

Power Station, Kearny, N. J., to Public Service Production Corporation, Newark, about $20,000,000.

Offices, Los Angeles, Calif., to P. J. Walker Co., San Francisco, $1,350,000.

Hospital, Nashville, Tenn., to Hegeman-Harris Co., New York City, $2,000,000.

Factory, Ottawa, Ill., to Jobst & Son, Peoria, over $5,000,000.

Lock, Illinois, to Green & Sons Co., Chicago, $1,460,012.

Hotel, Chicago, Ill., to Paschen Bros., $2,250,000.

Lock, Pittsburgh, Pa., to Dravo Contracting Co., $738,590.

Disposal Plants, Pittsford and Brighton, N. Y., to P. H. Murray, Rochester, $223,936.

Sewerage System, Brighton, N. Y., to Oakwood Constr. Co., Detroit, Mich., $393,467.

Sanitary Sewers, Pittsford, N. Y., to Rauber and Vicinus, Rochester, $131,-690.

Conduit, Portland, Ore., to Willamette Iron & Steel Works, $2,571,404.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the the issue of Oct. 4; the next, on Nov. 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.00
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.25	5.30	5.00	—4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	+4.00	3.20	3.45	3.85	3.65	4.10	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	53%	43%	47%	53–5%	36%	33.2@42.2%	35%	47.42
Cast-iron pipe, 6 in. and over, ton	63.60	—54.00	63.00	60.20	60.50	69.00	62.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.70@2.80	2.60	2.05	2.20	2.50	2.84	2.63	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	—1.85	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	2.00	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	62.00	39.00	52.25	58.50	44.75@45.75	48.00	41.00	29.50	70.00
Lime, finishing, hydrated, ton	18.20	25.00	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.60	1.75	1.50	1.50	2.70	2.10	2.80	—9.50
Common brick, delivered, 1,000	—22.40@23.65	11.00	11.60	11.00	17@19	12.00	15.00	15.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	.115	.0724	.0816	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1179	.102	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.98	1.00	—1.08	1.14/	1.02	1.12	+1.07	.86	—1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.50@.55	.35@.50	.50	.56¼@.62½	—.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.64). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.42; 6-in., $119.

Changes Since Last Week

Although a certain amount of stimulation is noticeable in the current market, most buyers are limiting purchases to actual requirements. The fact that domestic buying is confined to small lots and that the Japanese demand has not yet exerted its full effect upon materials resources, few changes, either up or down, are noticeable in the price tables.

Seattle reports a drop of 50c. per 100 lb. in structural rivets and Dallas, an advance of 5c. in reinforcing bars, due to scarcity of local stocks. Cast-iron pipe dropped $1 per ton and ¾-in. gravel, 5c. per cu.yd. in Atlanta.

Concreting materials and lumber remain firm, with few exceptions, throughout the entire country.

Common brick are quoted at $19@$20 per M., wholesale, alongside dock, New York, against $20, one week ago. The fluctuation is due mainly to heavy brick reserves being stored in the Hudson River district and to importations of considerable quantities of foreign brick. Extensive demolition of old buldings in New York, is throwing large quantities of second-hand brick upon the market, which have been quoted as low as $14 per thousand.

While San Francisco reports an advance of 3c. per gal. in linseed oil, the recent downward trend has not yet abated as evidenced by declines of 1c. and 2c. per gal., reported in Dallas and Montreal, respectively.

The iron and steel situation may be briefly outlined as follows: Pig-iron sales dropped to half of usual volume. Consumers purchasing on basis of month to month requirements. Japan will need about 60,000 tons of galvanized steel sheets. Japanese buying on strictly competitive basis, hence, several large steel orders placed in Germany. Steel plates firm at $2.50 per 100 lb., Pittsburgh, with reports of shading to $2.40. Structural market quiet but with no evidence of weakness; quotations holding firmly at $2.50. Bars firm at $2.40 base. Rest of steel list firm with exception of shading in black sheets and decline in scrap.

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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When Water Is Missed

IT'S a severe drought that does not do some good. In northeastern New Jersey many communities that had long postponed joining Newark in the development of the Wanaque supply have taken decisive action since the accumulated deficiency in this year's rainfall has caused serious water shortage in adjacent territory. In northeastern Massachusetts, too, a number of communities have been short of water of late. Some of these have been helped out from the Boston Metropolitan supply—sharply emphasizing their possible dereliction in not having joined the district long ago as well as bringing home to the whole district the fact that it, too, may be short of water if it does not go further afield at once. New York City began none too soon on its Schoharie Creek enlargement, this year's low rainfall and the low stage of the Ashokan reservoir indicate. The Hackensack Water Co., which supplies over fifty New Jersey municipalities in Hudson and Bergen counties, has an immense reservoir about ready for service. It showed foresight in building this. Had it not been for presumably unavoidable delays in its completion this reservoir might have made it unnecessary for the company to cut off the supply to dozens of industrial plants last week, thus throwing thousands out of work. All these things bring home to the people and the municipal authorities, what every engineer well knows, that in times of plenty of water money and other means should be provided to guard against droughts, for water is sadly missed when the well runs dry.

Earthquakes and Modern Structures

ENGINEERS who have been awaiting details as to the effect on engineering structures of Japan's earthquake tragedy of Sept. 1 will find the first authoritative engineering information in the report, elsewhere in this issue, by John W. Doty and W. W. Johnston, president and engineer, respectively, of The Foundation Co., New York. While conditions after the catastrophe prevented an exhaustive technical study of all structures demolished or standing, it was possible for these two American engineers to make a rapid survey of what the quake did in both Japan's capital and one of its principal seaports 18 miles distant. The most significant message Mr. Doty brings back from the Orient is that modern building design can produce structures which will stand up even when subjected to a test as severe as that of the Japanese earthquake last month. In such design, however, swaybracing must be extremely heavy and the various elements of the structure, particularly the floors and side walls, must be securely tied together to resist the battering ram effects of a severe and sustained seismic shock. Structural adequacy, however, is only a part of the story. An examination of the devastated areas in the Japanese cities indicates that the fire which followed the quake was responsible for a considerable portion of the destruction. The engineering lesson of the quake, therefore, must include a realization of the need, in any large city, subject to shocks, of fire prevention zones. In the rebuilding of the stricken cities it is certain that the authorities will prohibit, or at least minimize, the flimsy, top-heavy structure, and will lay out new work in accordance with a plan which will provide fire stops where needed. The government's first move toward these ends was the recent issuance of orders prohibiting the erection of any but temporary structures without a permit from the state.

Improved Road Contracts Again

CONTRACTUAL policies in highway construction were agreed upon a year ago by a joint committee of the Associated General Contractors and Association of State Highway Officials. They established a distinct advance in fair dealing. There remains the task of translating these approved policies into actual practices by state highway departments. This has already been done in some states. The results are satisfactory. One, therefore, is not proposing unprecedented action in asking that the joint committee, which has remained in existence and will next month go into conference to formulate its report, shall require that its conclusions shall be made articulate in state specifications and contracts for road construction. Until this is done generally the agreement reached last year is only a gesture. Such futilities have been too common in the work of contractors and engineers toward improvements in contract practice. In the road improvement of a decade to come the two have to work together in public service. If the agreement made a year ago is wise let it be enforced; if it is not wise let it be altered. Inaction is not worthy of either association.

Asphalt Simplified

ASPHALT simplification by the reduction to ten in the grades or varieties called for in specifications for street road work is now an accomplished fact. The Department of Commerce has just announced that, as a result of endorsement of the ten standard grades (as determined by penetration limits) by most of the state highway departments the leading engineering and specification-making organizations of the country and a substantial majority of the important producing companies, the new standards become effective Jan. 1, 1924, and form the Commerce Department's "Simplified Practice Recommendation No. 4—Asphalt." The new scale of grades (see *Engineering News-Record*, Oct. 18 p. 658) represents the joint recommendation of consumers and producers. It replaces the 50 or 100 different grades which it has been the practice to specify in the past. The obligation of highway engineers and contractors, however, does not end with the attachment of an O. K. to a report. The full fruits of the various asphalt conferences which have been held in Washington during the past year will be realized only if the asphalt users

specify, in their orders, one or more of the standard grades of material. The range of standard penetration limits adopted is sufficient to provide for every reasonable requirement of traffic or temperature.

Three in the Field

NOW that a sanitary section has been organized in the American Society of Civil Engineers there are three organizations depending almost wholly upon the same group of men for support. The two others are the State Sanitary Engineers and the Sanitary Engineering Section of the American Public Health Association. The meeting of the latter at Boston two weeks ago was so well attended—perhaps a hundred in all—and the four sessions, including the special conference on the treasury water standard, were so successful as to leave no question about there being a place for that organization. The State Sanitary Engineers have a distinctive field, being made up of the chief engineers of state health departments and a limited representation from the United States Public Health Service. As the newcomer in the field, the Sanitary Section of the Am. Soc. C. E. is on trial. However, the success of the informal dinners attended for the past few years by the sanitary engineers afford reason for believing that the more formal section will justify its existence, provided its meetings are judiciously handled in view of the existence of the other two organizations.

Water Pollution and Industrial Wastes

FOR many years past the problem of protecting the natural waters of the country from pollution by industrial wastes has been growing in seriousness. While there have been notable instances of progress, for the most part these have been isolated. From the viewpoint of governmental control, whether local, state, or federal, comparatively little has been accomplished beyond a long series of investigations and reports that have pointed the way to better things. Perhaps the greatest hindrance to progress has been the halting state legislation for the control of the pollution of waters by industrial wastes. There have been plenty of instances of sweeping prohibition of water pollution of any kind, but rarely has a statute been enacted that was, after all, much more than a formality since it is a well-known maxim that legislation without means of enforcement is futile.

Most of such legislation as has been enacted by our states has vested some degree of stream pollution control by industrial wastes in state boards or departments of health. Aside from the indefiniteness of some of this legislation and the lack of means of enforcement in nearly all cases, state health departments have been loath to undertake control of industrial wastes. This has been due to fear of political interference in case sufficiently strong action was taken to lead important industries of the state to expect great expense and trouble; and fear that the commotion thus stirred up might seriously interfere with work more vitally affecting the public health. To this, there may be added the inherent difficulties and complexities of the problem due both to the technical difficulties involved in treating many classes of industrial wastes and due also to an honest and legitimate concern for the industries themselves lest they be burdened with expense that might in extreme cases even drive them out of business.

Who should bear the burden of protecting our natural waters from pollution by industrial wastes? Some who fail or are unwilling to see that the growth of both city population and of industry makes impossible the keeping of many of our streams in what, to use the favorite phrase, is their "pristine purity," advocate unthinking and unreasonable extremes. If, instead of following them, a sane policy is pursued, there is no question but what the cost of adequate measures for protection in this field should enter into the legitimate cost of the products of industry and be met by the ultimate consumer. But so long as attempts to prevent water pollution by industrial wastes have been scattered here and there throughout the country with no well considered legislation and no ample means of enforcement as a rule, it has been only too apparent to any intelligent owner of an industrial plant that if he went to considerable expense to treat his wastes before they were discharged into whatever waters were nearest at hand, he would be handicapped by the fact that most, if not practically all, of his competitors were not even being seriously asked to assume a like burden of treatment.

Here, perhaps, is the greatest of the problems to be solved before material progress can be made in industrial wastes control. Fortunately, there is much encouragement of late in the growing willingness of manufacturers to co-operate with state authorities for the protection of our natural waters, provided only the authorities are reasonable in their requests.

The foregoing and many other considerations pertinent to this matter were either specifically or inferentially brought out at the stream pollution conference held at Philadelphia last week and reported in this issue. Much was also learned along these lines during the meeting of the American Public Health Association in Boston two weeks ago, when the sanitary engineering section of that organization devoted an afternoon to visiting industrial plants on the Neponset River, where two paper mills and a combined tannery and wool storing plant are each operating works for the treatment of their wastes that are on a par for complexity of the problems presented, the means used, and technical supervision exercised with almost any municipal sewage treatment plant in existence. This is in Massachusetts, and the results achieved there are attributed very largely to the reasonableness with which that state has proceeded in acting upon legislation passed years ago which on its face provided for very drastic action against these manufacturers.

One of the most hopeful indications of progress in sane measures of state control is reported by the action taken in Pennsylvania the present year. There the State Sanitary Water Board, created this year, is bringing together and co-ordinating the efforts of various state agencies having powers and duties in the field of the prevention of water pollution by industrial waste. Following and endorsing the later sane practice of the State Department of Health—as contrasted with the earlier idealistic attempts to stop all sorts of municipal sewage pollution at once—the streams of Pennsylvania have been divided into three classes and means for their protection against pollution both by municipal sewage and by industrial waste will be carried on accordingly. It is recognized that sewage disposal by dilution is legitimate; that some of the streams of the state are, for the present at least, so much given over

to sewage disposal that little can be done to reclaim them; that other streams are in a middle class and may be so treated; and that still others are but slightly polluted and should be carefully guarded—but all in accordance with the rule of reason, as to the expenditure of money, the burden that will thus be placed upon industrial and upon municipal treasuries, and the good of one sort or another that may be achieved by limiting or preventing pollution.

The protection of streams against pollution by industrial waste is a most promising field for work on the part of the engineer who can be both progressive and reasonably conservative, and who always bears in mind the value of the results that can be achieved from the measures which he proposes as compared with returns that could be gained for the same expenditures for another beneficial purpose.

What Is the Matter with Reclamation?

FOR twenty-one years the government has been at work reclaiming the arid public lands of the West. In that time hundreds of structures have been built and thousands of miles of canals have been dug so that eventually new homes might grow on land up till then made useless by lack of rain. It has been an enormous enterprise, costing millions today in order that future generations may benefit, and engaging the services of a fair proportion of our Western engineers. Yet during all this time the great body of the engineering profession—not being engaged in reclamation—has known of the work only casually. It has, to be sure, read with interest and pride of the large and excellent engineering structures which the government engineers have built. It has learned many things in hydraulic practice which it has applied to works other than those of irrigation. It has believed that the irrigation of government lands is an engineering problem, which is being solved with a fair degree of satisfaction by engineers.

The time has now come when engineers generally must take a more active interest in government reclamation. During all these two decades there has been another side to the problem—a political and a speculative side which culminated in the action of the present Secretary of the Interior in the removal of Arthur P. Davis as director of the United States Reclamation Service last July. The engineers engaged in irrigation have been long acquainted with this sinister aspect of reclamation. The engineers of the whole Western slope, in fact, know about it; but taken by and large the engineers of the country have not appreciated it. They have not known of the efforts underground and above ground which have been made to get Congress and the Department of the Interior to repudiate the law on which the reclamation of our public lands is based. They have not known the degree to which the land shark has robbed the settler of his heritage. They do not know the insistent political pressure that has been constantly brought to increase the profit of early holders at the expense of the rest of the country and of the future property owners on the reclaimed land.

All of this sinister influence came to a head last July, when Dr. Work sought to take control of the Service from the hands of the engineers and put it in the hands of the politicians. This act aroused the engineers of the country. It became evident that it was necessary that engineers everywhere should know about the operations of a service with which their fellow engineers were so intimately connected and the fortunes of which are tied up not only with the fortunes of the engineering profession but with the integrity of the government service and the proper development of the country as a whole. To inform the engineers of the country of the true inwardness of federal reclamation is the main purpose of the series of articles which start in this issue. The series is not partisan; it is not political. It is an honest effort to present to the engineers of the United States and through them to the rest of the thinking people of the United States an impartial picture of the reclamation of our federal arid lands. The future of the country depends upon the judicious development of its resources, and no resource is more important than the farm homes of the next generation. If the development of those homes is to be restricted by malign political influence, the people should learn about it in time to stop such an influence. The very evident demoralization of the Reclamation Service which has already set in from Dr. Work's performance of last July and the stimulus given to those who have long attacked the sound management of reclamation make it all the more urgent that Congress should act, and act soon, to assure security of the present development and to lay down a sound future policy for the more difficult problems ahead.

It is now the time to review the practical workings of the early policies of administration and it is to the engineers of the country that the rest of the country must look for an interpretation of the history of that work. It is certain that the enterprise has been vital to the West; that it has been efficient in plan and construction and operation. It is equally certain that it has not been perfect. The attention of the whole country should now be called to the defects of the law for the earliest revision, for the elimination of political control, and the broadening of the law to suit the coming needs of the West and elsewhere. In this the engineer can be of service. If every engineer, whether he has direct interest in irrigation or not, if he has only an interest in the proper development of his country and a justification of his profession, will read the articles which are to comprise the series and will act on the facts set forth in those articles, the engineering profession can do a great work in forwarding the reform necessary for the proper control of reclamation.

It is not the purpose here to describe methods or forecast results. We only urge upon every engineer reader the universality of the problems of reclamation. Let him read the story of its development and its application. Let him trace the story of the Reclamation Service from its Rooseveltian beginning to its latest demoralization. Let him realize how the science of irrigation, though reaching back to the beginnings of history, is still a new science with new facts and new troubles developing every year. Let him understand the degree to which the world-wide economic upheaval since 1914 has overthrown early dreams and theories in the irrigation country. And finally let him see how the thread of engineering control must run through all this if the fabric is to wear. Government reclamation of land is a great and continuing engineering problem. If this new series in *Engineering News-Record* can convince engineers of that—and through them Congress—we shall be content.

Federal Land Reclamation: A National Problem

1. Origin, Problems and Achievements of Federal Land Reclamation.

By F. H. NEWELL
Formerly Director, U. S. Reclamation Service

The First of a Series of Articles on the History and Performance of the Great Government Adventure in Irrigation of the Arid Lands of the West.

TO ALL engineers and in fact to all taxpayers and citizens, there is a peculiar interest in the life story of the U. S. Reclamation Service. The present time is appropriate for a review of its operations because of the fact that its history is now practically a closed chapter; the Service, as such, ceased to exist 21 years—almost to a day—after its creation. The work may continue as a bureau organization, but the feature which characterized the inception and development of its work has ceased to exist, namely, that this was an organization planned and officered by engineers, exemplifying the highest ideals of the engineering profession.

A review of the origin and development of the Reclamation Service is of importance at the present time not merely as a matter of history, but because citizens and taxpayers in various portions of the country are urging their representatives in Congress to adopt a broad national policy of land reclamation and settlement. This will involve expenditures of millions of dollars, not merely of federal funds, but of corporate and private moneys, in the creation of opportunities for more rural homes. A wise expenditure of these vast sums, which must be made as demands arise for more land, is dependent largely upon a full and correct knowledge of what has already been accomplished and particularly of the errors which should be avoided and of the mistakes which are inseparable with undertakings of this character unless careful study is given to similar undertakings. Public opinion must be guided not merely by sentiment or good intention, but by the hard facts of experience such as the engineer with his exact training alone can develop. While the engineer must necessarily be a man of vision, yet at no time can he afford to be visionary. "Without vision the people perish," without the dreams of the engineers, modern civilization would be impossible.

How Federal Reclamation Began

Taking it as a whole, the Service is an illustration that dreams sometimes come true. It accomplished in its life of twenty-one years larger results than had been seen by the dreamers, the men of vision, who looked forward to great accomplishment. The works which have been completed exceed in magnitude those which were anticipated, and the results in agricultural productivity far surpass the estimates made by its best friends. But the object of the advocates of the original reclamation act was to "make men, not money," and to do this through creating opportunities for small self-supporting farm homes on the vast area of vacant public lands. From such homes have come the leading men of our nation. The results achieved are therefore to be measured in true home-making, not in money profits.

Much of the vacant public land in the West had already passed out of the control of Congress when the reclamation act was passed in 1902, but many millions of acres remained, as shown in Fig. 1, including areas of fertile soil which might be cultivated, if only some natural obstacles could be removed, principally, the lack of water. Private capital had already been utilized in bringing water to ten million acres of these lands; all of the easily available localities where water might be had or applied to public lands had been taken up under one or another of the public land laws. But it was found that the large irrigation works needed for other of these lands were beyond the reach of individual or corporate efforts, largely because the cost of reclamation was too great to yield a profit on the investment.

FIG. 1—VACANT PUBLIC LAND IN THE WEST IN 1902
When reclamation started there was much vacant public land available. Contrast the blackness of this map with that of Fig. 2, opposite.

In 1888, the Congress of the United States had been persuaded by Major John Wesley Powell, the explorer of the Grand Canyon of the Colorado, at that time Director of the U. S. Geological Survey, to make an appropriation to ascertain the extent to which the arid region might be reclaimed and utilized in the making of homes for citizens. In his topographic mapping and geologic studies of the West, Major Powell had become impressed not only with the mineral wealth of the region, but, more than this, with the opportunities for homemaking in the fertile valleys. He had published in 1879 under the auspices of the Smithsonian Institution his classic statement on "The Lands of the Arid Region." Subsequently he had left no stone unturned to bring the mineral and especially the agricultural importance of the West to the knowledge of scientific men and of Congress.

The surveys and examinations begun in 1888 attracted wide attention and, when added to the results of the data accumulated by the census of 1890, showed a condition of affairs which demanded public consideration. These facts indicated that further development of the arid lands might be indefinitely delayed unless the Government, the owner of the vast extent of public lands, made some effort to reclaim these lands. The data showed that practically all of the plow lands, such as had been available on the great plains and had furnished homes for millions of citizens, had passed into private ownership, largely speculative. If population was to increase, or even to hold its own in the vast arid states of the West, it would be necessary to make some radical departure and to remove the obstacles which were preventing additional homemaking.

Although the public began to awaken to the necessity of taking some action looking toward the better use of the public lands, there set in a counter current

FIG. 2—VACANT PUBLIC LAND IN THE WEST IN 1922
Twenty years later the public lands of the West were practically all used up or reserved for park or forest.

against governmental action largely due to the fear, on the part of large land owners in the West, that the federal government would interfere with their systematic efforts in adding to their great acquisitions. Congress became stampeded for the moment and withdrew for a season further appropriations for investigation, stopping by act of Aug. 30, 1890, the setting aside of public lands which might be reclaimed and later, by act of March 3, 1891, restricting the reservoir sites and other lands needed for carrying out any plan of federal reclamation, specifying that such sites "shall contain only so much land as is actually necessary for the construction and maintenance of reservoirs, excluding as far as practicable lands occupied by actual settlers at the date of the location of the reservoirs." Demand for this arose from the fact that it was found that most of the best natural sites in the West had already been occupied in part as cattle or sheep ranches. The owners of these ranches in many instances had not taken the precaution of fully complying with the Land Office rules and regulations and thus the withdrawal of these publicly owned lands for purposes of reclamation interfered sadly with their plans of expansion.

In repealing, by act of Aug. 30, 1890, the permission to withdraw land for reclamation, Congress, however, provided that the "reservoir sites heretofore located or selected shall remain reserved." At the same time it, perhaps inadvertently, took a forward step, the importance of which was hardly recognized at the time. It provided "that in all patents for lands hereafter taken up," "there is reserved from the lands described a right of way thereon for ditches or canals constructed by the authority of the United States." At that time there was no authority for the government building such canals and the opponents of federal reclamation, that is, the large sheep and cattle men, were caught unawares. Thus, although the opportunities for future reclamation were greatly restricted, yet when the time came, ten years later, that the reclamation act was passed, it was possible to obtain necessary rights of way across public and privately owned lands under conditions far more reasonable than would have been possible had not this right of way been retained by the acts above noted.

In 1891 was held in Salt Lake City the first of a series of irrigation congresses. These were continued in successive years, with the result that public opinion gradually crystallized into a demand for action by Congress leading to federal recognition of the subject of land reclamation and settlement. The most active worker in Congress was Representative, later Senator, Francis G. Newlands of Nevada. He introduced bill after bill, but little consideration was given to the matter because of the usual objection by Congress to an increase of appropriations. Finally, the ingenious idea was wrought out, not of asking for a direct money appropriation, but achieving the desired results, without stating the quantity of money involved, by simply setting aside the proceeds from the disposal of public lands. These receipts had been shrinking rapidly, and, at the time the Newlands bill was under consideration, it looked as though the annual return to the Treasury would be less than a million dollars and would rapidly reach the vanishing point. Therefore, the prime objection to a reclamation policy was removed, as it was assumed that the amount actually available for such work would be quite small, and in any event would come from the states interested, and not through a direct tax levied upon the people of the whole country.

But even though the financial obstacle was removed, there did not appear to be enough general interest in the Newlands bill to secure action. The administration was indifferent and the leaders of both political parties were personally opposed to any such measure. It was not until the tragedy which brought Roosevelt to the presidency that the indifference was removed. One of the first acts of the new President, within a few days after being suddenly called to Washington, was to take up in private conference the whole subject of conservation, of forestry, and of reclamation. This he describes at length in chapter XI of his autobiography. As there described, he included in his first message to Congress his endorsement of the irrigation of the arid public lands. With this powerful advocacy, there was little delay, and on June 17, 1902 (Bunker Hill day), Roosevelt signed the reclamation act, making available the proceeds from disposal of public lands for the survey,

examination, construction, and operation and maintenance, of irrigation works in the sixteen arid states.

The then Secretary of the Interior, Ethan Allen Hitchcock, of St. Louis, Mo., upon passage of the Reclamation Act in 1902, having had no experience and with little interest in the matter, promptly referred the whole subject to Charles D. Walcott, the Director of the U. S. Geological Survey. He was the successor of Major Powell, who had been entrusted by Congress with the topographic and hydrographic surveys of the arid regions. Walcott in turn designated as chief engineer, F. H. Newell, who since 1888 had been studying the extent to which the arid region might be reclaimed and who had become the chief hydrographer of the Survey. The Reclamation Service was accordingly organized without specific authority of law, but as an instrument in carrying out the object of the reclamation act. It was not a part of the Geological Survey, but operated in co-operation with it, as the instrumentality through which the Secretary of the Interior carried out the intent of the law.

Basic Policies of Federal Reclamation

At the time the Reclamation Act was signed—twenty-one years ago—conditions were far different than they are today; the ideas then prevalent are now seen to have been not only vague but not based upon full knowledge by Congress of the available facts. The law was purposely made quite general in character; it gave broad authority to the Secretary of the Interior to execute the work, but did not indicate how it should be done nor did it provide any specific agency. The assumption was made that the secretary would have the necessary work planned by some of his employees, and then let a contract for a specified piece of work; later he would collect from the landowners, benefited by these works, the estimated cost of construction in ten annual instalments without interest. There is probably no law as far-reaching in its consequences as this in which such large discretion has been imposed upon one official. This discretionary power was its strength and also its weakness. It allowed the work to be adapted to the conditions found to exist and yet at the same time it left to the personal judgment of each of a frequently changing series of incumbents the larger policies on which success was based.

The policies fixed in the act pertained largely to methods of initiation of the work and to withdrawal of lands, a matter which had been the subject of much controversy, as before indicated, because of the reluctance of western men to permit the United States to exercise a control over public lands used by them for cattle and sheep grazing. This they regarded as an interference with their inherent rights to occupy lands belonging to the public. Emphasis was placed also by law on the limitation of the acreage of reclaimed lands which might be taken or entered by any one citizen. It was provided that the limit of area per entry "shall represent the acreage which, in the opinion of the Secretary, may be reasonably required for the support of a family upon the lands in question." The law also provides that the charges which shall be made per acre upon the entries or reclaimed land "shall be determined with a view of returning to the Reclamation Fund the estimated cost of construction of the project, and shall be apportioned equitably." As a matter of fact the word "equitably" has been applied practically as being synonymous with "equally," as it has been found impracticable to attempt to discriminate between adjacent farms or areas reclaimed by the same system, or to set terms which take into consideration differences of soil or location with respect to roads and centers of population.

The law also attempted to prevent non-resident ownership and provides that no right to the use of water "shall be sold to any land owner unless he be an actual bona fide resident on said land, or occupant thereof residing in the neighborhood of said land." Here, as in the case of the limit of entry, practice has developed most ingenious evasions of the object of the act, residence in the neighborhood being construed to include locations within 50 miles of the land, a single family or group of relatives occasionally holding several farm units, these being held in the name of the man, of his wife, of each son, and each daughter, of a brother, and so on.

The original law also required repayment in ten annual instalments, without interest, of the cost of water and provided for actual cultivation as well as residence.

It was necessary from time to time for the Secretary of the Interior to put into effect various principles which were not explicitly stated in the act but which could be inferred from its general object. It was fortunate that at the time of initiation of the reclamation work the men in direct charge had a large vision of the possibilities and a keen interest in the success of the law. President Roosevelt gave personal consideration to some of the larger principles and their application, being directly advised in this by Charles D. Walcott, the Director of the U. S. Geological Survey, with which the Reclamation Service was affiliated. In particular, the Secretary of the Interior from 1907 to 1909, James R. Garfield, brought to the law highly constructive efforts and ideals. In fact, it may be said that the larger policies of the Reclamation Service were developed under the immediate and personal consideration of Garfield.

At that time there was little or no urge that the smaller canals or distributing systems should be built by the government; practically all plans were made with the idea of carrying into effect the original conception, namely, that the government should build the reservoirs and main line canals and that the settlers, following the example of the older pioneers, should organize and build the small works themselves. Garfield devised and carried out an ingenious system by which this was being done. Unfortunately, his successor did not view the work in the same light and abolished the Garfield method, throwing upon the government enormous expenditures with the accompanying difficulties of building all of the minor works, even down to the fields of the farmers. To the abandonment of this principle of requiring the local land owners to help themselves as far as possible may be attributed many of the subsequent difficulties.

At that time there was no thought that the government would be called upon to go into all of these minor matters or be urged to actually level the small individual holdings and put these in condition for crop production. Congress and the people in general did not see the necessity for going beyond the original conception of the government building the larger works such as were beyond the ability of the pioneers. Thus no provision was made then for meeting the subsequent insist-

ent and rapidly growing demand for more and more work to be done at federal cost.

Complicating Conditions

Throughout the entire West there is more good land than there is water available for its reclamation. The choice, therefore, of areas to be reclaimed was limited not so much by the character of the land as by the location of the water. This fact had been brought out by the earlier surveys, but the people of the West in general had little conception of the limitations which existed as regards water supply.

Appropriation—To understand the conditions which confronted the Reclamation Service on the initiation of its work, it must be had clearly in mind that in the arid region the laws regarding the water are in one sense the reverse of the common law of England and that of the Eastern or humid states, where the so-called riparian laws prevail. These latter require that under ordinary conditions the waters of the streams shall be allowed to flow in their natural courses unchanged as to quantity or quality. In the arid region, the common need of the people, which ultimately assumes the force of common law, is that, if necessary, all of the water of a stream shall be taken out upon the dry lands. The water which ultimately returns to the stream through seepage, becomes greatly changed in quality since it receives the earthy salts or alkali washed out of the soil.

While in most of the Western states, legislation or court decisions established the doctrine of appropriation, in some states, as in California, the water laws were in a nebulous condition. In these states, the laws and decisions in some cases appeared to uphold riparian rights, in others, to limit or deny them, causing much uncertainty and delay in development.

Legal Limitations—The obstacles interposed by nature were less difficult and annoying than those just noted, of purely human origin, arising from neglect or abuse of the water laws. The Western representatives, aware of this condition and at the same time jealous of local rights and fearful that in some way these might jeopardize by federal interference, insisted upon the insertion in the reclamation act of a provision to the effect that all work executed under the terms of the reclamation act should be in conformity with state laws relating to water control. A few of the states, notably Wyoming, provided machinery and methods for ascertaining the amount of water in the various streams and the claims which were made to this water. In other states, however, the custom had grown up of each man's claiming everything in sight so that the aggregate of the claims often far exceeded the amount of water in the stream, and yet only a small part was actually being used.

It should be kept in mind that practically all of the best lands which might be available for reclamation had by 1902 already passed into the hands of individuals and from these had gone under corporate control. During the long years in which discussion dragged as to the possibility of Congress adopting a policy of reclamation, the enterprising citizens and the speculators, as well as the land and cattle companies, through their employees or friends, were extremely active in filing upon every acre of public land which might be developed and upon the waters in every stream throughout the arid region. This activity in acquiring reclaimable land was facilitated by the congressional acts of 1890 and 1891 above referred to, which prohibited public officials from withdrawing public lands excepting those actually needed for reservoirs.

Thus, when the time arrived that funds for reclamation were actually available, there were found to be many recently created obstacles. Some of the projects which would otherwise have been relatively simple and inexpensive of achievement, had necessarily to be passed over on account of these recently acquired rights in lands and waters; other more difficult projects had to be taken up—all of these having notable obstacles from the engineering standpoint. It is fortunate that at that time, during the initiation of the large works which have been carried on during the past twenty years, there was left in the hands of the Secretary of the Interior a large discretion which enabled the overcoming of some of these difficulties. Had it been necessary then, as it is now, to go to Congress for the solution of many of these details, it is easy to imagine that much of the work would not yet be started.

In shaping the original act, it was assumed that most of the land to be reclaimed was in public ownership and that this land would be entered upon after reclamation under the terms of the homestead act. In fact, the extension of the benefits of federal reclamation to the land in private ownership was of the nature of an afterthought on the part of the committee which had the matter in charge. Congress was with difficulty persuaded that the condition above described actually existed. As was ultimately shown, the privately owned land, reclaimed by public funds, has far exceeded in area and value the lands which were public at the time of the passage of the reclamation act and which have been opened to homestead entry under the terms of the act. The point has been frequently made that there can be little real difference as regards treatment between the land which was entered yesterday before reclamation and that which may be entered tomorrow after plans for reclamation have been adopted.

The first, the crucial, test of this principle came about immediately after the passage of the reclamation act in the case of the arid lands in the Salt River Valley in Arizona, near Phoenix, the capital city. Here were at least 200,000 acres of land which had already passed out of public ownership and on which some improvements had been made and lands cultivated in part with the inadequate water supply. Around these were a million acres of equally good land in public ownership open to homestead entry. The question was raised as to whether the water to be stored by expenditure of federal funds should be sold to the lands already in private ownership and then partly developed or be held for other adjacent lands to be taken up under the homestead act. If the latter course had been pursued, thousands of small land owners would have lost the value of the improvements already made; they would have been compelled to move and to re-establish their farms on other lands no better but for which the new water supply was provided. The decision was wisely reached that as between these alternatives the preference should be given to the land in the hands of small owners who had already spent all of their available means in attempting to make a home.

The situation was further complicated by the fact that in many localities there has been a conflict between the demands for water for irrigation and for development of hydro-electric power. Theoretically, the rights

to the use of the water should be based on a priority not strictly of time but to a large extent of use. In theory, preference should be given, first, to the needs for domestic and municipal supply, next to the production of food through irrigation, then to power and, last, to navigation. Where, however, power plants had already been established on the streams, particularly below points where water might be diverted for irrigation, it has been practically impossible to develop the irrigation projects without interfering with the vested rights of the owners of the power plants. Such conditions were found to exist, preventing the taking up of several enterprises. Where, however, the power developments were above the points of diversion for irrigation, then the difficulties were not so great. These obstacles, growing out of the acquisition of rights for power, are steadily adding to the complication of development of reclamation works.

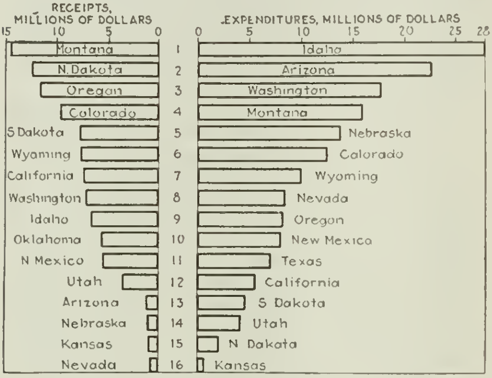


FIG. 3—RECLAMATION FUND, RECEIPTS AND EXPENDITURES BY STATES FOR 20 YEARS

Apportionment by States—The reclamation law, as originally passed, provided that where practicable the major portion of the funds arising from the sales of public lands in each state should be expended in that state. This clause was inserted as a concession to certain sectional influences. After a few years of practical operation, it was found that this provision of law had the effect of compelling the consideration of less meritorious projects in the states from which large funds were derived and that better projects in other states were being given less consideration. In fact, the need of reclamation was found to be in inverse proportion to the amount of money coming from a state. For example, the state having the largest area of public land, Nevada, has a climate so arid, with such small water supply, that the public lands cannot be sold, and yet at the same time the needs of reclamation are perhaps greater there than in other states where the lands were being rapidly disposed of. Although this provision was repealed on June 25, 1910, yet even now there continues to be a demand for construction in proportion to receipts from each state.

The present condition as regards receipts and approximate expenditures by states is given in Fig. 3, which indicates that the largest amount of money has come from Montana, while the largest amount of expenditure has been in Idaho, where about four times the amount of money received has been utilized in reclamation works. There is really no good reason why the money derived from disposal of public lands in any one state or group of states should be dedicated to homemaking in any other restricted area. That is to say, there is no inherent right for Idaho, for example, to claim that the receipts from public lands in North or South Dakota, Oklahoma, or other states are, by any moral or ethical consideration, dedicated to use in Idaho rather than for use in Mississippi or Louisiana, from which states the proceeds of public lands have gone directly into the federal treasury. Nevertheless, there has been a strong sentiment that the West is a separate entity and that the public funds derived, for example, from Oklahoma, should be used in the reclamation of some area to the West rather than to the improvement of a body of land to the East in Arkansas or Louisiana.

The passage of the reclamation act, and the works proposed under it, had a stimulating effect on state legislatures in inducing them to provide adequate methods of adjudicating the quantity of water available. It was plainly evident that federal funds could not be used in reclamation until there was some assurance that the water stored or developed by the use of these funds could be made available permanently for the lands to which the irrigating canals were built.

In some cases, enterprises otherwise desirable were passed over because there was reasonable doubt as to whether other claimants might not be able to establish a prior right to the waters needed for the government works. Thus considerable time was lost and a large amount of energy expended in development of these matters which should have been given earlier attention by the state legislatures.

In the years immediately following the passage of the reclamation act, there was somewhat general indifference as regards the place of expenditure. The popular imagination had hardly awakened to the possibilities of reclamation in building up industries and land values. In fact, in several of the states such as California it was quite difficult to get the state officials and public bodies to co-operate in securing necessary rights and privileges such as would facilitate the expenditure of federal funds. This fact seems now almost inconceivable and yet throughout that great state, although many projects were examined, it was found necessary largely because of this indifference, to select a project on the extreme north of the border of Oregon and another in the extreme south on the border of Mexico. Every other intermediate project was in the hands of investors or was tied up in such way that federal reclamation was not then practicable.

This condition of relative indifference was afterwards appreciated to be highly beneficial as a whole because it delayed the growth of political pressure and the throwing of the reclamation fund back under the direct control of Congress, putting it, like the river and harbor appropriation, into what has been termed "the pork barrel." While this is hardly an appropriate characterization, yet even the greatest optimist is forced to admit that the local politicians, who were indifferent during the early years of the Reclamation Service, later became extremely active in urging their pet projects, even threatening the official life of the men who opposed them. On the whole, however, it may be said that there has been a minimum of politics mixed with the work of the Service. No human institution can be said to

be entirely free, but the older projects of the Reclamation Service are notable in this regard perhaps largely because of the condition before noted, namely, that the politicians had not discovered the opportunities!

Thus, although the original projects were permitted to develop almost entirely upon their physical and economic merits, yet at all times it was necessary to make adjustments and to undertake enterprises which did not turn out well. For example, the law required originally that some work be undertaken in Kansas; the best opportunity from the physical and economic standpoint was chosen and yet this did not succeed largely because the climate was not sufficiently arid. Experience has shown that the land owners will not practice irrigation habitually unless forced to do so by constantly recurring seasons of drought. An occasional wet year practically destroys the value of permanent irrigation work. These enterprises which had to be taken up because of legal requirements and which did not succeed economically in the aggregate, however, form a very small proportion of the total expenditures, so that the claim may be properly made that the percentage of failures due to all causes has been as small and possibly less than that of any large corporate undertaking. Judging from the biographies of great captains of industry—Hill, Harriman, Morgan, and others, the percentage of success attained by them in their investments is, to say the least, no greater than that of the investment of the reclamation fund.

Planning and Construction

Beginning with a few projects, which had already been examined by the Hydrographic Branch of the Geological Survey, step by step the work was entered upon in each of the reclamation states. Contracts were let and an organization was built up for doing those things which could not well be covered by the usual form of contract. It was found, for example, that the awarding of contracts for deep foundations for dams in relatively inaccessible places or for digging of tunnels under conditions which could not well be determined in advance, resulted in many failures and in protracted lawsuits. Better results could be obtained if the risks of such enterprises were assumed by the government directly rather than left to competitive bidding, especially where contracts under the law must be awarded to the lowest bidders, many of whom were then unskilled in this particular type of work. The best results were obtained where the government forces and the contractors were practically on a parity, in that the results of one method could be checked up against that of the other. The highest degree of economy and efficiency was secured through the competitive spirit thus developed.

Because of this relative freedom of organization and of method it was possible to build up in the Reclamation Service a morale or an *esprit de corps* such as has been rarely attained in government service. Every engineer, technician, or clerical employee, who has been connected with the Service, looks back with pride on those days when the organization was pushing ahead, carrying on its great work not only with a high degree of precision, but, more than this, with the feeling of mutual respect and confidence due to the free expression of minds unhampered by outside control.

The organization of the Reclamation Service kept pace with the selection of new projects and the letting of contracts or beginning of work on these. In this selection consideration had first to be given, as before noted, to state lines because one of the requirements of law was that at least one project should be located in each state; hence the entering upon the Garden City project in Kansas, the Williston Pumping project in North Dakota, and a few others. Next to this was consideration of the existence of public lands. And here, as before stated, was encountered one of the first obstacles. For example, in Nevada the irrigable public land alternated with sections of land granted to the Central Pacific Railroad. Public exasperation against the railroad was such that the government was not justified in attempting to reclaim these public lands within the limits of the railroad land grant; moreover the railroad officials at that time were not inclined to make these lands available for reclamation and settlement, excepting under terms which were practically prohibitory. In this case, therefore, it was necessary to go outside of the railroad land grant limits and take lands which in some ways were less favorably situated.

Careful consideration was given to soil conditions, the probable extension of railroads, and possibly crops and markets. At that time the study of the soils was relatively in its infancy and while the soils were classified, yet few men dared to venture an opinion as to what kind of crops might be successfully grown after the lands had been irrigated a few years. They were wise in this position, because the outcome of twenty years' experience has shown that much of the soil then considered of the very best quality has become hard or impermeable to water, and other soils regarded as doubtful, have been transformed and are now productive. These changes are discussed by Carl S. Scofield in a succeeding article, but emphasis should be placed upon the fact that even today, with all the experience had, a man will be rash indeed who will attempt to select irrigable land on the basis of the ordinary soil survey and to predict what changes will occur during the next ten years.

This selection of land was of course controlled by the policy to obtain water and bring it by gravity to the highest point of each possible farm. Here the topography controlled, and while selection was made where practicable according to considerations of soil as well as climate, transportation and markets, yet the choice was necessarily narrowed down to the relatively few places where water could be had.

Moreover, the questions were not those simply of getting water but more than this of providing a quantity adequate for dry seasons and yet at the same time not restricting the area of land so greatly that the cost per acre would be excessive. In nearly all of the projects entered upon by the Reclamation Service some storage had to be provided. This is because of the fact that when the law was passed, all of the easily available sources of water had been filed upon and put to partial use leaving to the government only the excess water which came in irregular floods.

The problem of flood storage has been not merely that of holding enough water for the next year but of anticipating the probable demands for several successive years of drought. While it might be practicable to irrigate alfalfa for example, during a year of ample water supply, and then let the fields go without water during the next dry year, such course of procedure would be ruinous to orchards and to well planned sys-

tems of rotation. The providing of storage, therefore, is by no means a simple mechanical process but one involving careful judgment based upon long continued studies of the erratic water supply.

The one feature which characterizes work under the reclamation act, differentiating it from most of the private enterprises which had preceded it, was the relative permanence of all structures, especially of

FIG. 4—LOCATION OF GOVERNMENT IRRIGATION PROJECTS

storage reservoirs, diversion dams, flumes, and similar works. In the case of private enterprise, the heavy interest charge on permanent investment on the money borrowed for construction necessitated keeping down this amount to the very minimum, thus utilizing wood for dams and flumes, even though it was known that these would decay within a few years. It was hoped that those wooden or temporary structures would hold together long enough to permit the investors to get their money back. In the case of government funds, however, bearing no interest charge, and devoted to works intended to last for centuries, the chief consideration was permanence, this being in the long run the highest economy.

The construction at the outset was as a rule by contract, but conditions forced the taking over of some of these contracts and completing them by daily labor. The experience thus acquired showed that the government engineers with ample funds available could really do the work at less cost, all things considered, than could the usual contractor who was compelled to buy equipment for each new piece of work and to borrow money often at ruinous rates. Thus grew up the so-called force account and construction accompanied by careful cost-keeping not only of the work done by the government but of that done by contractors so that at all times a comparison could be made of the relative economies of each system of work.

The engineers and all others connected with the work were carefully selected by intelligent application of civil service rules. During the first decade at least, or until the politicians discovered the service, it can be truthfully claimed that not a single appointment or promotion was made for other than ability and merit. Thus was developed a somewhat remarkable body of men and today one of the greatest satisfactions is to find that practically every man and woman who has been connected with the Reclamation Service speaks of this connection with pride.

Out of this condition has grown perhaps a most remarkable series of engineering successes. It is true that, looking back, it would now be possible to improve some of the plans, but this can be done only because of the results developed in these earlier works. Many attacks have been made upon the Reclamation Service and for years congressional investigation committees took up one phase or another. At one time a body of army engineers was appointed by President Taft to make a study. Their report was highly gratifying and it is probable that no man in the Service would or could have written a more commendatory statement than that given in the cold language of an official report.

Work Done

Briefly enumerated, the total amount of work achieved may be summed up in the following statement: that on 26 projects located as shown in Fig. 4, water can be served to 3,000,000 acres in round numbers, including from these projects, 1,700,000 acres for which the government systems furnish the sole supply for irrigation. Of this latter, 1,200,000 are actually harvested. The total number of irrigated farms is 33,000 and the population of these farms, 125,000. The gross annual crop is valued at $50,000,000. The increase in value of lands and other properties on farms and in towns, within the projects is estimated at $550,000,000. The works as now constructed included 100 storage and diversion dams, reservoirs with a capacity of 10,000,000 acre-feet or storage, 4,000 miles of main line canals, and 8,000 miles of laterals or distributaries, 28 miles of tunnels, 140 miles of flumes, 9,100 bridges, and thousands of smaller structures.

Looking back over a stretch of twenty years of intimate connection with the engineering, technical, and administrative details of the Reclamation Service, there stand out amid the host of recollections certain impressive pictures. During this time over $140,000,000 of federal funds have been invested in building large works of reclamation, some of them monumental in character, all designed, however, with the ultimate object of providing opportunities for small self-supporting farm homes. The results attained in number of homes and in crop produced have exceeded the expectations of the advocates of the reclamation law. At the same time, however, there have been disappointments and failures, such as are inseparably connected with any human enterprise.

From the purely engineering standpoint, there have been notable advances in methods and efficiency of construction. These have kept pace with the development of similar work elsewhere, since the operations under governmental control have been checked up continually against those handled by corporations or individuals. There has been a continual interchange of ideas, the government works have been visited at short intervals by engineers and experts from all parts of

the world, incidentally contributing information or advice, as well as receiving inspiration for inaugurating similar works in other countris, and in other parts of the United States.

The files of *Engineering News-Record* contain full descriptions of most of the notable works and of methods employed in construction, so that at this time it is hardly necessary to comment upon these other than to refer to the fact that these works have served to a certain extent as a training school for many of the engineers of the present generation and to a certain degree as a laboratory of research into details whose practical applications were needed in the completion of other undertakings.

With the completion of the works, however, it may be said that "the real trouble begins." Under the original conception of the act, it was assumed that as soon as the works were done the government in some way would step out and would be concerned merely with the collection of the cost. This, however, has not been the case. Instead of being able to step out, the government has become more and more entangled in petty personal details of peddling water to thousands of land owners. Among these land owners are good farmers on good lands having good results, and on the other extreme are inexperienced or poor farmers on poor land pursued by bad luck. In between are all gradations of ability, experience, strength, good health and good sense.

In general it may be said that the reclamation act in many ways is ideal, but to be successfully operated it must have ideal men and ideal communities such as do not yet exist. Most of the efforts of Congress since the passage of the reclamation act have been along the line of trying to patch it up to fit the needs of the inexperienced land owner, the "town farmer" or speculator. The ideal land owner and water user is not in the majority. Year by year efforts are being made here and there to lower the requirements of payment and to add more and more money to the fund to make up for the fact that payments are not promptly made. There is now quite a volume of law and decision so that it is rather difficult to gain a comprehension of the actual intent and operation of the law. Because of this, many citizens are urging that there be a rather complete revision of the law based on the experience of the past twenty years, strengthening the desirable portions and modifying other parts to meet conditions which have arisen. Moreover, the excellent results which have come from the passage of the reclamation act have attracted the attention of taxpayers in other parts of the country and they in turn are asking that the law be made broad enough to cover the reclamation and use of waste lands in every and all parts of the United States.

[*This is the first of a series of articles discussing the problems and progress of the Reclamation Service. The next article will appear next week.*—EDITOR.]

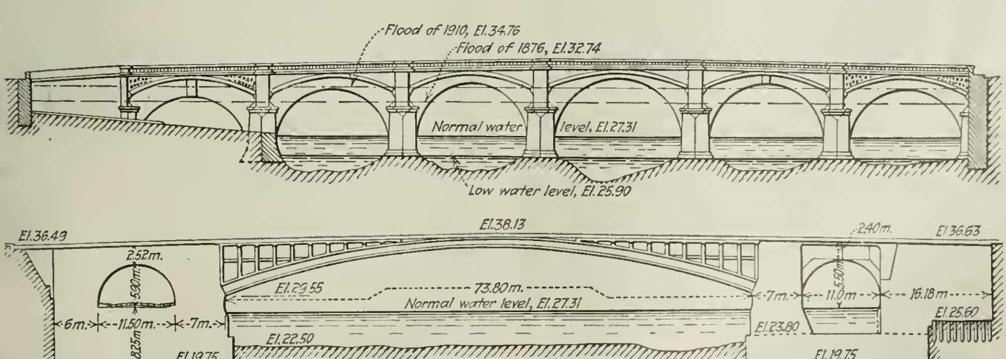
Rebuilding Tournelle Bridge as Flood Protection Measure in Seine River

FOLLOWING the extraordinary flood in the Seine which caused much damage to property in the region of Paris in 1910, important engineering works have been conceived to limit damage which might be caused by similar conditions. These projects have been of diverse nature, designed to be carried on as a comprehensive whole. For instance the program includes construction designed both to facilitate the passage of flood waters through the Paris district as well as to reduce the intensity of flood waters.

In the first group of improvements is found the repair of the shore works of the Island of Saint Louis and of the Tournelle bridge. The reconstruction of the Tournelle bridge is now being carried on. The bridge has been demolished and a new structure is to be erected as soon as certain legal obstacles to reconstruction have been disposed of.

The Tournelle bridge was one of the oldest in Paris, having been built in 1654. Like all structures of its era, it contained semi-circular arches of small opening, making navigation more or less difficult, particularly during high water. In addition, during floods, free passage of water was impossible because of the number of piers, and the spandrel walls formed a dam when the water rose above the crown of the arches. This was the case in 1910, the key of four of the six arches having been submerged. The new designe, says a recent issue of *Le Genie Civil*, contains a main reinforced-concrete arch 73.8 meters in span, resting on abutments 25 meters in length containing arches with opening of 11 meters and 11.50 meters, respectively.

The crown of the reconstructed arch is above the record water height of 1910. Passage of excessive flood waters is facilitated in another way by the new design which provides for the floor system to be carried on continuous columns spaced at 2½-meter intervals.



ELEVATION OF OLD TOURNELLE BRIDGE AND DESIGN FOR NEW BRIDGE

Damaged Earth Dam Repaired by Hydraulic Fill

Over 300,000 Cu.Yd. Pumped Into Embankment, Reduced by Settlement and Wave Action —Pump Fed by Drag Bucket

By M. E. Bunger
Engineer, Model Land & Irrigation Co., Trinidad, Colo.

A LESSON of faulty embankment construction is contained in the series of repairs to the earth dam of the Model Land & Irrigation Co., near Trinidad, Colo. Incidentally the work illustrates an interesting combination of equipment for making hydraulic fill.

The dam for the Model Reservoir is an earth structure 5,900 ft. long and 45 ft. high. It was built with a 1 on 1½ slope on the inside and a 1 on 2 slope on the outside and and 18-ft. roadway on top. Teams and dump wagons were used and the fill was not puddled and received only such rolling as would occur from hauling over it. An unexpected flood showed the fallacy of such construction; the water went right through the structure. For some unknown reason, however, the earth above the hole caved in and stopped the flow and only a small amount of damage was done. The dam was then puddled by pumping water into it through holes jetted down from the top.

The inlet ditch of 3,000 sec.-ft. capacity comes into the reservoir at the south extremity of the dam, and

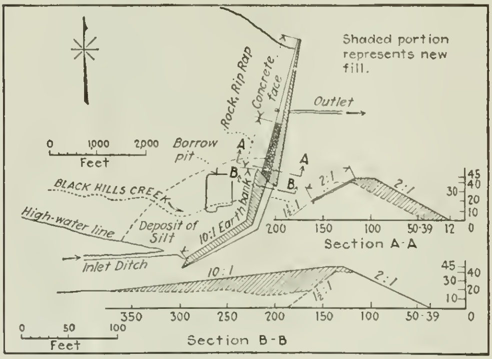


FIG. 1—PLAN AND SECTIONS SHOWING REPAIRS

as the outlet is near the north extremity the silt carried by the water was deposited along a greater portion of the inside face. This has been a great factor in sealing up the dam and making it safe for the storage of water.

On the inside the dam was faced with a 6-in. layer of concrete reinforced with hog wire fencing. The hog wire was placed longitudinally and the contractor was not careful to lap or fasten the wires. When the dam settled, lines of weakness developed at these points and the concrete face cracked. The waves, where these cracks occurred, would run up the concrete, enter the cracks and carry away the earth underneath. Concrete patches were put over the cracks but as no reinforcing was put in them, they would in turn crack and the earth was removed as before.

Several terrific wind-storms occurred during the month of May, 1920, while the reservoir was two-thirds full of water, with the result that the upper 19-ft. vertical elevation for a distance of 1,500 ft. in the center of the dam was completely destroyed. A partial failure also occurred on 2,500 ft. more of this facing on both sides of the center portion that failed. Where the concrete was not entirely destroyed the facing was repaired by placing over it a new layer, 4 in. thick, of 1:2:4 mix, reinforced with ½-in. square, twisted rods spaced 14 in. both ways. In the places where the old facing was destroyed the cavities were filled with earth and well puddled and a new layer of concrete 6 in. thick was placed over them. This repair work took care of 1,600 ft. of the facing.

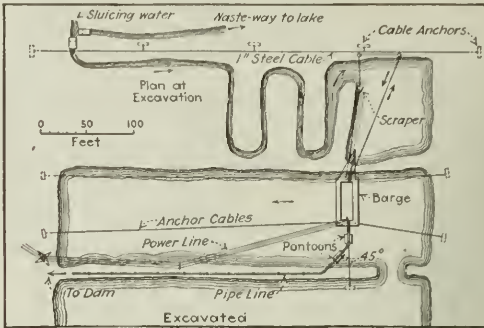


FIG. 2—PLANT LAYOUT FOR HYDRAULIC FILL OPERATIONS

On the next 1,500-ft. section where the concrete was entirely destroyed and over 2,000 cu.yd. of dam washed away, it was thought best to cut the face back to a 1 on 2 slope and face with riprap. It was thought that the riprap being rough would greatly decrease the wave action and would be more elastic than the concrete. The upper 19 ft. vertically of the dam for a distance of 1,500 ft. was then cut to a 1 on 2 slope and the earth used to build back the face. This earth was thoroughly puddled and packed. After this was done there was needed about 1,000 cu.yd. more to complete the face.

Hydraulic Fill Operation—The puddling of the dam and the manner in which it was built caused a settlement beginning with 0 at the north end and amounting to between 5 and 6 ft. in the center. It was necessary, in order to fill the reservoir to the capacity for which it was built, to build back this five or six feet. To increase the height and to maintain a roadway on top especially where the face was cut to a 1 on 2 slope, it was necessary to build up a layer of earth on the outside 27 ft. wide (Fig. 1). This work involved placing some 160,000 cu.yd. of earth, all of which if taken from without the reservoir would have to be hauled from the extreme ends of the dam as all suitable earth below had been used in building the dam originally.

Beginning at the south extremity of the dam and extending north for a distance of 2,800 ft., a large quantity of silt had been deposited, reaching a maximum depth of 20 ft. This silt extended out 1,000 ft. from the dam and was composed of layers of sand, gravel, silt and pure blue clay. The layers of clay varied from 2 in. to 4 ft. in thickness and were soft and boggy. It was figured that if a method could be found to utilize this material in the reservoir it would be cheaper on the south 2,900 ft. of the dam to place an embankment on the inside against the old facing and on top of the silt already deposited with a 1 on 10 slope on the in-

side, to resist wave action, than it would be to build up on the outside 27 ft. wide and repair the facing above the silt on the inside. It was decided to build a dredge in the lake and pump the material for the 1 on 10 slope on the inside for the south 2,900 ft. of the dam, and for the layer 27 ft. wide on the outside for the remaining portion and also to pump the material required to build back the face. The total volume to be moved was approximately 300,000 cu.yd. Pumping had the advantage of having the material thoroughly packed when it had settled and, where pumped on the outside, of forming a perfect bond between the old and new portions of the dam and puddling the old dam where it had not been puddled before; also the removal of the silt would increase the capacity of the reservoir.

A barge 24 x 50 ft. was built and equipped with a 10-in. centrifugal sand-pump, belt-driven by a 200-hp. motor; a 3-drum hoist driven by 25-hp. motor; a 2-in. priming pump driven by a 10-hp. motor; and other accessories necessary for the operation of the barge.

It was necessary to build 8 miles of standard transmission line for 22,000 volts, from one of the coal camps west of the reservoir. This current is transformed down to 2,300 volts and carried to the barge on insulated cables supported by movable towers 14 ft. high. The 200-hp. motor operates at 2,300 volts but transformers are placed on the barge stepping the current down to 210 volts for lights and the other motors. Twelve pontoons were built to carry the pipe line close to the barge. The pipe used consists of 300 ft. of 10-in. standard rolled steel pipe, 500 ft. of riveted steel pipe with flanges and 1,000 ft. of riveted steel pipe with slip joints.

After the dredge was in operation it was found that the material would not cave and readily slide toward the nozzle and that to run the pump to capacity some method of bringing material toward the nozzle was necessary. Sluicing with water by gravity was first tried. A hole was excavated 16 to 20 ft. deep with the large pump assisted by a high pressure jet from the small pump. Then a stream of water, about 15 sec.-ft., was turned into the hole. As long as this water was running through silt and sand it sluiced very readily but when a layer of clay was encountered cutting ceased and it became necessary to trench with shovels before the material began to sluice again. While this trench was being cut, the pump would be handling little or no solid materials and it was difficult to hold the clear water in the forms. Various scrapers were then tried that would cut through the blue clay rapidly and also drag it into the nozzle. A scraper was designed that would peel off a layer 2 or 3 in. thick of any material over which it would run, and was so designed that when it was loaded to capacity the cutting blade would automatically be lifted and the load pulled into the suction nozzle without further cutting. This scraper drags in from 1 to 6 cu.yd. at a trip depending on how the material caves in front of it.

It was found that some of the material would stand with a vertical face though the cut would be 20 ft. deep and the only way it would cave would be to undermine it. If the bottom layer happened to be sand this undermining could be done very readily with water, but if it happened to be clay, water had little effect on it. A modified road plow was bolted onto the side of the scraper in such a fashion that as the scraper was being drawn back empty the plow would turn out a furrow from under the cliff whether the material was clay or sand and generally after two or three trips with the plow the bank would cave.

The method of operation has been to lay out the silt in areas 100 ft. wide and 500 ft. long and construct a sluicing-ditch back and forth across this area (Fig. 2). The dredge was started at one side and moved as the material was excavated. The sluicing is done in a trench perpendicular to the direction of the scraper This gives a maximum fall for the water and allows the material caved by the scraper as well as that caved by sluicing to become thoroughly mixed with water before being brought to the nozzle (Fig. 3). As the scraper comes to the nozzle, the nozzle is lifted by the operator and the hole underneath is filled with the scraped material. Then while the scraper is going back after another load, the nozzle is worked up and down and gradually clears out the hole for the next scraperful. This method does not choke the line with mud and gives an even flow of solids. The sluice water runs toward the nozzle and is carrying solids continually. A dike is maintained between the barge and the end of the nozzle in order that clear water may be available for the small priming pump and also to confine water so that all sluiced material will settle where either scraper or sluiced water can reach it. A small dike is also

FIG. 3—SUCTION PIPE AND SUMP FOR SAND PUMP

maintained between the area being scraped and the one previously scraped out to confine the water within the area accessible to the scraper. This dike is removed when the dredge is ready to be moved to a new location. After one area 100 ft. x 500 ft. has been excavated the dredge is floated into the pit and a new land opened up.

Settlement of Pumped Material—Where the material is used to build up a layer 27 ft. wide on the outside of the dam a wooden form is used on the outside consisting of two 2 x 12-in. x 16-ft. boards bolted to two 2 x 4-in. x 2 ft. 6-in. long uprights spaced 4 ft. from the ends. These forms are lapped and held by three pipes which are old boiler flues cut in 5-ft. lengths. These pipes are driven into the ground a distance of 2 ft. No bracing is used on these pipes except at the lower end where a pool of water is held to aid in the settlement of the extremely fine particles. The tail water from the outside is run back into the reservoir

through a 24-in. tile placed through the north extremity of the dam when it was constructed. When the form is filled the pipes holding the forms are removed and the boards are placed on the filled portion 4 ft. from the edge. A little straw is placed where the board rests on the sand and an embankment is thrown against the form with a railroad wing plow pulled by horses. This prevents the water from cutting under the boards. This outside form is 2,700 ft. long and six men are employed to watch it to prevent leaks and to turn the current when it runs toward the form. About five days are required to pump the form full and two days more are required to change the forms and plow the embankment against them.

On the inside where the fill is made with a 1 on 10 slope no wooden forms are used but a dike is thrown up with the wing plow and only two men are employed to watch 2,500 ft. The water, when the material is pumped inside, after all the solids are settled out, gets back into the sluicing-ditch and is used again.

The delays so far have not been very serious or have not added greatly to the cost. The main causes of delays are breaks in the sluicing-ditch, breaks in the forms on the outside and the choking of the nozzle with lumps of coal and trash. When the nozzle is choked the sluicing water is cut down and the speed of the pump is reduced to the minimum and the nozzle is raised as high as permissible without losing the priming. The operator then gets down and removes the material caught on the screen either with his hands or

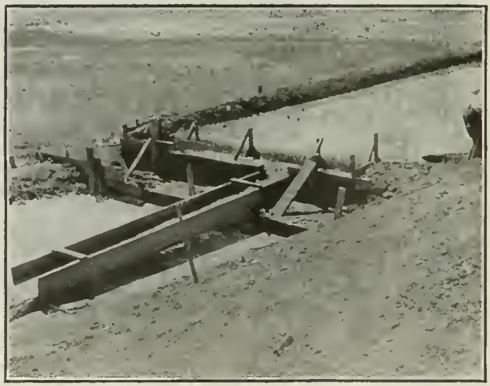


FIG. 4—WASTEWAY AT END OF FORM FOR DOWNSTREAM FILL

feet, sometimes using a bar. After it is clean, the nozzle is lowered and the pump speeded up The advantage of this method is that the priming is not lost.

A log of operations is kept and there is not lost during the 9-hour day over an average of ¾ hr.

The cost of the entire plant ready for operation was $41,084.91. The cost of labor, power, repairs and all other expense incidental to the moving of the earth has been $25,504.52, and the total yardage removed to date has been approximately 210,000 cu.yd. at a cost of 12.14c. per cubic yard. Figuring the cost of plant into the work, the total cost to date would be 25.83c. per yard.

The cost of reinforced concrete averaged $17.50 per yard and the cost of the rock riprap averaged $7.50 per cubic yard laid on the face.

Through the Reclamation Country

By F. E. Schmitt
Associate Editor, *Engineering News-Record*

A SERIES OF ARTICLES on Federal Land Reclamation starts in *Engineering News-Record* in this issue. It will give a history of the twenty-one years of government irrigation, state the many problems of operation—engineering, agricultural and financial—analyze the various complaints that are being so emphasized by those who are seeking a reform of the current law and methods and seek to present some views as to a constructive policy in the future. Through it all will run the evident theme that irrigation, from planning, through construction to operation, is a continuing engineering problem.

As a part of the preparation of the series Mr. Schmitt is now traveling through the West, visiting irrigation projects, studying developments and interviewing builders, operators and settlers. He is writing this series of letters of running comment on the situation as he sees it on the ground. These are not the final result of his trip but they will serve to acquaint our readers with the actualities of reclamation as revealed to an unprejudiced investigator.

This is the fourth letter. The first appeared in the issue of October 4.—*Editor.*

Portland, Ore.

Complaints Against Increased Costs—A common matter of complaint by farmers on the reclamation projects is the high cost of the works, and more particularly the excess of cost over what was originally estimated or (as they say) promised. This subject seems to have been a source of animosity from an early period.

A newspaper editor who has lived near the Uncompahgre Reclamation project for many years says that he saw the engineer's original memo giving $22 as the construction cost per acre, with a safety margin. The project has cost $70 per acre and may cost more if drains are built. He protested against the injustice of burdening the farmers with excessive construction costs and said that unforeseen troubles and costs should be borne by the government, just as a contractor sticks to his bid and puts the job through even at a loss.

In Idaho, on the north unit of the Minidoka project, a representative of the water users complained of the effect upon the farmers of what he called the wrong estimates of the engineers. He claimed that the first announcement of cost was below $25 per acre, that later, on account of building laterals, the figure was raised to $30, and that now it is $42 because of expenditures for drains.

The facts are that in every case after a cost had been definitely announced each proposed increase in expenditure was discussed with the water users and carried out only with their approval; that the first plans for many projects contemplated building only the main supply lines; and that the data which answer complaints and criticisms like the above are available to the leading men among the farmers. The case of the Uncompahgre costs was fully dealt with by Arthur P. Davis in a statement presented before a congressional committee last winter. The Minidoka people know that their costs are moderate. Complaints against costs are repeated probably because they are convenient talking points rather than because they represent genuine grievances. The costs in all cases represent necessary investment to make the land productive.

Laterals and Drainage—From their early days the needs of the reclamation projects have expanded. Originally it was the plan of the Service to build in the way that most private or group irrigation systems had been built, that is, to provide the supply (storage or diversion) and main canals, leaving the farmers individually or in small groups to dig their lateral ditches. Even today most private systems are on this basis. But the government settlers needed to have the laterals brought to them. The Service therefore built canals up to each farmer's land. Even so, an occasional farmer complains because the government did not carry its ditch to some other point of his farm, that would suit him better.

Drainage became necessary later. It does not appear to have been foreseen in the original planning that continuous irrigation would raise up the ground-water contours and in time waterlog the lower points of the area. Drainage ditch construction has had to be undertaken on an extensive scale by the government. The drainage is being steadily extended on most projects, as the ground-water surface has not yet reached a stable level even after fifteen or twenty years of irrigation. Incidentally, exactly the same is true on private projects, and the South Side Twin Falls district, some distance west of Minidoka, is now busily engaged in drainage work, though it has been in operation for more than fifteen years and is underlain by hundreds of feet of fissured lava beds with free vent to the Snake River Canyon, along one edge of the area.

There have been some increases in cost due to unforeseen natural obstacles—as the construction difficulties of the Gunnison tunnel supplying the Uncompahgre project, which made the contractor abandon the work and required the Service to complete it—or due to changes in labor cost and the like. In some cases too, there has been unfortunate concentration of cost, as when the irrigable area was reduced by abandoning part of the land so that the remaining land was made to bear all the costs. But the reclamation farmer has not been burdened with the costs of waste or failure, as represented by the Jerome Reservoir in Idaho (private) or the Tumalo Reservoir in Oregon (State) both failures. The Reclamation Service has done its work well.

The aggregate fact is that irrigation costs are inevitably uncertain at the start, and that some misunderstandings may easily result herefrom. Again, however, private projects furnish parallels to the experience of the Reclamation Service. On the North Side Twin Falls project, says its manager, R. E. Shepherd, the original calculations of cost showed $25, $35 and $40 per acre, respectively, for three successive divisions, and land was sold accordingly (this was a Carey Act project); but the actual cost, with accumulated interest, today stands at $80 per acre, and on present sales this amount is asked.

Criticisms of Water Supply—There are some criticisms of inadequate water supply. This is a very natural subject for differences of opinion. The water required for good irrigation results depends on the soil, being greater for porous than for tight soil. In some districts it also depends on the salt content of water and soil, which may require excess water for leaching purposes. But in all regions it also depends on the farmer; he must give some extra attention and labor to use the water economically and to avoid waste by overflow. On the south unit of the Minidoka project, where all the water is pumped, the farmers' representatives claim that they are hampered by insufficiency of water in July, and a specially careful and thrifty farmer said to me that, while his crops are good, he thought he could do considerably better with more peak-season water. Leaching is not required at Minidoka. On the face of the crop records this unit is producing as well per acre as neighboring irrigation areas, which rather opposes the claim of harm from water shortage. As the pump and canal capacity do not permit of increased flow, moreover, one might expect the farmers to be content with conditions, at least for the present. That they are not, seems to be merely another illustration of the unrest, not to say demoralization, created by the element of politics in reclamation.

However a vote of the farmers on increasing the supply was taken at Minidoka, a few weeks ago, under orders from Washington; the proposition was defeated. It may be that the farmer's good sense is getting the better of political quarrelsomeness.

Construction Costs in France

Paris Correspondence

A REPORT of the Federation National Française du Batiment et des Travaux Publics has the following to say with regard to construction costs in France.

Construction costs are arrived at from the consideration of three principal elements—material and its transport, labor and general overhead.

Since 1914 prices of building materials in France have undergone important and frequent variations.

In the mass there was general and steady rise of material costs until 1920 when they reached their extreme height with a coefficient of increase (the quotient being the figure of 1914) between 4 and 5, on certain items even exceeding the latter figure.

A notable fall in the prices of many items was remarked in 1921 and continued progressively until the beginning of 1923, at which time the prices in general began to climb again, without however, having, as yet, reached the figures of 1920. This situation of 1923 is laid to two causes, the increase in the cost of combustibles and the high rates of foreign exchange.

In general, wages have undergone notable increases and overhead expenses have continually increased by reason of various forms of taxation which today apply to the contractor and construction engineer which hitherto had no part in the fiscal policies of the government.

Summing up, it was estimated that construction costs were 3.5 times as high as in 1914. Taking into consideration interest charges and the value of money in the financial market the owner of a rented building was justified in charging four times a pre-war rental, assuming that it was a new building with which he was dealing.

U. S. Weather Bureau Aids Rain Insurance

Many insurance companies have been working on the question of the risk involved in insuring entertainments such as fairs, fashion shows, ball games, balloon races, stock exhibits, etc., against poor gate receipts because of rainy weather. While rain insurance is a private enterprise, the U. S. Weather Bureau is called on to furnish data as to the frequency and amount of rainfall in given places at stated seasons, or otherwise to supply information that will aid rain insurance companies to estimate their risks and adjust their rates.

Modern Steel and Reinforced-Concrete Structures Survive Japanese Earthquake

Report of John W. Doty and W. W. Johnston, American Engineers, Gives Results of Survey in Yokohama and Tokyo After Disaster of Sept. 1

The first authoritative information regarding the condition of engineering structures after the earthquake and fire which destroyed portions of Yokohama, Tokyo and other smaller municipalities of Japan on Sept. 1 is contained in a report to the Secretary of State, Washington, D. C., prepared at the request of Ambassador Woods by John W. Doty, president, and W. W. Johnston, engineer, the Foundation Co., New York, who were aboard ship in Yokohama harbor when the quake occurred. This document, the source of the information which follows, adds a great amount of detail, based on personal observations of the two American engineers from Sept. 1 to Sept. 12 in both Yokohama and Tokyo, to Mr. Doty's diary published in "Engineering News-Record" of Oct. 4, p. 569.—EDITOR.

THE FIRST earthquake shock occurred at 11:57 a.m. Sept. 1, causing the greatest damage in an area of about 80 miles, north and south, and 65 miles, east and west, centering in the neighborhood of Yokohama. The quake at Yokohama seemed to be continuous for a period of from 40 to 60 sec., and was followed by repeated shocks of lesser intensity over a period of five or six days. About 700 shocks were counted during the first four or five days. A report issued by the Japanese Government on Sept. 4 stated that there would be at least an additional 300 shocks before the earth's surface would readjust itself.

Tokyo, the capital and largest city of Japan, has a population, including suburbs, of more than 3,000,000. It is about 18 miles from Yokohama, the seaport, which has a population of 423,000. Japan itself has a population of 56,000,000. The area seriously damaged by the earthquake contains about 4,500,000, or 8½ per cent of the total population.

On Sept. 3 Mr. Doty and Mr. Johnston began an inspection of the effects of the earthquake on various types of structures in Yokohama and Tokyo. From their joint diary of this trip the following excerpts are taken:

Quake's Effects in Yokohama

The sea walls along the waterfront at Yokohama were seriously damaged and portions of them overturned. The first structure of note was the bridge across the canal at the south end of the Bund. This was a modern riveted-steel structure about 100 ft. in length. The superstructure was not damaged but the wing walls of one abutment were broken and the approaches to the bridge had settled some 2 or 3 ft.

We walked along the Bund where all the buildings were completely destroyed and there were many fractures noticeable in the streets. The walls of the City Hall were standing but the whole inside of the building had been burned. The street was a mass of fallen electric service wires and at the junctions of the streets it was in places difficult to get through them. A large reinforced-concrete building of some six stories facing the end of that street had been completely burned, but the concrete frame and floors appeared to be undamaged by either the earthquake or the fire. We passed the Chamber of Commerce, a brick building of 3 or 4 stories with a clock tower 100 ft. high. This building was destroyed by fire, but the walls and tower were standing.

The Yokohama Specie Bank, a three-story structure 200 ft. square, equipped with steel fire doors and shutters which had been closed prior to the fire from the outside, appeared to be the only building in this part of the city which was intact. It was subsequently rumored that the building had been destroyed inside by fire which had gained access through the roof. This we were not able to verify.

DAMAGE ALONG THE BUND, YOKOHAMA

We passed along the main street where most of the structures were of the older type with brick walls and probably wooden floors and partitions. All of these buildings were totally destroyed and most of them appeared to have collapsed prior to the fire, and no wood or other burnable material was to be found amongst the wreckage. This would indicate the tremendous heat of the fire. There were two small buildings of modern reinforced-concrete construction whose general framework seemed to be intact but the contents had been totally destroyed by fire.

The bridge in front of Sakuragicho Station, which is a modern structure, seemed to be in fairly good condition, although the street approaches had settled. In this vicinity there were also large fractures in the ground, some of which were 18 in. wide, running at right angles to the canal and parallel to the main shore

of the bay a half mile away. This confirms the statement of some eye-witnesses that these fractures were parallel to the crest of the land waves which were plainly visible.

Crossing the bridge we arrived at Sakuragicho railway station. A few of the walls were standing but the structure was, for all practical purposes, totally destroyed and all the district around the station had been not only destroyed by the earthquake but also by the subsequent fires. Not even a wall was standing, but the brick retaining walls of the railroad embankment seemed to be intact.

Proceeding along the main road to the Yokohama station it was remarkable that the only two buildings remaining intact, a modern type reinforced-concrete and an old fashioned brick building, are side by side and show no indication of having been damaged by either earthquake or fire, although they are surrounded by complete destruction by both. Back of these buildings and against the hill some two blocks distant, the gasometer was uninjured, although the pumping station directly adjoining it was damaged by both the earthquake and fire, and all the other scattered houses along the hillside had been burned. In this section we saw two unburned street cars. Most of the main Yokohama Station had collapsed and had been damaged by fire although some of it was standing.

Under the bridge where the railway crosses the street at the Yokohama station there were many large fissures in the ground and beyond the bridge the street was practically covered with fissures. A 20-ft. embankment on the branch railway had been shaken down and the rails and ties remained suspended. Several structures between the railway and the waterfront remained standing and were apparently uninjured. It cannot be too strongly emphasized that, with the exception of those buildings named and a very few damaged dwellings in the foreign settlement on the Bluff, all of Yokohama has been completely destroyed.

Beyond Yokohama Station along the road parallel to the railway tracks a great many fissures occurred on the streets and practically all the distance to Tokyo. Along this road through Kanagawa and to Kawasaki, a distance of $2\frac{1}{2}$ or 3 miles, all the buildings were destroyed by the earthquake and fire. The railway bridge out of Yokohama, which was constructed of deck plate girders spanning the canal was destroyed by fire. The girders sank vertically about 6 in. by the heat. The ties were completely burned and the rails, although remaining connected, were buckled, resembling a letter "S." This bridge was a two-span 4-track structure about 75 ft. long.

The fire ended very abruptly at a narrow street not more than 20 ft. wide. Along one side of this street the light frame houses had been completely burned, while across the street, although the houses of a similar type had collapsed into a mass of matchwood, they had not caught fire. From this point to the Rokugo River, about half way between Yokohama and Tokyo, there had been no general conflagration and comparatively few of the houses, which were all of native type, had collapsed in the earthquake, although many had been shaken and damaged.

Two railway bridges over the Rokugo River had been damaged but could be readily repaired. The wooden highway bridge on pile bents had been severely damaged by the sinking of two of the pile bents, but remained passable for foot traffic. On each side of and parallel to the river, fissures in the ground were noticeable for 200 ft. from the water's edge.

From the Rokugo River to Shinagawa and beyond, almost to Shiba Park in Tokyo, the damage visible from the road was comparatively small.

At Shiba Park it became evident that although certain districts in Tokyo had not been seriously damaged, in a large part of the city the destruction had been as complete as in Yokohama, and from Shiba Park to the Imperial Hotel many fires were still burning. We arrived at the Imperial Hotel at 7.45 p.m. and found it undamaged but in total darkness. We learned that the American Embassy had been burned and that the Ambassador had established headquarters at the Imperial Hotel.

Damage in Tokyo

In Tokyo an area of approximately 30 sq.mi. was completely destroyed. In this area a small portion known as the Marunouchi district, which included a number of large bank buildings, new office buildings and the Tokyo central station, and a section which included the Peers' Club, the Imperial Hotel and most of the various government buildings were only partially destroyed. That part of the city outside of the completely destroyed districts was severely damaged by the earthquake and isolated fires probably to the extent of 25 per cent of its value. It is estimated that between 60 and 70 per cent of the total property value of the city of Tokyo was destroyed.

The buildings which existed in Tokyo can be classified under five heads: (1) Native frame houses constructed principally of pine; (2) small structures with brick walls and wooden interiors; (3) larger government and office buildings of heavy exterior and interior brick walls, with wooden floors; (4) modern buildings of four to eight stories with structural steel frames and fireproof or slow-burning walls and floors; (5) reinforced-concrete buildings of from two to eight stories with concrete floors, exterior walls of concrete, or veneered with masonry or stone. Probably at least 80 per cent of the buildings in the city were of frame construction, 15 per cent of brick and frame, and 5 per cent of the remaining three types referred to above. Buildings are limited by law to a height of 100 ft.

In the area totally destroyed by the earthquake and fire all the buildings, irrespective of classification, were destroyed, the framework only of a few isolated reinforced-concrete buildings remaining standing. In a small unburned area from the government buildings near Hibiya Park to the Marunouchi district, with comparatively wide streets and a number of open spaces, containing principally massive or modern buildings of substantial construction, practically all the structures were more or less damaged by the earthquake, but only a few of them collapsed, although a number of them were burned. This area was saved from the general conflagration principally by a change in the direction of the wind, which caused the fire to turn back just before it reached this district.

Our observation of some of the buildings which remained standing was in general as follows:

Imperial Hotel—The building was standing practically uninjured. Following the moat toward the Marunouchi district from the Imperial Hotel, the Life Insurance Co.'s office building, a modern structure, was

not damaged by the earthquake and fire, although directly behind it a large three-story frame structure had burned.

Police Headquarters—This heavy governmental type of structure had withstood the earthquake but had been gutted by fire some time later.

Imperial Theater—The roof of this building, a modern structure of its type, collapsed on the first shock, and fire, which started from within, burned the whole interior but most of the exterior walls are standing. This example shows the necessity, in earthquake zones, of strongly buttressing the side walls and practically bridging the roofs in theaters or similar structures with large roof spans. If a large number of people had been in the theater at the time of the earthquake probably none would have escaped.

The Kaikwan—This structure, known as the Palace Restaurant, next beyond the Imperial Theater, was a modern steel-frame structure of six stories. The shock of the earthquake caused the outside walls and the interior partitions of the third story only to shatter and fall, leaving every steel column on that floor exposed. The lower two stories and the upper three stories appeared to be only slightly damaged. The exposed steel columns of the third floor were bent out of plumb, however, and the upper three stories were thrown on an offset of approximately 15 in. from the line of the lower two stories. The building had not been damaged by fire.

COLLAPSED PIER IN YOKOHAMA HARBOR

WAREHOUSE DAMAGED AS PIER SUBSIDES

There were a number of structures beyond the Kaikwan which were only slightly damaged by the earthquake and fire. These were principally three or four stories in height, of ordinary brick construction. Nearby, the structural steel framework for a new building which was being erected had collapsed and carried down with it some 200 workmen. In erecting steelwork where earthquakes are liable to occur each floor should be riveted and sufficient sway-bracing should be embodied in the design to make the frame of the building independently strong.

N. Y. K. Building—A new, modern, 6-story structure, which had just been opened, was of structural steel with very heavy masonry and brick walls. The exterior walls enclosing the second story were fractured by the earthquake, and cracks in the wall formed a distinct X in each panel running diagonally from top to bottom. The first story and the stories above the second appeared uninjured.

Marunouchi Building—A modern steel-frame office building of six or seven stories occupied an entire block. Although the building stood, some of the outside veneer was fractured or had fallen off. Across a wide plaza from the Marunouchi Building the Tokyo Central Station and Hotel, a massive brick-and-steel structure of four stories, was not seriously damaged by either the fire or the earthquake. The Kaijo Building was a modern six or seven story office building, having structural steel frame and brick exterior walls. The walls of this building were shattered throughout and in places had fallen to the ground, exposing the steel work. This building did not take fire. The Industrial Bank Building, probably the most modern building of its type in Tokyo, which had just been completed, the frame being either of reinforced-concrete or steel (our impression is reinforced concrete) seemed to withstand the earthquake without any damage whatsoever, even the large windows being unbroken.

Bank of Japan—This structure, outside the Marunouchi district and across the canal, is of old type, with heavy masonry walls. The fire doors and shutters were closed and most of this building seemed to be undamaged by either the earthquake or fire. It is the only building of importance in the totally burned zone that is now standing in usable condition. All other structures in its vicinity, including the Mitsui Building and the Mitsukoshi Department Store, were burned, but the frames of a number of modern structures of reinforced concrete type remained standing, although the buildings had been gutted by fire and, in many cases, the exterior walls thrown down. In the greater portion of the 30 sq.mi. of the totally destroyed area, however, few frames or walls of any description remain standing.

Most of the small canal bridges of modern construction seem to be little damaged.

In reconstructing Tokyo a proper building code should be adopted to minimize, as far as possible, damage by earthquake and, what is much more serious, the spread of fire, as the destruction by fire was far greater than by the earthquake.

Most of the isolated government buildings of heavy brick type of construction, located south of the Imperial Palace Grounds and west of Hibiya Park, were not seriously damaged by the earthquake or fire.

Interview with John W. Doty

In an interview with a representative of *Engineering News-Record* last week, Mr. Doty amplified some of the points covered in the foregoing report. He emphasized the fact that the earthquake alone was not responsible for the widespread damage done in Yokohama and Tokyo. The toll both in lives and in property damage was greatly increased by the fire which swept over the stricken cities after the shock. In any program of

reconstruction, therefore, Mr. Doty believes that the provision of fire zones and the widening of the old narrow, twisting streets assumes an importance equal to the building of modern engineering structures of reinforced concrete or steel, designed to resist earthquake shock.

"I believe I am well within the facts," said Mr. Doty, "when I state that 95 per cent of the real engineering structures of modern design in Japan withstood the earthquake. Many of these structures were later gutted by the fire, but, regarded solely from the structural standpoint. they proved adequate. In some cases, of course, the curtain walls on these modern structures were shaken down, but the main framework stood up and the damage was comparatively slight. With our present-day knowledge of building design and construction methods, we can produce structures for which I would have no fear in the event of a repetition of the earthquake shock of Sept. 1."

The big lesson to be learned from Japan's disaster, according to Mr. Doty, is the necessity of having the columns, walls, and floors of structures tied firmly together, forming, in effect, a rigid cage.

"Many people," Mr. Doty continued, "have a false conception of the action of an earthquake. It is not a single shock, like a quarry blast, for example, but is a series of violent oscillations extending over a considerable period—in the case of the shock at Yokohama from 40 to 60 sec. On a building whose main elements are not well tied together the effect of a quake is like that of a battering ram. During the first few seconds, if the structure be improperly designed, gaps will be opened between the floors and side walls. Into these openings will fall material shaken down from above. Beams, girders and flooring moving back and forth rapidly like the piston in a steam engine literally batter down the side walls of a building. This result, of course, cannot be produced if the parts of the structure are integral. The action on a building, during a quake, is comparable also with that of cracking a whip. The structure is actually a cantilever with its top end being snapped back and forth. It is necessary, therefore, to design the structure to resist great shearing stress."

In the case of reinforced-concrete structures Mr. Doty believes that resistance to earthquake shock can best be accomplished by casting the walls and columns as a unit, in this way tying the structure together. Japan's building laws at present limit the height of structures to 100 ft. Mr. Doty considers this restriction reasonable and would even go further, by reducing the figure to 75 or 80 ft., resulting in a building with a maximum of about six stories.

Japanese cities inherited from the days of the old empire flimsy structures of wood and brick, often covered with a heavy tile roofing. Unprovided with sway bracing, the walls during a shock would spread, allowing the roof, with its heavy load of tile, to collapse. It is probable, Mr. Doty believes, that these old types of structure will not be rebuilt. In replacing the smaller residence buildings he sees an opportunity for the effective use of asbestos shingles for roofing.

It is Mr. Doty's opinion that the results of the earthquake indicate that for moderate sized structures reinforced concrete is well adapted to resist shocks, while for the larger office buildings and other commercial structures either reinforced-concrete or modern skeleton steel-frame types will be found adequate. For the smaller structure he pointed out substantial economies in favor of reinforced concrete as compared with structural steel.

There is no doubt in Mr. Doty's mind that in the rebuilding of Yokohama and Tokyo modern methods of design and construction will be largely employed. It is significant that the Japanese government has ruled that only temporary structures may now be rebuilt without a permit. Due to rapid commercial developments land values in the larger Japanese cities have been increasing at a rapid rate, making uneconomical the low, old-fashioned structures in which Japanese business was housed. This will mean, it seems probable, taller and stronger structures.

If any larger-scale building program along modern lines is adopted, it is certain that Japan will call upon other nations, the United States and England particularly, for modern construction equipment and supplies. While the Japanese, during the last generation or two, have made substantial progress in modernizing engineering design, they are not equipped, as is the United States, with the machinery and tools to prosecute work according to American construction methods. The hazards of earthquakes, Mr. Doty believes, need not be regarded as a bar to the profitable investment of foreign capital in Japan, for the recent disaster has demonstrated conclusively that modern methods of building design and construction can be depended upon to produce structures that will stand up if adequate attention to the structural features of the problem is supplemented by intelligent planning to prevent the spread of fires.

Another A.I.C.E. Ethics Committee Case

AT A meeting of the American Institute of Consulting Engineers held recently, the Committee on Professional Practice and Ethics presented its report on a hypothetical question known as Case No. 21. The two phases of this Question and Answer, as reported by F. A. Molitor, secretary of the Institute, are reproduced herewith.

Question 1—When a member of the Institute has a partner who is not a member of the Institute and that partner, without his knowledge or consent, conducts himself otherwise than in accordance with the Code of Ethics of the Institute, what duty, if any, does the member of the Institute have to his brother engineers and the public with respect to the conduct of his partner? *Answer*—It is the duty of the member of the Institute to induce his partner to shape his conduct so as to harmonize with the ethical principles which the Institute has laid down for the conduct of its members, and failing to do so he should consider it his duty to sever his connection with either his partner, or the Institute.

Question 2—When an engineer, being a member of the Institute, conducts his professional practice through a professional service corporation, and representatives of that corporation, not under his direct control, conduct themselves, and the business of the corporation, otherwise than in accordance with the Code of Ethics of the Institute, what duty, if any, devolves upon the member of the Institute with respect to his brother engineers and the public? *Answer*—It is the duty of the member of the Institute to induce the responsible representatives of the professional service corporation so to conduct themselves and the business of the corporation as to harmonize with the ethical principles which the Institute has laid down for the conduct of its members, and failing to do so he should consider it his duty to sever his connection with either the professional service corporation or the Institute.

Industrial Waste Pollution Conference a Success

Held at Philadelphia Under Joint Auspices of Engineers Club and Local Section, Am. Soc. C. E.

A WELL-ATTENDED conference on the pollution of streams was held on the afternoon and evening of Oct. 16 at Philadelphia, under the joint auspices of the Philadelphia Engineers Club and the Philadelphia Section of the American Society of Civil Engineers. Among the hundred or so at the conference were many well-known sanitary engineers from New England and the Middle Atlantic States and also a goodly representation of conservation commissions and of the oyster, paper, and other industries. Among the topics on the program were federal and state control of pollution, stream pollution as affecting navigation, industrial wastes in relation to water supply, stream pollution at Philadelphia, and coal mine drainage contamination of water supplies.

The stream pollution investigations of the United States Public Health Service were briefly outlined by Surgeon W. H. Frost, who stated that so far as he can judge the chief interest now lies in the organic pollution of streams and resulting nuisances, but added that the time would doubtless come when consideration could be given to the effect of distant bacterial pollution on public water supplies. George T. Hammond, consulting engineer, Brooklyn, said that perhaps sanitary engineers are chiefly interested in the effect of stream pollution upon the bio-oxygen demand especially in connection with sewage-works. H. P. Eddy, consulting engineer of Boston, spoke of the tremendous effect of very few industries upon the character of the streams. He mentioned the three rubber reclaiming plants at Akron, Ohio, which together contribute 117 lb. of solid wastes to the river for each 100 lb. contributed by the city sewage.

Government Control—In the course of his presentation of Government Control of Pollution, C. A. Emerson, Jr., formerly chief engineer of the Pennsylvania Department of Health and now associated with the Philadelphia office of Fuller & McClintock, consulting engineers, remarked that about 80 per cent of the state health departments of this country now have sanitary engineers. Mr. Emerson spoke approvingly of the methods of control of stream pollution employed in Great Britain, where joint commissions or river boards having charge of entire drainage districts prove useful. These boards are generally large, their membership extending to 25 or 30, and the members being elected by the local governing boards of each municipality in proportion to population. There are similar boards in Germany, but some of these, like the Emscher District Board, have representation by industries, as well as by municipalities. There is a notable difference between available machinery for the control of stream pollution and health matters in Great Britain and Germany, on the one hand, and in the United States on the other. Whereas the two former countries have national health departments, we have none in this country. Mr. Emerson expressed the opinion that any centralized control of stream pollution in the United States would not be welcome if it were designed to set aside state agencies, but thought that some means might well be devised for federal co-operation in stream pollution control.

An outline of "The Powers, Duties and Policies of the Sanitary Water Board of Pennsylvania," presented by W. L. Stevenson, chief engineer, Pennsylvania Department of Health and secretary of the board just named, was an outstanding feature of the conference. *(An abstract of Mr. Stevenson's paper follows on p. 684.)*

Sanity and Adaptability—The discussion on Mr. Stevenson's paper was opened by H. P. Eddy, of Boston, who said the code goes a long way in the direction of sanity in the control of industrial wastes. In general, there should not be an attempt to compel each industry on a stream to comply to one standard or any industry always to try to attain the same standard for that industry. State control should not establish arbitrary rules or standards, but instead should require cessation of pollution without saying how, since if an attempt is made by the state control body to define methods of stopping pollution and the methods proposed are followed and results are not satisfactory, there may be serious embarrassment to the control body.

By way of illustration of elasticity of means of preventing stream pollution through variation of the methods employed to suit temperature and river stages, Mr. Eddy stated that a tannery in Massachusetts employs varying degrees of treatment at different seasons of the year to meet fluctuating conditions. At times of low stream flow, treatment is supplemented by dilution from water stored for the purpose. When both treatment of the wastes and stream dilution are not sufficient or water enough for dilution is not available, then, as has been done this year, the stream is dosed with nitrate of soda in order to increase its available oxygen.

Col. George A. Johnson, consulting engineer, New York City, complimented Pennsylvania on being the first state to attempt the control of pollution of streams from their source to their mouth. He remarked on the fact that if 100 per cent treatment of industrial wastes were required some industries might be financially ruined or driven from the state. Robert S. Weston, consulting sanitary expert, Boston, spoke a word in behalf of manufacturers, most of whom he thinks are favorably disposed toward the prevention of stream pollution. In support of the latter opinion co-operation of owners of industrial plants in Rhode Island was cited.

George W. Fuller remarked on the great difference between theory and practice in government control. The first British Rivers Pollution Act of the seventies was on the statute books some fifteen years before much was done to comply with its requirements. Little was accomplished until the rivers boards mentioned by Mr. Stevenson were created.

Progress resulted when a balance was established between what is being done by the municipalities and by the industries to stop stream pollution. Mr. Fuller stressed the point that consideration should always be given to whether money could be better spent for the prevention of river pollution or for some other public purpose, like the building of parks and playgrounds or providing other recreational facilities. Speaking for the second time on Mr. Stevenson's paper, H. P. Eddy stated that in stream pollution control the rule of

reason must be followed. J. F. Jackson, engineer, Connecticut Board of Health, also emphasized the fact that success in stream control depends upon the wisdom shown in both drawing and enforcing regulations.

Dr. W. H. Frost, surgeon, U.S.P.H.S., referring to remarks by Mr. Emerson to the effect that there was a diversity of laws regarding stream pollution in the different states, said that the administration of the laws was far more uniform than the laws themselves, this being due to the fact that the administration is in charge of men who are working along common lines arrived at in part by the conferences of state sanitary engineers that are held each year.

Remarkable New Filter—The "Stream-Line Filter" was described in a paper by George W. Fuller, consulting engineer, New York City, as "one of the most interesting exhibits at the shipping, engineering, and machinery exhibition at Olympia, London, last month." This filter is the invention of Dr. H. S. Hele-Shaw, president of the British Institution of Mechanical Engineers last year. It consists of a pack of specially prepared paper held together between two press-heads. The liquid to be filtered is forced through the filter between the sheets of paper and the pressure is varied according to the character of the liquid or of the material which it is desired to abstract. An abstract of Mr. Fuller's paper will appear in a later issue.

Navigation—"Stream Pollution as Affecting Navigation" was the title of an address by F. C. Boggs, colonel, Corps of Engineers, U. S. A. Federal control comes through the interstate commerce clause of the constitution and is administered by the Corps of Engineers, Col. Boggs said. Navigable waters are construed as being any waters that will float logs. In the control of navigation the army engineers have no jurisdiction over pollution as such. What they do control is (1) solids which may impede or cause deposits that will impede navigation and (2) semi-solid matters injurious to shipping. It has been held that (2) does not include oil but Congress could legislate on that subject. In fact it has legislated so far as New York harbor is concerned where oil discharges are under the control of the supervisor of the port. The present oily wastes from ships in New York harbor are pumped from the ships and the oil is recovered by a private company. There is need for a separator available for use on each ship.

As to remedies for the oil nuisance, Dr. Frost said that the enactment of laws is first thought of but if enacted who would enforce laws? Again the first thought is the federal government. It is deeply interested, Dr. Frost said, but he did not suggest that it could undertake the work. He did say, however, that it appears that anti-pollution measures, like charity, should begin at home, making it the principal duty of the federal government to control interstate and international oil pollution. Too great a burden must not be thrown upon industries for ultimately this burden will be borne by Mr. Private Citizen.

Russell Suter, senior assistant engineer, New York Conservation Commission, Albany, N. Y., said that there had formerly been much trouble from an oil refinery at Olean, N. Y. The Standard Oil Co. put in a plant for preventing stream pollution which is reported to be profitable. Other oil wastes, Mr. Suter said, are not so much different as would be thought and probably they also could be successfully treated. It has been asserted that oil wastes injure fish. Mr. Suter said he was not sure as to this, except that he had reason to believe that they do not injure shell fish. Morris R. Sherrerd, chief engineer, Department of Streets and Public Improvements, Newark, N. J., cited the Passaic River which was formerly much used for boating, but which sewage pollution had made useless for that and many other purposes. The expenditure of $20,000,000 by the Passaic Valley Sewerage Commission to prevent the pollution of this stream may perhaps restore boating to the river.

Pollution by automobile oils contributed to sewers from public and private garages was the subject of considerable discussion during the conference. The consensus of opinion seemed to be that this is a serious matter in many cities. In Philadelphia a city ordinance requires intercepting traps to keep the oil out of the sewers. There seemed to be some difference of opinion as to the effectiveness of this ordinance.

Public Water Supplies—A review of data on industrial wastes in relation to water supply, collected by a committee of the American Water Works Association, and presented at the recent Detroit meeting of the association, was presented by Almon L. Fales, of Metcalf & Eddy, Boston, chairman of the committee. The data show that some 250 water supplies widely distributed in the United States and Canada are affected by industrial wastes, and that of these 138 are in Pennsylvania alone. There are some 25 different kinds of industrial pollution. Over 100 water supplies are affected by mine drainage. The whole matter of control here should be considered from the broad viewpoint of public welfare. Investigation should precede legislation.

In discussing this paper, R. S. Weston said that the committee has made clear that it is not yet possible to satisfactorily treat all classes of industrial wastes. For instance, this has not yet been found possible with the sugar factory wastes in Cuba, which discharge into small or almost dry streams; also creamery wastes. We are still in need of technical as well as legislative and administrative progress. Mr. Weston said his own leanings are toward rivers boards working in co-operation with industries. Such co-operation is being obtained in Rhode Island through the work being done by Stephen DeM. Gage and the Rhode Island Board of Purification of Waters.

In a paper on "Stream Pollution in Philadelphia" Maj. J. A. Vogleson, chief engineer, Bureau of Surveys, said the problem of industrial wastes is inseparable from that of the general sewage of the city since the industrial plants are scattered throughout the city and discharge into the sewerage system. There are 162 outlets discharging into the Schuylkill and Delaware Rivers. Many years ago an intercepting sewer along a portion of the Schuylkill diverted sewage below the water intakes on that stream and later on other interceptors were built and some are now under construction for the further diversion of sewage from the tributaries of the Schuylkill and Delaware and for its delivery to three treatment plants. As an illustration of the progressive pollution of the Delaware River, Maj. Vogleson stated that in examining samples of the raw water taken from the Delaware River before filtration there were employed successively 1 c.c., 0.1, 0.01 and now 0.001 c.c. The first of the large sewage treatment

plants included in the plan adopted in 1916 for cleaning up the rivers, construction on which was postponed by the war until 1921, is about ready to go into operation. This includes 32 Imhoff tanks located about two miles below the mouth of Frankford Creek.

A striking example of the damage to sewers sometimes done by industrial wastes was cited by Maj. Vogleson. About 1,700 ft. of invert of a concrete sewer was ruined within three weeks of the time that there began to be discharged into it some heavy acid wastes from an industrial plant. This sewer is of the basket section type, equivalent in cross-sectional area to about a 7-ft. circular sewer. The invert to a width of some 30 in. has been badly damaged, the acids in some cases penetrating to a depth of 7 or 8 in. It is estimated that it will cost $70,000 to repair this stretch of sewer.

Coal Mine Drainage—In a paper on "Coal Mine Drainage Contamination of Water Supplies." J. W. Ledoux, consulting engineer, Philadelphia, reviewed the problem, particularly as it is presented in Pennsylvania, and outlined some possible means of treating mine drainage. This paper followed somewhat the same general lines as the one presented by Mr. Ledoux some months ago before the Pennsylvania Water Works Association, as abstracted in *Engineering News-Record*, April 19, 1923, p. 698. The possibilities of using barium oxide or hydroxide for the purification of coal mine water were discussed by Mr. Ledoux who concluded as the result of his investigations that this is the only satisfactory chemical to use and that while the cost would be prohibitive without the utilization of the byproduct—barium sulphate—yet by such utilization it would be practicable. Mr. Ledoux said: "With an average mine water containing over 2,000 p.p.m. total solids and over 1,000 p.p.m. sulphate it would require in the neighborhood of 7½ tons of barium oxide per million gallons, and there would be about 13 tons of barium sulphate as a byproduct."

In discussing this paper, R. C. Bardwell, of Huntington, W. Va., said that when legislation against water pollution by oil wells in Kansas was enacted he was told that nothing would come of the legislation if its enforcement was likely to be a handicap to a basic industry of the state. The legislation proved to be of no effect. This would be the case with any legislation against coal mine drainage, Mr. Bardwell said. He urged that consideration should be given to the burden placed upon water users and water consumers by industrial wastes, and stated that it has been estimated that a group of Ohio River steam plants are burdened with an expense of $2,000,000 a year on account of stream pollution. How these evils can be corrected has not yet been determined. Co-operation seems to be the most promising way. Self-help in this direction is illustrated by what one railway did in Illinois. It stored water when it was usable against the time when it would be bad.

Terminal Engineers Hear Weather Talk

The Municipal Engineers of the City of New York at their meeting Oct. 24 were given an address on the work of the weather bureau and its relation to the welfare of the public, entitled "Is It Going to Rain?" by James H. Scarr, meteorologist of the U. S. Weather Bureau in charge of the New York district.

Pennsylvania Sanitary Water Board: Powers, Duties and Policies

By W. L. Stevenson
Chief Engineer Department of Health, and Secretary, Sanitary Water Board, Harrisburg, Pa.

Abstract of a paper presented to the Conference on Pollution of Streams Held by the Engineers' Club of Philadelphia and the American Society of Civil Engineers (Philadelphia Section) at Philadelphia, Oct. 16, 1923.

ONE of the principles of reorganization of the State government of Pennsylvania proposed by Governor Pinchot [on coming into office early this year] was the coordination of duties and authority having a common purpose and to that end "The Administrative Code," approved June 7, 1923, created in the Department of Health the Sanitary Water Board to have jurisdiction over stream pollutions of all kinds.

This Board consists of the secretary of health, as chairman, the secretary of forests and waters, the attorney general, the commissioner of fisheries and the chairman of the Public Service Commission. The powers and duties of the Sanitary Water Board include: (a) The administration of the laws of the Commonwealth prohibiting the pollution of the waters of the State; and (b) the study, investigation and reporting upon ways and means of eliminating and preventing stream pollutions which are detrimental to the public health, the health of animals, fish or aquatic life or to the recreational use thereof.

The principal advantages to be obtained from vesting all the anti-stream pollution laws in a board instead of separate administration as heretofore are uniformity of policy and the classification of streams to provide for the several kinds of uses of the waters of the State and expediting action in cases involving the jurisdiction of the several departments concerned.

Fundamental Policies—The Sanitary Water Board has established a number of fundamental policies through the adoption of resolutions. The first of these resolutions approved certain policies of the Department of Health relevant to sewerage and stream control, including the following: (1) That streams which are used as sources of public water supply after filtration should, in addition to being reasonably clean, provide a raw water sufficiently low in organic and pathogenic bacterial content that it can be safely and reasonably economically purified for domestic purposes. (2) That streams which are used as sources of public water supply with only chlorination should be kept free from all artificial sewage pollution unless adequate assured long-time storage is used for the water supply and in such cases the sewage effluent should be adequately disinfected as a further safeguard. (3) Requirements made to restore sewage polluted streams, not used as sources of public water supply, or to maintain clean streams in a clean condition should be begun at the head waters and progress down stream. (4) Requirements made to protect sources of public water supplies should be, in general and subject to local conditions, begun at the first source of sewage contamination above the water-works intake and progress up stream. (5) The agreement between Pennsylvania and New Jersey establishing a "Uniform Policy as to Degree of Treatment of Sewage Discharge into the Delaware River" (see *Engineering News-Record*, Aug. 10, 1922, pp. 215 and 243).

Classification of Streams—A resolution of the Sanitary Water Board adopted Aug. 8, 1923, for Classification of Streams, is as follows:

Whereas, The degree of pollution of the waters of the State varies widely from the pristine purity of a small stream flowing through a virgin forest to the grossly polluted stream draining a valley given over to intense municipal and industrial development, and

Whereas, Such differences in condition and the present and probable future use of the streams must be recognized in determining the required degree of treatment of sewage and industrial wastes, and

Whereas, The natural powers of streams to inoffensively assimilate and dispose of polluting matters by dilution must be utilized so far as compatible with the general interests of the public in order to establish a practicable and economical program for stream control, therefore

Resolved, That the waters of the State be classified as follows:

Class A: Relatively clean and pure streams—streams in their natural state probably subject to chance contamination by human beings but unpolluted or uncontaminated from any artificial source, hence generally fit for domestic water supply after chlorination, will support fish life and may be safely used for recreational purposes.

Class B: Streams in which pollution shall be controlled—streams more or less polluted, where the extent of regulation, control, or elimination of pollution will be determined by a consideration of (a) The present and probable future use and condition of the stream; (b) the practicability of remedial measures for abatement of pollution, and (c) the general interests of the public through the protection of the public health, the health of animals, fish and aquatic life, and the use of the stream for recreational purposes.

Class C: Streams now so polluted that they cannot be used as sources of public water supplies, will not support fish life and are not used for recreational purposes and also from the standpoint of the public interests and practicability it is not now necessary, economical or advisable to attempt to restore them to a clean condition; and further,

Resolved, That all artificial pollution of Class A streams shall be prohibited and any sewage or industrial wastes on the watershed shall be treated to such a degree that the effluent shall be practically free from suspended matter, non-putrescent and disinfected and that recreational use shall not be sanctioned within prejudicial influence of water works intakes, and further

Resolved, That the degree of treatment of sewage and industrial wastes discharged into Class B streams shall be determined for each particular stream or portion thereof after consideration of the general interests of the public and the economics of the particular case, and further

Resolved, That sewage and industrial wastes may be discharged into Class C streams; provided, however, that such discharge shall not create any public nuisance or menace to health.

Clean Streams Must Be Kept Clean—This resolution establishes the policy that streams now relatively clean and pure shall be kept in that condition. No future pollution thereof will be permitted. It also recognizes that, due to existing intense industrial development on certain watersheds, the streams thereof have become so polluted that they are now totally unfit for use as sources of public water supply nor will they support fish life and hence are practically set aside for the disposal of industrial wastes. The cost of construction and maintenance of works for the abatement of the pollution of such streams will far exceed the value of the benefits to be derived by the public through their restoration to a clean condition. Therefore, efforts will not be made, at this time, to accomplish any more than the prevention of menace to the public health and creation of nuisance in streams which may be designated as Class C.

The majority of the larger streams draining developed areas will naturally be found in the middle group, designated as Class B. The resolution recognizes the natural powers of streams to inoffensively assimilate a certain amount of polluting matter and that the use of the scientific method of disposal by dilution is essential to the success of any program for stream control because of the economics of the problem. The usual requirement to be met in determining the pollution load which a stream can receive when considering disposal by dilution is the maintenance of the stream in a cleanly condition as measured by sight or smell. But when the Sanitary Water Board designates any stream as Class B it will also determine the degree of treatment of polluting matter and this will be based upon the use and condition of the stream both at present and in the probable future in order to compare the cost of treatment on the one hand with the value of the benefits to the public obtained through protection to sources of public water supplies, fish life and recreational use of the stream.

Co-operation Essential—The co-operation of municipalities and private persons and corporations with the State is essential to the success of the comprehensive program of the Board for stream control and hence a resolution has been adopted authorizing the Secretary of Health to notify all municipalities on the watershed of any stream that has been classified as to the required degree of treatment of sewage. Thus each municipality along the classified stream will know that as the means for abatement of pollution are progressively installed from the headwaters on downstream, they will benefit by the expenditures of their upstream neighbors and in justice they must do likewise for other municipalities situate on downstream.

Existing law requires the issuance of a State permit before public sewers can be constructed and provides penalties for unlawful discharge of sewage; hence, the Sanitary Water Board in administering the law will both confer privileges and impose obligations upon municipalities. The board has established the policy that good faith must be shown by municipalities in complying with requirements of sewage permits before they are granted further privileges or are relieved from penalties. For extending the limits of cleanliness of streams whose headwaters are not now polluted, plans have been made to have such streams examined by State employees whose regular duty includes the traversing of them in order to ascertain the first source of pollution and thereafter, if the board shall deem it expedient, means will be adopted to secure abatement. In this way the cleanliness of headwater streams will be gradually extended and increase the available sources of public water supplies, benefit riparian owners along the banks and provide more clean streams in the State for the pleasure of the public who are learning the healthfulness and value of recreation in the open through camping, hunting and fishing.

Complaints Must Be Concise and Well Founded—Various state officials and departments are constantly in receipt of complaints from the public concerning pollution of streams or the destruction of fish. Occasionally these complaints are concise and well founded, but generally they are vague and indefinite. The board has therefore established the policy that only well founded and concise complaints will be considered. Forms are sent to complainants in duplicate for furnishing the data and the statements made must be sworn to. Upon receipt of the properly filled in complaint form charging violation of law against any person, firm or corporation, the copy thereof is sent to the respondent who is afforded opportunity to make abatement or to submit defense of the charge in the complaint. After consideration of the formal complaint and the respondent's reply thereto, an investigation is made and if violation of law found and abatement is not made, prosecution is instituted. The board has by resolution placed the matter of handling complaints relative to destruction of fish with the Commissioner of Fisheries, pursuant to Section 501 of The Administrative Code.

The magnitude of the task confronting the Sanitary Water Board may be seen when it is realized that 13 per cent of the 4,419 named streams of Pennsylvania have drainage areas of over 25 sq.mi. and an aggregate length of 13,000 mi. and, by proportion, it is probable that the total length of all named streams is about 100,000 miles. Also it is estimated that the total average flow in Pennsylvania streams is at a rate of about 2,600,000,000 gal. an hour.

The sources of pollution are innumerable, diverse in character and of both public and private origin: there are 974 municipalities in the State of which only one-half have public sewer systems from which sewage or sewage effluent is discharged to the streams; also many towns have storm drains to which sewage connections have been made and countless private sewers discharge sewage.

It has been estimated that stream pollutions may be caused from about 2,500 industrial places representing a capital investment of over $1,000,000,000 and yielding products valued at over $1,500,000,000 a year. Hence the solution of the problem confronting the Sanitary Water Board must be approached sanely and deliberately with recognition of the financial aspects, so as to successfully carry out in an orderly and logical sequence, a comprehensive, practicable program for stream control in the Commonwealth of Pennsylvania.

A Half Day with Karl Imhoff

By W. W. DeBerard

Associate Editor Engineering News-Record

FOR THE first time in ten years Dr. Karl Imhoff, German consulting sanitary engineer and inventor of the two-story type of sewage tank bearing his name, has visited the United States. It was the writer's privilege to accompany him and Langdon Pearse, sanitary engineer, Sanitary District of Chicago, on a tour of inspection of the large Calumet sewage-treatment works where two-story tanks are used. I was anxious to learn of the doctor's reaction on seeing this plant, which is equipped with all of the essential labor and modern high-grade machinery for ideal operation. A gasoline locomotive was pushing into the sludge beds a train of a dozen side-dump sludge cars and half a dozen men cut lawn on the area saved for future use.

Ten years ago engineers by the score were visiting Germany asking all manner of questions, begging blueprints and eager for operating data because sewage-treatment plants of the biological type in the United States at that time were few and operation data scarce. For ten years Germany has built few sewage-works. "We are too poor," said the doctor. "Only those absolutely essential are even operated and it is surprising how few sewage plants are absolutely necessary. The tables are now turned. Within two weeks I have seen many works not in existence ten years ago. America now has taken the lead. The only activated-sludge plant in Germany is a unit at my laboratory."

At Calumet—Dr. Imhoff's first observation was of the incoming sewage. "The morning's grist," said Mr. Pearse, "rather fresh and well comminuted," the sewage having been through the centrifugal pumps and coarse screens. "It carries a lot of paper," I remarked. "Yes, American sewages always have much more paper than German sewages," said the doctor. Then we came to the chimney-like gas vents at the base of which was a thick heavy black scum, perhaps a foot or more thick. "Good," said the doctor. "But you must clean out the channels and add the scum to the sludge-drying beds." He could not understand a scum on the tanks which though not large in quantity was being skimmed off and dumped into the gas vents. The scum was greenish from algae and oily from garage discharges. "It is not solid material from the sewage," explained Mr. Mohlman, chief chemist for the Sanitary District, much to Dr. Imhoff's relief, for at first he thought that by some means the gas traps were not operating and sludge was being carried to the surface. He advised against putting this oily algal growth into the gas vents, for the whole must eventually be removed. This was just one indication of the little economies for which his eye had been trained in recent years to look.

Then we came to a tank with the sludge discharging by means of air lift, an inky black heavy liquid having the consistency of curdled milk and an odor not unlike fresh humus. "Good, proper and ripe," ejaculated the doctor. Farther along he hopped into a bed of dried sludge and brought out for inspection a cake 4 in. thick of dark brown porous cork-like humus with little or no odor which he proclaimed ideal. The bed had the characteristic irregular cracking after drying on the sand for two weeks.

"What causes the higher level of scum here, Doctor?" asked Mr. Pearse, as we came to gas vents nearly full of black foam. "Tanks which went into operation in the fall have given no trouble while those that were started in the winter have only settled down to regular work after considerable foaming."

"Acid methane formation in the winter," was the answer, "which did not permit the tanks to ripen all winter long. Then an accumulation of the wrong kind of organism persisted. The solution is to draw off the sludge frequently, probably twice a month."

Conditions in Germany—Dr. Imhoff indicated that many plants have been closed down there. Only the Ruhrverbund plants which discharge into the Ruhr River have to produce a high-grade effluent, for this is one of the few rivers used for water supply. The trend of present German practice is toward economy, both in operation and design. In extending the usefulness of existing plants, the period of settling has been shortened and existing sludge capacity increased by separate sludge-digestion tanks into which the fresh sludge, mixed with well-ripened sludge, is pumped. This has proved a practical way of taking care of the sludge, the mixture with well-ripened sludge giving inoffensive digestion. This practice is somewhat analogous to the practice of John D. Watson of Birmingham. England, who uses well-ripened sludge to seed the fresh sludge from septic tanks, in order to promote quick, inoffensive digestion.

The effect of heat upon the digestion of sludge is important. Probably the sludge chamber of the Imhoff tank is at a more uniform temperature the year around than in most tanks of other types and certainly more so than in the sludge-digestion experiments made in the United States, where the sludge is pumped into a separate basin and allowed to stand indefinitely and chill. Experiments are being conducted at Essen upon the effect of heat, both on Imhoff tanks and on separate sludge digestion, the heat being supplied by introducing small amounts of hot water every day through the sludge outlet pipe. A certain amount of liquor is likewise removed to even up displacement. The hot water is supplied by burning the gases from the gas slot under a small hot water boiler. Dr. Imhoff believes that the digestion of sludge should be more uniform and faster in a warmer climate where the sludge can be kept at summer temperatures the year around. (California and Texas engineers please note.)

"We are very poor," reiterated the doctor. "We must economize all we can. Some of our sewers are concrete-lined open trenches and recently in hunting for the cheapest kind of treatment we have found shallow sedimentation will give us a fair result compared with deep basins. In fact six basins not deeper than sludge beds have been built at one point. The area as well as depth is now taken into account in the latest design of the Imhoff tanks, whereas formerly we paid more attention to depth. We use less 'flowing through' depth and add as much depth as we can afford to the sludge-digestion chamber."

It is evident that necessary economy may force some interesting developments in German sewage-works. One last remark of Dr. Imhoff impressed itself on me in these days of the elevation of the so-called business man to administrative engineering positions: Although Germany has had a revolution the technical men in charge of technical works operation are not disturbed.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Poured Construction Joints for Concrete Pavements

By J. G. Bragg
Senior Testing Engineer, N. J. State Highway Commission

ENGINEERS who favor the installation of expansion joints at frequent intervals in concrete roads may abandon their theory in favor of smoother riding qualities, knowing from experience the difficulties encountered in obtaining a "smooth-riding" joint. There has been considerable doubt also as to the effectiveness of the conventional type of pre-molded joint, and core drill operations have proven that few of these joints are set according to plans and specifications. They are thrown out of alignment or raised off the subgrade by removal of the bulkhead and frequently do not

JOINT FORM ALSO SERVES AS BULKHEAD

therefore insure a complete separation of adjacent slabs. A serious defect also of the pre-molded joint is the lack of bond between the slabs and joint material, expansion and contraction of the slabs permitting a separation or crevice in the joint through which surface water may reach the subgrade.

A new type of poured joint is being used to some extent on New Jersey pavements, and the results obtained to date are quite commendable. While poured joints are generally frowned upon because the cost of installation is considered to be prohibitive, the type under discussion has many features tending toward economy of operation, bringing it in close competition with the pre-molded joint. Briefly, the method consists of installing a corrugated paper bulkhead which is left in place without forming an obstruction to the strikeboards or finishing belts. This paper bulkhead is later removed, leaving a clean-cut opening of whatever joint width is desired, and this opening is then filled with a 40-60 mixture of pre-mixed asphalt and sand. During the process of pouring and finishing the concrete, a sheet-metal cap is placed on the top edge of the paper bulkhead. The paper for each joint is, of course, discarded but the same metal top caps are used repeatedly. The accompanying photograph shows the McGovern poured joint as it is being installed on a section of a New Jersey state highway. The main advantages claimed for this type of joint are:

Smooth-riding quality, uniform thickness of joint and complete separation of slabs, exclusion of surface water from joints, greater capacity for expansion of slabs, and less and more efficient maintenance.

Economizing Materials Storage Space in Building Construction

By Henry S. Hines
W. G. Wilkins Co., Engineers and Architects, Pittsburgh, Pa.

STORAGE and handling of materials in building construction is always a problem in metropolitan districts, where traffic is so great streets are not usable for storage. Methods used in the construction of the Atlantic Bldg., a 24-story structure recently completed at the corner of Broad and Spruce Sts., Philadelphia, are believed to represent about the best practice in materials handling.

The building occupies the lot from Spruce to Manning St. and Broad St. to a restricted areaway at the rear of the building line and the absence of any material stored on the streets has been very noticeable. The sidewalk along Spruce St. was removed and at the completion of excavation was planked over. Trap doors were cut in the planking, allowing the trucks to back up to the curb and dump all foundation concrete material directly into bins at basement floor level, from there it was handled into portable mixers set at convenient places in the sub-basement.

The steel frame was erected by using two 80-ft. boom derricks, placed in such positions so as to reach three sides of the building. All material was "picked off" the wagons and trucks and landed on the floors. Delivery was timed according to the speed of erection. After the first floor steel was set and riveted this floor was planked over solid and a driveway provided through the rear of the building from Spruce to Manning St. and down the center corridor from the Broad St. entrance. Under this driveway was placed the cinder and sand bins, mixer, etc., for the fireproofing.

A $\frac{3}{4}$-yd. bucket was placed in one of the elevator hatches and the cat head raised as each floor was poured. The elevator contractor followed the steel erection very closely with his main rails and the general contractor utilized these for his three material hoists, doing away with any street obstructions whatsoever.

The delivery of outside terra cotta, brick backing, window frames, etc., was made directly onto these hoists and distributed on their respective floors. A portable mixer was placed in the sub-basement near one hoist and all mortar was lifted in wheelbarrows and distributed directly where wanted.

There is a $3\frac{1}{2}$-in. monolithic concrete top floor over

the entire building. For this work the aggregates were stored at a convenient place on the first floor, a portable mixer was placed near one of the hoists in such way that it would dump directly into a concrete buggy which remained on the hoist, then hoisted and delivered to the floor where wanted. These hoists were used by the night crew to lift the tile, conduit and all other material for the next day's run.

The elevator contractor used a gasoline hoist in one hatch for his equipment. The plumbing and heating contractor rigged an electric hoist in one of the air shafts which took care of all their material. There were three Skinner engines weighing 10 tons each unloaded on the first floor and lowered to sub-basement through one of the elevator hatches. All the plastering material was handled through the basement.

At times it taxed our limited storage space inside the building but we were able to keep everything entirely off the street and due to this fact the police and highway departments have given us every consideration.

Joseph F. Kuntz of Pittsburgh, Pa., was the architect. The writer represented both architect and owner on the job. Metzger, Fisher & White of Philadelphia were the general contractors with A. Erickson, superintendent.

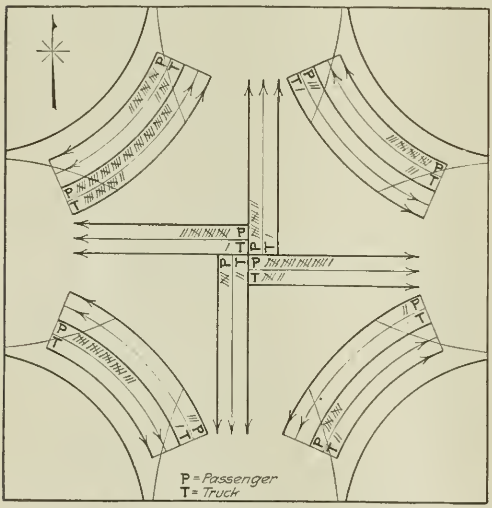
From Job and Office

Hints that Cut Cost and Time

A Self Reading Traffic Chart

By Jacob L. Crane, Jr.
Municipal Development Engineer, Chicago

For the purpose of expediting the registration of traffic counts at busy intersections a graphical chart is used. The advantage of the one shown lies in the



A SIMPLIFIED TRAFFIC COUNTING CHART

fact that the recorder jots down each vehicle showing graphically its origin and its direction of travel to and from the intersection. The chart gives the flow of traffic in both directions on all four streets and also the direction of the flow around the corners.

One recorder has taken a record on this chart of traffic running up to 1,000 machines an hour and two men can take a record of the busiest intersection encountered. To secure the same information on ordinary traffic counts charts would ordinarily require from four to sixteen men.

In the view herewith the count is an actual one taken at Lake Bluff, Ill., Green Bay and Scranton Sts. between 7 and 8 a.m., June 16, 1923.

Spreading the Gospel of Traffic Safety

In a recent county safety parade, the Wayne County (Michigan) Road Commissioners took advantage of the occasion to spread the gospel of traffic safety. The float herewith pictured shows the means used.

Box-Car Loader Made From Parts Obtained From Scrap Pile

A piece of equipment which has given efficient service was recently made by W. R. Hoback, engineer for the Gager Lime & Manufacturing Co., Sherwood, Tenn., entirely from parts obtained from the scrap pile excepting for the motor which drives it. It is a conveyor box-car loader used mainly for loading lime into box cars.

The machine is mounted on three casters, which makes it easy to move in any direction and in and out of the cars. The frame, which is of timber is 18 ft. long. On its under side, about 6 ft. from the lower end,

CONVEYOR LOADER MADE FROM SCRAP MATERIAL

From Job and Office
For Contractor and Engineer

is mounted a $1\frac{7}{16}$-in. shaft fitted with a 14-in. steel pulley having a face of 3 in. This is belt-driven direct from the motor's 4-in. pulley. The opposite end of the shaft is fitted with a 6-in. sprocket which is chain-connected to the head pulley at the upper end of the frame. Directly under the driving shaft is a steel support, made up of $\frac{1}{2}$ x 3-in. flat bars. This takes care of the greater part of the loader's weight and also serves as a support for a pair of return idlers.

The belt was also taken from the scrap pile. It is 12 in. wide, lagged with 16-gage sheet iron turned up 4 in. at the sides, which prevents spillage and increases the carrying capacity.

The motor is of 2-hp. capacity. Current is supplied through one cable, of which there is sufficient surplus to permit moving the machine about. It will load 30 to 40 tons per hour. The machine is also adjustable as to height and lowering for different-sized cars.

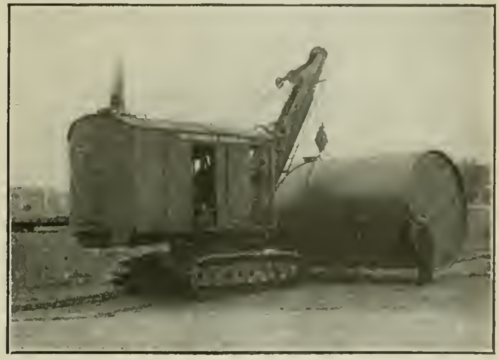
Movie Machine to Make Continuous Construction Record

IN ORDER to obtain a practically continuous record of construction operations on a large western job a motor-operated moving picture machine was mounted in a small house at a point commanding a good view of the work. The mechanism was arranged for automatic operation except that the current was shut off at night.

HOUSING FOR AUTOMATIC MOVIE CAMERA
Construction is designed to avoid excessive heat that might effect the film. Wires supply current for timing and cranking motors.

Two small motors were employed, one for operating a "contactor" or timing device, by which the second motor, which cranks the camera, was started and stopped. The contactor was designed to be adjusted for various speeds permitting a range from 2 min. to 2 hr. in the time between exposures. When the contactor mechanism closed the contact the cranking motor turned the camera crank 90 deg. which caused the camera to make two exposures or frames. The purpose in this plan was to provide a film, which when projected at the normal rate of 16 exposures a second, would show rapidly the sequence of operations throughout the entire construction period.

Steam Shovel Moves Steel Storage Tank



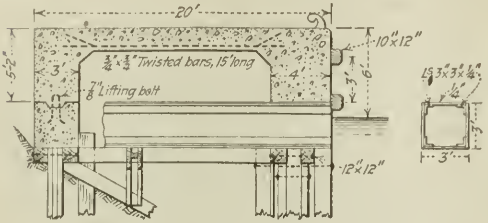
A GASOLINE filling station recently erected in the Middle West offered quite a problem to the contractor. The station was to be equipped with a 15,000-gal. steel storage tank, but since the station was about one quarter mile from the nearest railroad spur, the contractor was confronted with the necessity of finding some means of moving the tank that would be both cheap and quick. The size of the tank prohibited ordinary hauling as it weighed more than $5\frac{1}{2}$ tons, and was about 25 ft. long and 9 ft. in diameter. Finally a nearby steam shovel was secured for the job. The dipper and dipper handle were removed and a chain cradle was placed around the tank and made fast to the sheave block. The shovel then easily lifted the tank clear of the ground and with a man walking at either end of the tank to prevent undue swinging, it was carried across a field about a quarter of a mile, and placed in a 12-ft. excavation. The continuous treads on the shovel made movement across lots possible with a considerable saving in time.

Sewer Outlet Through Concrete Dock

BY D. H. FLEMING
City Engineer, Owen Sound, Ontario

THE CITY of Owen Sound was recently confronted with the necessity of providing an outlet through the concrete deck of a government dock for a 36-in. concrete pipe sewer line. The substructure of the dock afforded no support for the concrete pipe, and the concrete deck presented construction obstacles. Decision was then made to remove sections from rear and front concrete blocks supporting the decking, and insert a steel flume, 3 ft. square.

Blocks were removed by drilling five or six holes almost half way through the concrete and in an almost horizontal plane. Drilling was done on the front face of the dock with a steam jack hammer operated from a raft; and the holes were kept clean by a $\frac{1}{2}$-in. hose line from a city water tap. Holes were spaced so that they controlled an area 3x6 ft. in plan. They were then loaded with dynamite and shot, one or two holes



SECTION OF DOCK SHOWS FLUME INSTALLED

at a time, by an experienced man. In this way the block was shot clean and was easily removed. The steel flume was then inserted, forms were set and the other half of each block was repoured.

The flume was made of ¼-in. steel sheets with 3-in. angles ¼ in. thick at the corners.

Device Measures Height of Concrete Cores

By G. W. Hutchinson
Assistant Engineer, North Carolina Highway Commission

The testing of concrete cores drilled from finished pavements makes it necessary to have a suitable method by which the height of the specimen can be measured and proper correction ("Correction Data for Comparative Test Results from Field Specimens" *Proceedings*, American Concrete Institute, 1923) made for comparison of the test result secured with those obtained from specimens of standard size. Numerous

THREE-POINT DEVICE FOR MEASURING CORES

methods, including measurements by displacement and calipers, have been tried out by the Division of Tests and Investigations of the North Carolina Highway Commission, but the most satisfactory one consists of a three-point device shown in the accompanying photograph.

The use of this device allows consideration to be given to the irregularities of the top and bottom of the specimen when obtaining the average height. The core rests horizontally on two circular supports held by a pair of guide rods and which are adjustable according to the height of the core. At both ends of the device are the frames holding three screws which are brought in contact with the ends of the core for taking actual measurements. The frames are movable but can be held at convenient positions on the guide rods by means of thumb-set screws.

The core is placed on the supports and one frame brought into position to touch the end of the core. It is then clamped and held in that position. The other frame is moved into place with respect to the other end of the core and then clamped and its position marked by means of a sliding lug on one of the guides. The three screws in each frame are then manipulated until they just touch the ends of the core. When the core is to be removed, to allow the measurements to be taken, the second mentioned frame is unclamped and moved back and the core taken out. The frame is then moved forward into its original position in contact with the lug on the guide rod. The distance between the three opposite sets of screw points is then measured and the average of the three readings taken as the height of the core.

The average measurements of repeated operations check very closely when this method is used. The three points measured are equidistant from the center and outside of the core and also from each other.

From Job and Office

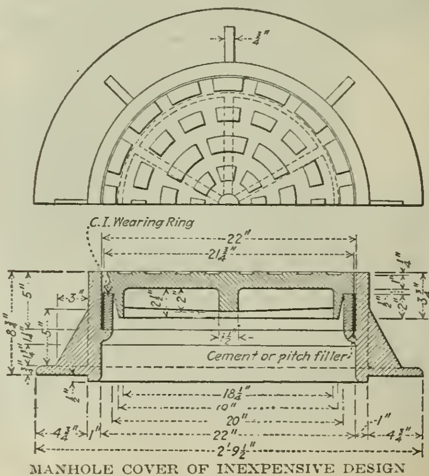
Hints that Cut Cost and Time

How Jacksonville Saved Money on Manhole-Cover Replacements

By C. V. Imeson
Engineer of Sewers, Jacksonville, Florida

An improved manhole cover designed to eliminate costly replacements of worn-out manhole covers in paved streets, brought out by the Sewer Department, Jacksonville, Florida, and adopted as standard, is shown in the accompanying drawing. A careful check of replacement costs has shown an average cost of approximately $50 for each job, which cost includes repairs to the street. The adoption of the cover shown herewith brings the cost down to about $6, with no repairs to the street necessary.

Barricading the street while repairs are made has been eliminated. About one and one-half hours' time of one man is all that is necessary to break out the old ring, insert the new one and place the filler back of the ring.



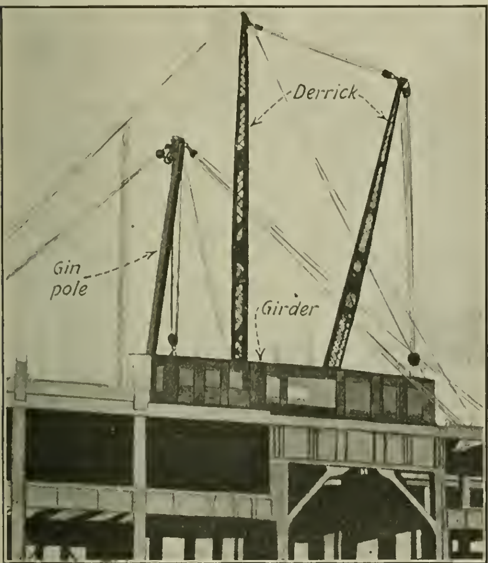
MANHOLE COVER OF INEXPENSIVE DESIGN

From Job and Office

For Contractor and Engineer

Derrick and Gin-Pole Lift Heavy Girder

IN PLACING a 68-ton plate girder 55 ft. long and 11½ ft. high at the fifth floor level of the Straus Building, Chicago, the load was divided equally between one of the two regular erection derricks and a special gin pole, each having a 100-hp. hoist. The guyed derrick which handled one end of the girder has a 123-ft. mast and 110-ft. boom, both of box lattice construction. The gin pole was a 50-ft. stick of Norway pine 20x20 in., guyed by six 1½-in. lines and having a set of blocks and tackle by which it could be boomed up in the same way as the derrick. The upper six-sheave hoisting block was slung from cable wr^pping around the head of the pole.



ERECTING A 68-TON PLATE GIRDER

Metal and Concrete Ties in India

Steel, cast-iron and concrete ties are used extensively on railways in India, besides various native and imported wood ties. The Northwestern Ry. is reported to have laid 1,200 miles of line with cast-iron plate ties in the past few years, while in 1922-1923 it laid about a hundred miles with the Stent concrete tie described in *Engineering News-Record,* Sept. 27, page 511. Steel trough ties are said to be in good condition after thirty years' service. It is thought they may be introduced again, although none have been purchased by this road for about twenty years. On the Great Indian Peninsula Ry., wood ties have been largely replaced with cast-iron pot ties. Both plate and pot ties consist of two separate cast-iron rail supports connected by a steel tie bar, and the Stent tie is an adaptation of the plate type in concrete construction.

Steady Output of 400 Cu.Yd. Per Day with a high mark of 600 cu.yd. has been attained in pouring concrete on the sewage disposal plant at Jones Island, Milwaukee, through efficient use and placement of concreting plant. All concrete is handled from a central plant and is chuted either from the hoist tower or a rehoist tower to all parts of the work, the ground plan of the structure being 650 x 750 ft., with the highest point of concrete averaging 20 ft. The central mixing plant includes two tilting mixers, two steel hoist towers, 216 ft. high with 1½ yd. capacity buckets. The towers are so arranged that power is supplied both hoists by a 100-hp. double-drum electric hoist. Aggregate is fed into the mixers from two overhead bins, each about 100-yd. capacity, these being fed by two 100-yd. per hour capacity bucket chain elevators. The entire bin feeding apparatus is electrically driven. A cement bin of about two-car capacity is located close to the bins, but is used for emergency storage only, a gravity trolley system of cement containers of the bottom-dump type, each of about 80 bags capacity, being constantly used to dispatch cement to the mixers direct from cement cars. The two main towers at the mixing plant supply one line of chutes 450 ft. long to a rehoist tower 196 ft. high. This rehoist tower in turn supplies a 120-ft. tower in the center of the job, which supports a line of chutes 280 ft. long on each side of the tower with a 50-ft. counterweight chute on each end, which is used to pour the circular tanks in the center of the job. A guy derrick of 10-ton capacity with a 115-ft. mast and 100-ft. boom supports the double counterweight chute system with total operating radius of 170 ft. This is placed in four different working setups and supplies concrete either direct from the two main hoist towers or from the rehoist tower. The mixers are operated alternately, and with specifications calling for 1½ min. mix have reached the maximum of 600 cu.yd. per day in a continuous pouring. The information herein was supplied by the T. L. Smith Co.

To Show in a Few Minutes the progress of work occupying several months, a series of moving pictures is being taken during the erection of the 32-story steel frame Straus Building at Chicago. In Grant Park, at a point opposite the new building, a wooden tower was built, with camera house having a tripod cemented to the floor and supporting the camera. Every morning, the photographer mounts the tower and runs a few feet of film. When the building is completed these strips will be run as a continuous picture.

Sinking a Shaft Through Rock will often uncover seams from which there is a considerable flow of water, causing discomfort to the workmen and poor results when placing the concrete lining. A method of taking care of this water was used in a rock shaft in New York City and is briefly outl'ned as follows: At the place in the rock where there is a considerable flow of water, two or three holes are drilled, in the same horizontal plane, a little below the outlet of the water. Into these holes are inserted square iron rods of sufficient length to project to within several inches of the form (when it is placed). These rods are then covered with sheet metal and the space between the rock and the sheet metal plugged with oakum, dipped in grout. A brick dam, about 5 in. wide and at least 6 in. high, is built in the approximate form of a segment of a circle, and a 1-in. pipe placed flush with the sheet metal and the inside face of the dam. The other end of this pipe is threaded and the pipe should be long enough to project well beyond the future inside surface of the concrete shaft lining. An elbow and a length of pipe can be screwed on this end and the pipe wedged with pieces of rock at the other end to reduce the strain on the pipe through the dam. This pipe will take care of the water during the drilling. After the shaft lining concrete has been poured, grout is forced into the pipe leading from the dam, and when sufficient time has elapsed this pipe is cut off flush with the shaft lining, the dam remaining embedded in the concrete. It was found that no leaks occurred in any of the shafts where this method was employed.—*Contractors Atlas.*

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

In Defense of the Cement Supply Man

Sir—I read with great interest the letter of O. T. Reece, County Engineer, Neosho County, Kansas, in your issue of Oct. 4, 1923.

The profits of the building supply merchant are the subject of much speculation, agitation and misinformation. The impression Mr. Reece seeks to convey in regard to the distributor's profit on cement is too good to be true. The "tribute of twenty-five cents to sixty cents per barrel" needs explanation from Mr. Reece—explanation backed up by a detailed recital of circumstances surrounding it.

From a first hand knowledge of portland cement manufacturing and distribution, I question the accuracy of Mr. Reece's statement regarding the size of the tribute unless it was at a period when through the blundering shortsightedness of highway officials, road construction was delayed for cement, and stocks, bought at a premium, were diverted to save the same highway officials' faces.

Mr. Reece, like many others, is able to see only one side of the shield, unable to see that the economic distribution of any commodity cannot be planned and carried out on the basis of an individual operation. Mr. Reece can be assured of one thing. If it was not for the entire distribution system furnished by the construction material merchant, not only his county, but every farmer, builder and contractor in his county, would pay a good deal more for cement than they are at present doing.

The supply merchant offers to Mr. Reece and all county and state officials every facility for economic and even distribution of cement regularly throughout the year. That this offer is not taken advantage of is the reason for the roar that occasionally goes up from public officials.

The supply merchants of Neosho County, Kansas, are citizens and tax-payers, and Mr. Reece is the servant of citizens and tax-payers, so it is his duty to work with all, for the good of all; and while I do not personally know a single supply merchant in the locality presided over by Mr. Reece, yet I am sure they are just as willing to honestly and legitimately aid the county in its efforts to secure materials at a fair price as is Mr. Reece.

E. K. Cormack,
Business Counselor,
National Builders Supply Association.

Detroit, Mich.,
Oct. 9, 1923.

Decomposed Rock Under New York City

Sir—In your issue of Sept. 27, 1923, an article discussing the rock foundation at the Public Library on 42nd St. raises some questions of the future decomposition of the bed rock in New York. There is an implied suggestion that since the surface rock at the site of the library shows some decomposition, such decomposition may be generally expected elsewhere in the town, with a resulting danger to foundations which may be based upon rock, now sound, that may in the future become weakened through surface decay.

Decay of the surface rock of the Manhattan schist series has been observed at a number of places on Manhattan Island and in Westchester County. In the excavations for the old subway in the 42nd St. neighborhood weak material near the surface was exposed in several places and removed in the process of excavation; the excavation of shaft 17 of the Catskill aqueduct, at 6th Ave. in Bryant Park, exposed disintegrated rock near the surface. Because of deep decay the Catskill aqueduct tunnel was located in some places 700 ft. below the surface.

It is undoubtedly true, however, in spite of such local occurrences, that the New York rock as a whole has been little affected by weathering since glacial time. The glacial markings on the rock surface so commonly observed on outcrops of the Manhattan series are the best evidence of the permanence and enduring character of the rock.

We are not even sure that the disintegration observed did not occur in pre-glacial time; it may be (and probably is) old rotten rock of pre-glacial origin not eroded by the continental ice advance. At the north approach of the Garrison tunnel of the Catskill aqueduct, near Garrison, N. Y., the excavation passed through about 600 ft. of rotten gneiss, undoubtedly a remnant of the original surface rock decayed in place, and not scraped away by the plowing action of the glacial ice. South of the glaciated boundary, the rock surface is covered by a mantle of disintegrated material, except where streams have removed it, but in the glaciated region such deposits are rare.

The New York rock is very old. There is no occasion to expect that it will change in the life of the structures based upon it. The city is fortunate in having as a foundation a rock which is as old and stable as can be found in any section of the country.

James F. Sanborn,
Consulting Engineer.

New York City,
Oct. 13, 1923.

Another Delay Caused by Red Tape

Sir—I have just read with very much interest you editorial in *Engineering News-Record*, of Oct. 4, 1923, p. 540, entitled, "Red Tape and a Pontoon Bridge." This brings to my mind a similar instance of a few weeks ago.

About the middle of September the Nueces and Frio Rivers, running through the boundaries of this county, were up about thirty feet due to heavy rains to the north and northwest of this county. At the present time there are no high-water structures on the highways crossing these streams and concrete slabs are used, since the water is very low normally and only loose gravel makes the slabs necessary. The high water carried out three crossings on the Frio and one on the Nueces, the last mentioned being about thirty-five miles northwest of Uvalde and on highway No. 4, an important mail and freight route to the counties northwest of here which are not served with a railroad.

Just as soon as possible the author made a trip to this crossing and decided that a temporary affair made of sand bags would be the most economical crossing that could be built in the shortest possible time. Immediately upon returning to Uvalde, communication was obtained with the chief engineer officer at Ft. Sam Houston, requesting 500 sand bags. The author was informed that although plenty of sand bags were available, permission for their use would have to be obtained from the Secretary of War. A wire was sent the Secretary of War on Sept. 24 requesting permission to use 500 sand bags from the engineer warehouse at Ft. Sam Houston. On Sept. 26 a wire was received to the effect that the order had been referred to Ft. Sam Houston. On Sept. 28 a wire was received from Ft. Sam Houston to the effect that rice bags could be obtained from a Houston, Texas, firm for 5c. each, cheaper than the sand bags used by the army (so the wire stated), and requested the county to obtain the bags from this firm.

The reader will please bear in mind that this last wire was received four days after the first wire sent to the Secretary of War. In the meantime, fearing that the delay was becoming expensive and irritating to the public, cement sacks in sufficient quantity, but costing 10c. each, were obtained and the temporary crossing was built and was ready for traffic by the time the wire of the 28th was received.

This in the opinion of the author is just another case of where the army could have been of great assistance to a community with practically no expense and very little trouble. Just before this incident occurred, the author spent the greater part of two days assisting an army convoy, consisting of four heavy cars and five trucks, in finding a crossing over the Nueces River in order that they might reach Marfa, Texas, in time for maneuvres at that place. It is supposed that if this incident had not taken place, no answer at all to telegrams would have been received.

M. B. Hodges, County Engineer.
Uvalde County, Texas.

Uvalde, Texas,
Oct. 9, 1923.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

President Coolidge is Taking Up with the State Department, it is understood, the matter of calling an international conference to discuss oil pollution. It was stated at the White House that the President attaches much importance to this matter. It is expected that he will request active consideration of the entire subject in the hope that remedies may be attempted at the earliest possible moment.

The Governor of Hawaii Is En Route to Washington to take up with Federal authorities and members of Congress the matter of extending the Federal aid plan to the highways of that Island. Porto Rico has similar plans. Apparently highway officials of the various states have no objection to such extensions of the act since their organization recently has admitted to membership the highway commissions of those islands.

For the Purpose of Drafting a uniform building code for all future building construction in the national parks, the superintendents of the national parks of the United States will meet at Yellowstone Park the week beginning Oct. 22. By request of Secretary Work of the Interior Department to Secretary of Commerce Hoover, J. M. Gries, chief of the Bulding and Housing Division of the Department of Commerce, will attend the meeting.

A Proposed National Forestry Policy has been formulated by a special committee of the Chamber of Commerce of the United States (Washington, D. C.) and is being sent out for ballot to the 1,200 business organizations making up the membership of the Chamber. Among the eight items to be voted on are proposals for federal and municipal acquisition and planting of waste lands; for a national forest council; for a national survey and inventory of forest resources; for increased federal appropriations for the protection of timber lands against fire; and for an enlargement of federal forest research work.

A Committee on Russian Trade has been formed with Henry T. Hunt, former member of the Railroad Labor board, as chairman, and with headquarters at 120 Broadway, New York City. The committee will prepare an industrial report, investigations for which are being made by experts, including Valerian E. Greaves, a former professor of law in the University of Petrograd, and Ellery A. Baker, formerly in charge of the industrial department of the National City Bank, and will co-operate with export bodies and trade associations of American manufacturers to obtain credit insurance on shipments and to make arrangements for financing trade with Russia to make use of the extensive resources of the Russian Soviet Republic.

C. & N.W. Celebrates 75th Year

The 75th anniversary of the Chicago & Northwestern Ry. was observed Oct. 24 by ceremonics including a dinner to men who have been in the company's service for fifty years or more. From the first 10-mile line between Chicago and Maywood the system has grown to a total of some 10,000 miles extending into nine states.

Washouts on Government Railway in Alaska

A severe rainstorm combined with a high tide 6 ft. above any record level has put 100 miles of The Alaska R.R. out of commission, according to a telegraphic communication received by Secretary of the Interior Hubert Work from railroad officials at Anchorage, Alaska.

No estimate of the damage is furnished, but the entire section of the line between Seward and Potter has suffered from washed-out embankments and cave-ins on cuts. Two large bridges near Spencer Glacier and Bartlett Glacier have been washed away. The bridge destroyed at Spencer Glacier is a 120-ft. span.

Information is not full at this time, but it is believed the line can be reopened within two weeks, was the report from Alaska.

British Claim Damages on Rio Grande Reclamation Project

The American and British Claims Arbitration, an international tribunal, will hold a hearing in London on Nov. 5 to consider claims growing out of the construction of the Rio Grande reclamation project in Texas and Mexico by the Reclamation Bureau of the Interior Department.

The claims, ranging from $3,000,000 to $5,000,000, represent alleged damages suffered by British capitalists, who attempted to develop irrigation along the Rio Grande River in Texas and Mexico some years before the American government took up the project. Later, after its construction by the United States, the British capitalists charged that the Reclamation Service of the United States was responsible for their failure and had wrongfully deprived them of their rights.

The State Department represents the United States in denying the equity of the claims and at the hearing will present written briefs and arguments against granting them. Sir William Willcocks, a British irrigation engineer, is expected to give oral testimony in behalf of the British subjects.

Arthur P. Davis, recently dismissed, by Secretary of Interior Work as Director of the Reclamation Service, has sailed at the request of Secretary of State Hughes to aid in presenting the case of the United States.

Am. Soc. C. E. Fall Meeting in Virginia

Main Meeting at Richmond With Boat Trip to Hampton Roads and Washington

Engineering News-Record Staff Report

Excellent attendance and increased interest in the technical sessions marked the fall meeting of the American Society of Civil Engineers which was held Oct. 17-20 between Richmond, Va., the Hampton Roads district, and Washington, D. C. Just before the end of the meeting it was announced that 471 had registered, which included a greater proportion of non-residents as usual, and nearly 200 took the two-day boat ride which included stops at William and Mary College, at various places in the Hampton Roads district, and ended in Washington, where trips were made to the Arlington experimental farm of the Bureau of Public Roads and around the city of Washington. Entertainment included a Southern buffet dinner, entertainment and dance in Richmond, automobile trips around the city of Richmond, and a luncheon by the Washington Section on the final day.

No business was transacted, except the unanimous and enthusiastic endorsement of the letter which the Board of Direction had prepared to send to Dr. Hubert Work, Secretary of the Interior, in answer to his earlier letter explaining or attempting to explain his action in dismissing Arthur P. Davis from the Reclamation Service. This letter is printed in another column. Announcement was also made of the award of prizes noted in this journal last week.

Technical Sessions

The technical sessions comprised two morning general meetings, the first devoted to highways and the second to the port problems of Hampton Roads, and a simultaneous afternoon session of, in one room, the power division, and, in another room, the highway division. All were very well attended, and while there was not time for much voluntary discussion there had been arranged a more than usual amount of discussion which illuminated the general subjects treated.

The main paper in the road session was entitled "Fundamental Principles of Highway Financing," by Thomas H. MacDonald, chief of the Bureau of Public Roads. Mr. MacDonald prefaced his remarks by stating that it is time that people be made to understand that the engineer is to be trusted in matters of finance, particularly in financial policies for such matters as road building. In this, he explained, engineers were much more sound than the banker. He said a financial policy for road building must be based on the earning capacity of the highways and requires an examination in each locality before a policy is outlined. This examination should discover the saving in the cost of maintenance and operation of the vehicle, the earnings due to increased value of prop-

erty served, the earnings due to the time saved, all of which means that the benefits to society, to industry including agriculture, and to the road users must be analyzed. The extent of the improvements planned as necessary should not be in excess of an earning capacity. He said that there has been in no state a successful pay-as-you-go policy, and that there must be authority for taxes to support the bonds which ought to go only for permanent improvements, the motor tax to go for maintenance alone.

Highway Sessions

George E. Hamlin, superintendent of repairs of the State Highway Commission of Connecticut, and J. S. Mackay, chief, Division of Highway Economics and Transport of the Bureau of Public Roads, both discussed, under the head "Road Service in Industrial Regions," the results of the well-known Connecticut traffic survey which is just completing its first year. They repeated the figures regarding the first three months of this survey, which have already been published, and indicated that much valuable material is to come from the whole year's survey. Mr. Hamlin, in addition, called attention to some of the necessities for a road service in an industrial region. He noted the fact that there must be markers to speed up traffic and that the numbering system of roads must be elaborated. He called attention to the fact that the whole New England States system had agreed now on a single system of numbering so that the tourist could follow a road through all of the states. He emphasized the necessity for policing roads. A certain amount of traffic increase can be expected by such methods, but, after all, in the East roads are rapidly becoming saturated and the only solution is to widen or parallel. We must expect new trunk lines for fast and safe traffic. Continuity of service is demanded, and as a part of this snow removal is a necessity in the North. One tractor with a plow can open 10 miles of highway in Connecticut; 1,500 miles of highway were kept open for $175,000 last year—$120 per mile under very extreme conditions.

Prof. Mackay emphasized the necessity for traffic surveys and called attention to the Connecticut, the California, and the Tennessee work, and stated that Pennsylvania is to start this month on one of the most elaborate surveys ever undertaken. He said that the field for motor transportation in the future is (1) urban motor truck transportation in congested areas; (2) organization of motor freight service to supplement and extend the present service of rail and waterway; (3) short-haul zone of freight under 30 miles, non-competitive service; (4) transportation of a limited number of small commodities, where delivery time and cost of goods are important factors. He does not believe that there is any danger of competition with the more established freight services, but that special fields are bound to develop.

In the highway division special sectional meeting, C. M. Upham, chief engineer of the North Carolina State Highway Commission, described the new development of the system in his state, and the work was commented on by Clifford Older, of the Illinois Highway Department, and George H. Biles, formerly commissioner of highways of Pennsylvania. In the power division, W. S. Lee, chief engineer of the Southern Power Co. and the Quebec Development Co., outlined the developments of the Southern Appalachian power system. He called attention to the fact that in the southern district superpower was already in operation, but that it was of a different type than in any other part of the country. Here they have no large blocks of power and they do not send the power long distances, but the various companies are tied together over an extended area and the interconnection consists in the repeated transfer of power from one to the next adjoining district. In effect, this constitutes the transfer of power over the whole area. He also showed motion pictures of the construction of several of the large power plants in the South.

Thursday morning's session was devoted to a categorical description of the port problem of the Hampton Roads district and to the showing of some motion pictures by A. T. Goldbeck, of the Bureau of Public Roads, on the operation of the road testing work at the Arlington farms, outside of Washington.

In addition to the foregoing meetings, there was an informal conference of representatives of the local section held one afternoon.

Illinois Central R.R. to Start Electrification in Chicago

The Illinois Central R. R. Co. has applied to the Interstate Commerce Commission for permission to issue preferred stock not to exceed $12,022,450 par value and $12,022,450 of common stock. The latter is to be issued from time to time at the request of the holders of preferred stock and to be exchanged share for share for that stock.

The funds thus secured are to be applied upon the electrification of the company's lines within the city of Chicago.

In its statement to the Interstate Commerce Commission, the Illinois Central estimates that the work ultimately will cost $88,801,562. Eighteen years will be required to complete the work, it is estimated.

Prof. Wagner New President of Rose Polytechnic Institute

Frank C. Wagner, for twenty-eight years a professor of engineering at Rose Polytechnic Institute at Terre Haute, Ind., and acting president since the resignation of Dr. Philip B. Woodward last May, has been elected president of the school. Professor Wagner graduated from the University of Michigan in 1883 with an A. M. degree and also the degree of mechanical engineer. He was an instructor in the engineering school at the University of Michigan at two different periods, between which he was sent to Mexico by the Thompson-Houston Electric Co. of Lynn, Mass., for whom he did engineering construction in Mexico City and built a street lighting plant in Pueblo.

The school was recently moved from within the city of Terre Haute to a new building and extensive grounds in the open country near the city (see *Engineering News-Record*, Aug. 30, p. 351.)

Am. Soc. C. E. Convention Condemns Dr. Work

Protest Sent Secretary for Summary Removal of A. P. Davis and Implied Slander of Engineers

After a detailed investigation of the action of Secretary of Interior Work in dismissing A. P. Davis from the position of Director of the Reclamation Service, the American Society of Civil Engineers, in an open session at the fall meeting of the society at Richmond last week adopted the recommendation of the Board of Direction that a condemnatory letter of Dr. Work's action be dispatched him immediately. The letter offers a vigorous protest of the Secretary's action and his slanderous implication that engineers are not possessed of the highest business qualifications. The letter, which was sent Dr. Work Oct. 17, follows:

"Your courteous reply of Aug. 14 to our inquiry of June 27 has been very carefully considered, and the whole matter of your dismissal of Director A. P. Davis of the Reclamation Service has been investigated by this Board, aided by a special committee of two fair-minded engineers, widely experienced in public service and business affairs, one of whom is an honorary member and the other a past-president of this society.

"We regret to have to state that after mature deliberation we feel constrained to protest against your action with the utmost vigor.

"1—Because the dismissal, made so suddenly and but little over three months after you became secretary, was arbitrary, and was unjust to a highly efficient and experienced public official, a most eminent civil engineer, of long recognized national and international standing in his profession, whose high qualifications you yourself have certified by offering to make him consulting engineer of the Reclamation Service.

"2—Because the action necessarily must undermine the morale and loyalty of the whole Reclamation Service, tending to substitute political standing for merit, and leading to the danger that the public funds may be wasted through inefficiency. Similar action applied to other technical bureaus would demoralize the entire technical and scientific service of the government.

"3—Because the action was taken by the device of nominally abolishing the position and immediately creating its equivalent under another name, a subterfuge which, as we are informed, it has been attempted to legalize by an ex-post facto executive order. Furthermore, the charge repeatedly has been made in the press, and without denial by you, that your offer to retain Mr. Davis as consulting engineer of the Reclamation Service was on condition that he omit to state that his resignation was requested by you. Of this fact your letter contained no reference.

Effect of Work's Action

"4—Because there is great danger that the effect of your action eventually may lead to the waste of vast sums of public funds to meet political demands put forward on behalf of selfish private interests. Disagreeing entirely with your views, we consider it established that efficient technical bureaus, such as the Reclamation Service in the past

(with its world-wide recognition as a model for other nations) can meet all the just needs of the government irrigation projects. Farmers generally throughout the United States are suffering under present conditions no less than those on reclamation projects.

"Engineering ability and experience are essential to the direction of the management no less than to the building of the reclamation projects.

"5—Because business and engineering ability both are necessary qualifications for the efficient discharge of the duties of the Director of the Reclamation Service, or, as now called, the Commissioner of Reclamation.

"Indeed, the whole engineering profession resents most strongly the slander (implied in your letter) that engineers cannot, or at least do not possess business qualifications of the highest order. In transportation, in mining, mechanical, electrical and other great industries, engineering executives play a most important part. Engineers are presidents of the Pennsylvania R.R., the New Haven, the Delaware & Hudson, the Chicago & Northwestern, the Santa Fé, the Great Northern, the Chicago & Great Western, and many others. Both presidents of our two big electrical companies are engineers; many of our large industrial and manufacturing operators are headed by engineers; in fact, engineers play important parts in business affairs in the long list of human activities in the United States. The fact that hundreds of thousands of Americans are content to trust investments of billions of dollars to the hands of engineers is ample proof—if any be needed—of the falsity of the charge that engineers are not business men.

"Your explanation, therefore, is inadequate in every respect. Your action is of a character most dangerous as well as unjust. We protest it in the strongest terms.

"The Board of Direction of the American Society of Civil Engineers.

"By C. F. Loweth,
President.
"John H. Dunlap,
Secretary."

More Power to Be Developed at Stave Lake, B. C.

Work has been started recently by the British Columbia Electric Company on a plant to develop more power at Stave Lake on the properties acquired from the Western Canada Power Co. A total of 157,000 hp., it is estimated, may be added to the present output and it is intended that this shall be developed in three separate units as the market may require.

The first development will be a 25,000 hp. addition to the present Stave Falls plant and will be located in a separate structure to be erected near by and operated by the same crew as the present plant aided with remote control apparatus. The second plant will be located on the upper end of Stave Lake and will be supplied with water from Alouette Lakes by the aid of a dam on that lake and a 3,900-ft. tunnel. This plant will utilize a drop of about 140 ft. and will develop 12,000 hp. The third plant will have a capacity of 120,000 hp. and will be located about 3½ miles down the river from the present power house.

Illinois Nears 1,000 Miles Record of Hard Roads in Year

Illinois' goal of 1,000 mi. of hard road before the close of 1923 seems within reach. The State Division of Highways announced on Oct. 15 that 906.42 mi. had been completed and that with favorable weather for the next five or six weeks the thousand-mile mark should be reached. During the week ending Oct. 11 a new week's record was set with 51.21 mi. The report shows there are now 118 mixers, 9,600 men and 2,200 teams employed in building new roads for Illinois. Last year Illinois set a record of 722 mi. of hard roads.

To Form Joint Committee on Structural Safety

In order to carry on the work inaugurated by its committee on structural safety, the New York Section of the American Society of Civil Engineers at a meeting held on Oct. 17, to which it had invited representatives of the architects and builders, resolved to ask the local architectural societies to co-operate with it in the formation of a joint committee to consider the whole subject and make recommendations to their respective societies. The adoption of this resolution followed an animated discussion of the report of the section's committee on structural safety in which the fact was brought out that, although there is some divergence of views as to the architect's or engineer's responsibility for the execution of his design, the architects and engineers agree that until there has been a radical change in the present methods of building which will result in none but competent builders being allowed to undertake any work, laws or changes in building codes will be of little value. Both sides feel that it is necessary that they should co-operate to arouse public opinion to the necessity of putting a stop to construction by irresponsible builders.

For Reference—New York Subway Articles Reprinted

Realizing the importance, for reference purposes, of a complete description of all engineering features of New York City's rapid transit system, *Engineering News*, in 1914, engaged Fred Lavis, consulting engineer, with a long experience in railroad and general construction work, to prepare a series of articles on this subject. These articles were published beginning Oct. 1, 1914, and in response to numerous requests they were reprinted in book form. A recent examination of our stock-room showed that 150 copies of this book are still available for distribution, and while the supply lasts they will be sent to any *Engineering News-Record* reader on receipt of 25c. to cover postage and handling charges.

The book consists of 73 pp. (9x12 in. in size) profusely illustrated with photographs and drawings. The text covers such subjects as history and extent of rapid transit in New York, organization of engineering staff, construction arrangements and operating contracts, superstructure and track, ventilation, drainage and waterproofing, subsurface structures, timbering, excavation, underpinning, tunnels and concrete work. The final chapter is on elevated railways.

A.A.E. Board of Directors Re-elects Drayer

Resolution Also Adopted Protesting Against Dismissal of Davis by Work

At the quarterly meeting of the board of directors of the American Association of Engineers, Oct. 4, 5 and 6, C. E. Drayer was unanimously re-elected secretary and H. W. Clausen re-elected as treasurer.

Other action of the board follows:

The conventions committee's report on San Francisco as the next place of meeting was accepted. The date is not set but will be after June 10, 1924. A resolution of protest on the dismissal of A. P. Davis as director of the U. S. Reclamation Service was directed to the Secretary of the Interior. The annual publicity contest by chapters will be held under the same rules as in the past. It starts Nov. 1 and ends May 15. Felicitations were extended by resolution to the President of Mexico on recognition of his country and a formal resolution will be directed to the engineers of Japan expressing the feelings of American engineers on the recent earthquake disaster. Owing to the appointment of Dr. F. H. Newell as consulting engineer of the Pennsylvania Giant Power Survey he has had to be released as field secretary.

Davis Resolution

The Davis resolution reads as follows:

"Whereas, Arthur P. Davis, Director of the U. S. Reclamation Service, was recently removed from the office that is believed he has filled honorably and efficiently; and

"Whereas, the U. S. Reclamation Service investigates the feasibility and practicability of engineering works, and engages in the design, construction and maintenance of such works; and

"Whereas, under the direction of technically trained heads the service has for a long time been free from all suggestion of political interference, improper conduct, or inefficiency; and

"Whereas, it should be evident that all engineering and technical divisions of the Government should be free from political interference, and that engineers or technically trained men should be able to administer them with peculiar effectiveness;

"Be it resolved by the Board of Directors of the American Association of Engineers in regular meeting assembled that it strongly deprecates the replacement of an able and faithful engineer by a politician under the plea that a "business man" can serve more effectively than an engineer as head of the Reclamation Service; that it deplores the woeful ignorance of facts indicated when it is implied that an engineer is incapable of exercising business judgment equal or superior to that possessed by the follower of any other profession or calling; that it vigorously protests against the injection of politics into the affairs of one of our Government's most important technical divisions; that it requests and urges that the next Congress institute a rigid public investigation of the removal of an engineer and the appointment of a non-technical man to head the U. S. Reclamation Service; and that copies of this resolution be sent to the Secretary of the Interior of the United States and furnished to the press."

Work Addresses Reclamation Fact-Finding Body

Starts Committee on Investigation of U. S. Reclamation Service After Substituting Bureau

The following statement was made by Secretary of the Interior Work Oct. 15, at Washington, D. C., at the opening meeting of the Fact-Finding Committee to investigate government reclamation methods:

"Soon after I was called upon to act as Secretary of the Interior, in March, 1923, my attention was particularly directed to conditions relating to the reclamation projects constructed or being constructed by the department in the western states, among which I have lived for thirty-five years.

"Through complaints from organizations of water users, individual water users, reports of agents, inspectors, official records of the department and Congress, it appeared that nearly all of the projects were in such condition that some radical reforms or improvements must be had if they were to be saved, farmers protected from loss of their homes, and the return of the money advanced by the government for their construction and maintenance was to be secured.

Complaints and Criticism

"The complaints and criticisms cover a variety of points, too numberous to be described here, but included charges that in many of the projects the original estimates under which settlers were induced to go upon the projects were from 50 to 100 per cent too low, and that the actual cost has been so great that it is impossible for the farmers to pay out within the time and manner fixed by law, or even at all; that mistakes, engineering and otherwise, had been made which added materially to the cost of constructed projects; that others had been undertaken that should never have been started; that the overhead costs of the service and many of the individual projects, all borne by water users, were burdensome and excessive.

"Under the system used in the Reclamation Service I have been unable to get figures that appear to be dependable as to the cost of individual projects or the total money expended on all projects. It is represented, taken from the records of the bureau, that the government's total investment to June 30, 1923, in round numbers is $181,000,000, and its total receipts about $46,000,000, leaving a balance invested and unpaid of $135,000,000.

"The Reclamation Service, for which this department is responsible, apparently requires reorganization. Annual reports on some projects indicate their insolvency and pending failure. Out of the 28 projects only one has met its obligations as they fell due. Long extensions of time for payments due are being urged individually and by projects. The original twenty-year period for payment is expiring on certain projects and an additional twenty-year extension is being asked. In one instance, such extension is to be preceded by a five-year moratorium.

"Reclamation of arid lands by irrigation from government funds, as heretofore practiced, is failing on a majority of projects as a business procedure and must be promptly readjusted as to methods of reimbursement for funds appropriated and for the purpose of securing to the settler a permanent home.

"Your committee is requested to survey the whole subject in its entirety, and give to the bureau your opinions concerning our operating methods that we may avoid errors, and finally your recommendations which Congress may study and which should ultimately preserve the sanctity of contract, secure to farmers safety for their investments already made and insure a return of invested funds. I want to improve and extend the service in every way possible, and solicit your suggestions and recommendations.

"Government reclamation has accomplished much. There is a great field for its future. Reclamation in the West by private enterprise was begun thirty years before the government began this work and has largely redeemed the West. Government reclamation should make a comparable showing, relieved as it is, from interest charges, which is the basis of calculation in all enterprises employing private capital. I am anxious that a policy may be developed that will safeguard the future of government reclamation which is my only cerncern in this inquiry."

Portland Lets Pipe-Line Contract for $2,571,403

A contract for the laying of Bull Run water-supply line, conduit No. 3, has been awarded by Portland, Oregon, to the Willamette Iron & Steel Works of that city, at $2,571,403 for lock-bar steel pipe. The total length of this line is 132,000 ft. of which 52,400 ft. will be 58 in. and 80,000 ft. 50 in. in diameter. Under arrangements made by the successful bidder with the East Jersey Pipe Co. the plates will be shipped from Leetsdale, Pa., in a partially fabricated condition and the Willamette company will complete the operations of rolling, pressing, testing and dipping at their Portland plant. It is expected that this arrangement will be conducive to the placing of additional lock-bar pipe on the Pacific Coast. The Portland contract is the result of alternative bids asked on either lock-bar or riveted steel pipe. Other bids were as follows:

	Lock-Bar	Riveted
J. H. Tillman Co.	$3,032,135	$2,628,645
F. J. Shea		2,647,161
T. A. Gillespie Co.	2,696,090	
Western Pipe & Steel Works, of California		2,708,381
Lyon S. Atkinson, Jr., Los Angeles		3,093,367

Fred M. Randlett is chief engineer of the Portland Water Bureau.

New Quebec Power Project Begun

The Laurentian Hydro-Electric, Ltd., has completed its financial arrangements and begun construction work for the development of power on the North River, Quebec. It has a franchise for ten years to supply light and power to the towns of St. Jerome, St. Adele, Strawbridge, Val Morin and other places in the Laurentian district. William Kennedy, Jr., and E. W. Loignon are retained as engineers and will supervise the construction of the plant.

Random Lines

A Super-Literary Allusion

Sir—To show that the use of the term "engineer" by professions hardly deserving that title is not confined to our own country, I copy the following from "The Unsocial Socialist" written by George Bernard Shaw nearly forty years ago:

"JEFFERSON SMILASH
Painter, Decorator, Glazier, Plumber & Gardener.
Pianofortes tuned. *Domestic Engineering* in all its Branches.
Families waited upon at table or otherwise.
Chamounix Villa,
(N. B.—Advice Gratis. Lyvern.
No reasonable offer refused.)"

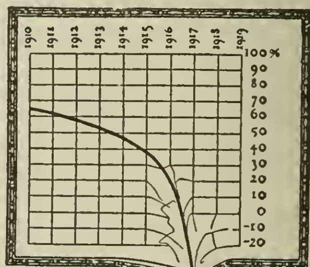
D. C. K.

—"Work wanted by *Practical Heating Engineer*—caring for furnaces."—Advertisement in daily paper.

—"Planning French Hat's an Engineering Feat—They make a regular survey and every cranial bump and depression counts."—Headline in Albany *Times-Union.*

* * *

The New York *Evening Post* in the accompanying chart introduces a new idea in plotting progress. Something



A chart showing the percentage of excellence in the physical properties of books published since 1910.

might be done with it in tracing the productivity of bricklayers or—at the upper end of the scale—with the cost of construction.

* * *

There Are Advantages

From The Complete Amorist: "A hair-net is a thing that gets caught in the buckle of a wrist-watch." A hair-net, in the brave old military days, was a thing that used to get caught on the collar insignia. Hundreds of officers, we have been told, got themselves transferred from the Infantry to the Engineers for no other reason. F. P. A. in the New York *World.*

* * *

Moving Sidewalks?

"We are not so much advertising men as Sales Engineers. Seeking and exploring through science avenues to the human mind that will move it to action in the supplying of needs; in the creation of wants."—From the advertisement of a Pittsburgh printer.

Cement Manufacturers Protective Association Ordered Dissolved

By an order handed down on Oct. 23 the Cement Manufacturers' Protective Association, a trade organization comprising 19 of the largest cement makers of the Lehigh and Hudson River districts, was ordered dissolved by Federal Judge Knox, New York City. Thus disposition is made of the equity case against the defendant organization, a case filed at the same time in 1921 when criminal indictments were returned against many of the association's members and officials of the member companies.

The criminal trial was held last year but ended in a jury disagreement. At that time it was agreed that all of the evidence adduced during the criminal proceedings should be the basis of any action in the equity case.

The Cement Manufacturers' Protective Association has not been functioning, except superficially, for a year.

War Camp Suits Must Give Bill of Particulars

In an opinion handed down by Federal Judge John E. Sater in the case of the government against the A. Bentley & Sons Co. of Toledo, Ohio, the builders of Camp Sherman, Judge Sater upheld the motion of the defendant that the government submit a bill of particulars as to the fraud with which the contractor is charged. Judge Sater ruled that the defendant company is entitled to such reasonable particulars as will indicate upon what evidence is to be given, namely, as to what materials or what quantity of the same were wasted, as to wherein the defendant purchased and resold at a profit materials and equipment needed and not needed.

The court also ruled that as the petition charged fraud, it should show with reasonable certainty of what the fraud consists, how it escaped detection by the government officer in charge, and why it was not detected at the time of its perpetration or for so long a time thereafter; that the petition should show that the plaintiff did not consent or was ignorant of the subletting of portions of the work to various subcontractors. The judge also ruled that the averment about the patriotism of the persons and concerns intrusted with the performance of emergency work should be omitted, as there is nothing in the contract which indicates that patriotism was any part of the consideration.

In regard to the government's claim that the contractor in operating on a cost-plus contract was in the position of a trustee of the government Judge Sater stated that the claim is not sustained in law, that when the government enters into a contract with an individual or corporation it divests itself of its sovereign character as to that particular transaction and takes that of an ordinary citizen and submits to the same law as governs individuals under like circumstances. He upheld the claim of the government that under the contract it had a right to make a deliberate review of the payments made the contractor in order to correct mistakes which arose due to the urgency of making prompt payment, but he stipulated that if the government has, as it claims, found that the contractor defrauded it of $5,000,000 the defendant contractor is entitled to particulars.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga., Nov. 12-16.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Meeting, Washington, D. C., Nov. 13-15.

AMERICAN ROADBUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 14-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York, Jan. 16, 17.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich. Annual meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

The Brooklyn Engineers' Club on Nov. 8 will have for special feature a paper, with lantern slides, "Arching Effect in Soil," by Emil Bie, engineer of the New York Board of Estimate.

The North Carolina Section of the American Water Works Association will meet in New Bern, N. C., Nov. 13-15, and discuss papers on metering, fire protection, algae in water supplies, streamflow records, filter operation and direct-oxidation.

The Four-States Section, American Water Works Association, had a luncheon at the Engineers Club, Philadelphia, preceding the conference on water pollution held at the same place on Oct. 16, and reported elsewhere in this issue. About 70 members were present. George W. Fuller, president of the association, called attention to new constitutional provisions under which there will be nine geographical sections instead of the present six, thus making feasible the creation of a Canadian section, whereas heretofore the Canadian provinces have been included with several American states in a section. To avoid confusion the term "division" instead of "section" will be applied to the Chemical and Bacteriological Section and any other technical sections that may hereafter be formed.

Personal Notes

F. C. MAGRUDER has accepted a position as city engineer of Enid, Okla., which city plans to spend a million dollars next year in construction work for an additional water supply.

ADAMS & ADAMS, consulting engineers, Detroit, is the new firm name of William H. Adams and his brother, Ralph W. Adams, whose recent admission to partnership with him is announced. The offices of the firm are in the Campau Bldg., Detroit, and they will practice in general construction engineering.

KENNETH M. CAMERON, assistant chief engineer of the Department of Public Works of Canada since 1918, has been appointed chief engineer of that department succeeding the late Arthur St. Laurent. Mr. Cameron is a graduate of and has a master's degree in hydraulics from McGill University. He had early railroad experience in the office of the chief engineer of the Canadian Pacific Ry., was inspection engineer of the Canadian Niagara Power Co., for some time was with Smith, Kerry and Chace, consulting engineers of Toronto, and in the Public Works Department was located successively at London, Sherbrooke, and at Ottawa in the dredging branch.

DANIEL C. COOPER, formerly construction superintendent with the United States Gypsum Co., at its Oakfield, N. Y., and Lancaster, Ohio, plants, is now connected with the Power Corp. of New York, Watertown, N. Y., as construction engineer.

EARL PHILLIPS, city engineer of Peru, Ind., has resigned and the appointment of PAUL SHADINGER to fill out the unexpired term is announced.

JOHN E. ALLEN, formerly with William Steele & Sons, of Philadelphia, as concrete engineer, is now engineer in the structural division of Stone & Webster, Inc., Boston, Mass.

A. D. MCLARTY, Urbana, Ill., has been appointed secretary of the Illinois Municipal League, and will give all his time to this work. He succeeds Prof. R. M. Story, who has resigned.

E. C. LAWTON, who has been made a highway research specialist in the Bureau of Public Roads, Washington, D. C., formerly was assistant engineer of construction on main highway work at Buffalo, N. Y., for the New York State Commission of Highways.

G. W. FLEMING, formerly assistant structural engineer with the Leonard Construction Co., Chicago, Ill., is now doing similar work with the George F. Hart Engineering Corp. and is located in Brooklyn, N. Y.

M. F. LONGWILL, division engineer of the Detroit division of the Wabash R.R., with headquarters at Montpelier, Ohio, has been promoted to assistant chief engineer of the eastern district of the Wabash lines, with headquarters at St. Louis, Mo. Mr. Longwill is a graduate of Ohio Northern University. He has held various positions with the Missouri Pacific Ry. and the Union Ry. of Memphis, and has been with the Wabash lines since 1918.

GEORGE D. FAIRTACE, recently city engineer of Dallas, Texas, has been appointed city manager and engineer of Highland Park, Texas.

J. D. TRAMMEL, recently chief engineer of the Spavinaw water supply project at Tulsa, Okla., in which were constructed at a cost of $6,800,000 a dam and a 61-mi. pipe line, has opened offices at Ft. Worth, Texas., in the Waggoner Bldg., and will conduct a consulting practice.

T. H. DILLON, of the firm of Titus & Dillon, engineers, and at present county engineer of Shelby County, Texas, has been appointed also engineer on the highway work of Panola County, Texas.

JOSEPH GRESHAM, formerly county engineer of Mason County, Texas, and S. A. DIETZ, formerly engineer for Hidalgo County, have been appointed assistant county engineers of Jim Wells County, Texas, under County Engineer L. W. S. MANTELL, at Alice, Texas.

Obituary

FREDERICK T. BAGSHAWE, civil engineer, died recently in Winnipeg, where he had resided for many years. He was born in England where he received his education, and was engaged in railway construction there and in Australia before going to Canada, where he has been in charge of several civic undertakings and has superintended bridge and track construction for the Canadian Northern Ry.

WILLIAM G. BLIGH, for many years executive engineer of the Public Works Department of India but more recently a resident of Toronto, Canada, died Oct. 16 in Calgary, Alta., aged 77 years. Mr. Bligh designed and constructed some of the largest irrigation works in India and Burma, and his book, "Practical Design of Irrigation Works," is a recognized text book on the subject.

GENERAL EDMUND HAYES, engineer and formerly chief of the staff of engineers for the state of New York, died Oct. 19 at his home in Buffalo, N. Y., from a stroke of appoplexy at the age of 74 years. He was born in Farmington, Me., and attended Dartmouth College two years and graduated from the Massachusetts Institute of Technology. In 1874, becoming associated with General Field, at Buffalo, he entered the business of the Morrison & Field Bridge Co., later the Central Bridge Co., and was engaged in many projects during the period of railroad expansion of the 70's. After this firm sold to the United States Steel Corp., General Hayes became interested in the Ontario Power Co., the Fidelity Electric Power Co., and the Niagara, Lockport & Ontario Distribution Co., these interests later being sold to the government. It was as chief of staff of engineers of New York State that he won his commission.

HARRY H. HAMILTON, civil and chemical engineer, was killed Oct. 10, by falling into a vat of boiling chemicals at the St. Louis Coke and Chemical Works, where he was employed. Mr. Hamilton was 30 years old. He was a resident of Portland, Ore., and graduated in 1912 from the Oregon Agricultural College. He was an enlisted marine officer and saw service in France during the war.

COL. JAMES A. MCCREA, since 1920 vice-president of the Pennsylvania R.R. system in charge of the Central Region, died of pneumonia Oct. 17 in Allegheny, Pa., aged 48 years. Colonel McCrea, the son of the late James McCrea who was president of the Pennsylvania R.R. from 1907 to 1913, entered the service of this railroad in 1895, after graduation from Yale University, and rose rapidly from rodman to engineer of maintenance-of-way of the lines east, then was made superintendent of the Cincinnati Division and later was general manager of the Long Island lines. He served in France 1917 to 1919, first as general manager of transportation, then as a member of the general staff of the A. E. F., and was awarded a Distinguished Service Medal.

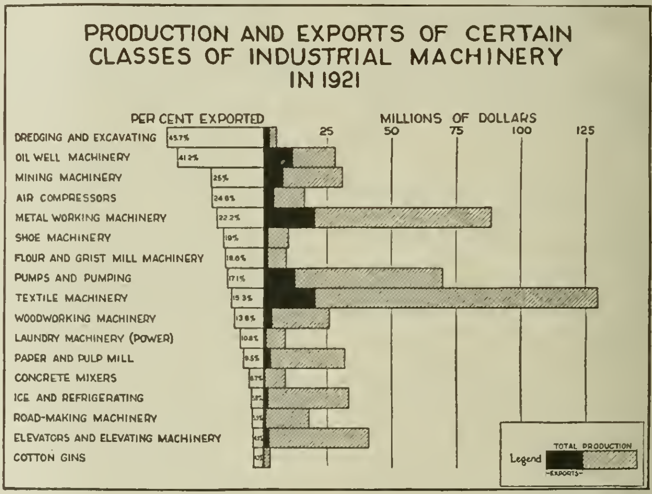
From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Export Ratios Need Study in Industrial Machinery Field

Virtual Withdrawal of German Goods Offers Opportunity to American Manufacturers

MANUFACTURERS of air compressors, according to statistics compiled by the Department of Commerce, have a better export business than manufacturers of concrete mixers. At first thought, according to an analysis of export ratios for various types of equipment by W. H. Rastall, chief of the department's industrial machinery division, one might expect the advantage to lie with the concrete-mixer manufacturer because of the nature of the work and the surroundings under which his product is commonly employed.



Why, Mr. Rastall asks, should the percentage of export orders secured by a manufacturer of excavating machinery be twice as great as that of a manufacturer of machine tools? American excavating machinery usually represents a high state of engineering development. These units are frequently very costly and one might expect that the labor conditions in most foreign countries would make it unnecessary to employ machinery of this character, while machine tools are necessary for a great number of manufacturing operations and would seem to be in more general demand.

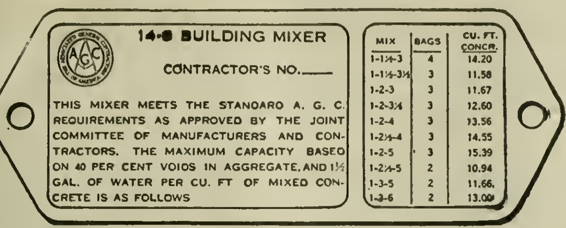
A great many similar questions naturally arise in considering the accompanying chart, which indicates the total volume of production and the percentage exported applying to certain classes of American industrial machinery, and it is interesting to speculate whether the situation illustrated by this diagram is the result of fundamental conditions or merely expresses the comparative business ability and sales effort manifested by the management of these different producers of machinery.

Conditions have now reached a point, according to the Department of Commerce, where American machinery manufacturers should give careful attention to their export business. Unusual opportunities are to be found in these foreign fields because Germany appears to be almost eliminated as a competitor. Before the war Germany furnished perhaps 45 per cent of the machinery that went into international trade and since the armistice there have been times when the depreciated condition of the mark gave German manufacturers a peculiar advantage in this trade. That situation has now passed and in great measure German prices already exceed world-market levels. Experience shows that deliveries from German manufacturers are slow and frequently uncertain, and in a great many ways it is difficult for foreign buyers to buy in Germany on a basis that is at all satisfactory. Business that formerly went to Germany will more and more fall into other hands.

Although there are a number of countries in the world that produce machinery for export, the countries of most outstanding importance at present are Great Britain and the United States, and the indications are that the large volume of machinery business formerly secured by German manufacturers will now be awarded to either British or American producers.

QUALITY SHOULD BE BASIS

American engineering and American machinery are distinguished in the world's markets for their superiority. Americans are noted for their engineering achievements, but, because of this superiority, American machinery is



Rating Plates for Standard Concrete Mixers

Showing ratings and maximum capacities for standard sizes of concrete mixers, as adopted by the Joint Committee on Construction Equipment at Chicago, July 30, plates of which a sample is shown herewith, have been designed at the request of manufacturers for attachment to the machines to avoid any misrepresentation, over-rating or underrating of mixers. It is announced by the Associated General Contractors that new plates will begin to appear on equipment as soon as the different manufacturers can arrange their designs and shop practices to conform with the new standards. Complete standardization is to be achieved before January, 1925.

The sizes of paving and building mixers adopted as standard are as follows:

Paving Mixers	Building Mixers	
21-E	21-S	5-S
13-E	28-S	7-S
7-E	14-S	3½-S

Portland Cement Output

Monthly output records for the portland cement industry in the United States were broken during September when mills produced a total of 13,109,000 bbl. as compared with 11,424,000 bbl. in September of last year. Shipments for September, 1923, were 13,698,000 bbl., which is higher than for the same month a year ago, but less than for certain other months in 1922 and 1923. The foregoing figures are based on statistics issued by the Department of the Interior and prepared under the direction of Ernest F. Burchard, of the Geological Survey, from reports by portland cement producers.

For the first nine months of 1923 portland cement production totaled 101,016,000 bbl. as against 81,563,000 bbl. for the same period during 1922.

Shipments for the first nine months of 1923 totaled 104,607,000 bbl., a gain of 15,923,000 bbl. over the same period for 1922.

Mixer Chokes on Contractor's 1 : 2 : 5 Charge

One of the Koehring Co.'s customers complained about the inability of the "Dandie" mixer to hold a 1:2:5 mix. A representative was sent out to investigate. He reported that the contractor was very much "peeved" and that the machine was certainly slopping. On investigation, however, he discovered that the contractor's conception of a 1:2:5 mix was one bag of cement, two wheelbarrows of sand and five wheelbarrows of stone. The contractor was complaining because the mixer wasn't big enough to take an extra wheelbarrow or two occasionally when the inspector was not looking.

usually higher in price than similar equipment secured from foreign sources and must be marketed on a quality rather than a price basis. In other words, this trade, which formerly went to Germany, will now pass to British manufacturers unless American products are supported by constructive sales effort of such character as to demonstrate that American equipment is worth the price asked, and more. Manufacturers should now organize their sales effort along such lines as will accomplish this result.

Export business is becoming more and more essential to the prosperity of the individual manufacturer. The accompanying chart shows that it is vital for manufacturers of dredging and excavating machinery. The difference between a satisfactory or an unsatisfactory export ratio can easily represent the difference between profit and loss on the year's balance sheet. Manufacturers have a very definite opportunity to improve their export ratio, and it remains for them to make the sales effort necessary to secure these results. The present international situation provides an unusual opportunity.

Figures Show Scope of Brick, Tile and Terra Cotta Industry

The Department of Commerce announces that, according to reports made to it, the value of products of establishments engaged primarily in the manufacture of brick, tile, terra-cotta, fireclay products, pottery, and non-clay refractories amounted to $335,518,035 in 1922, as compared with $278,492,385 in 1921, $388,746,923 in 1920, and $286,261,276 in 1919.

For brick, tile, terra-cotta, and fireclay products the value reported for 1922 was $229,435,610, which was an increase of 23 per cent over 1921 and 16.2 per cent over 1919, but a decrease of 14.1 per cent compared with 1920.

For the pottery industry the value of products in 1922 was $91,986,297, which was an increase of 9.3 per cent over 1921 and 18.1 per cent over 1919, but a decrease of 13.8 per cent compared with 1920.

The reports for 1922 involve 1,973 establishments, including 1,651 primarily engaged in the manufacture of brick, tile, terra-cotta and fire-clay products, 270 primarily engaged in the manufacture of pottery, and 52 in the manufacture of non-clay refractories. Of the 1,973 establishments reporting in 1922, 331 were located in Ohio.

Prepared Roofing Simplified

At a meeting held in Washington, D. C., Sept. 26 at the Department of Commerce with representatives of the Division of Simplified Practice and the Chamber of Commerce of the United States, manufacturers, distributors and consumers of prepared roofing agreed to the following simplifications as being of benefit not only to the industry but also to the public at large:

1. To eliminate all grades or kinds of slate-surfaced and also stone-surfaced prepared roofing that do not measure up to the requirements of the "Class C Label" of the Underwriters Laboratories.
2. To reduce the varieties of smooth surface roofing to seven lines or grades —weights and qualities being considered.

This Simplified Practice Recommendation is to become effective Jan. 1, 1924, and is to hold for one year.

According to W. A. Durgin, chief of the Commerce Department's Division of Simplified Practice, this is another step in the general program fostered by Secretary Hoover for the elimination of waste in industry. "The proposed eliminations," he said, "were strongly supported by the American Institute of Architects, the National Retail Hardware Association representing 21,000 retail hardware dealers throughout the United States, the National Retail Lumber Dealers Association, the Southeastern Builders' Supply Association, and the Prepared Roofing Association."

Several other simplifications of building materials have been completed notably common and face clay brick. Others in process of completion are lumber, hollow building tile, cement brick, block and tile and clay drain tile. All of these simplifications are contributing to the general effort to reduce the needless wastes in the building field.

Business Notes

KOEHRING Co., Milwaukee, has let contracts for an addition of 100 ft. to its light erecting shop to increase its output of cranes, draglines and power shovels. Plans for another new shop unit are now being drawn.

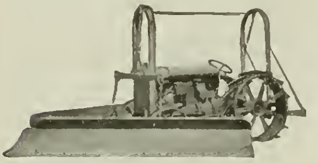
WESTINGHOUSE ELECTRIC & MANUFACTURING Co., at its South Philadelphia works, has established a general engineering division which will be devoted to the study of central station and industrial plant problems involving the application of steam power apparatus such as steam turbines, condensers and reduction gears. This department will also co-operate with the sales organization in providing engineering service to purchasers of this equipment.

REEVES BROTHERS Co., Alliance, Ohio, builders of steel tanks, oil refinery equipment, cement and mining machinery and creosoting plants announces, effective Oct. 1, an office at 2012 L. C. Smith Building, Seattle, Wash., from which all Western business will be handled. Percy E. Wright, consulting mechanical engineer, has been appointed assistant sales manager of the company and will be in charge of the office.

Equipment and Materials

V-Shaped Snow Plow on Tractor Clears Full Width of Road

Designed for attachment to the front end of a Fordson tractor, a new model of V-shaped plow for clearing snow from the full width of highways at one operation has been designed by the Stark Plow Co., 943 Little Building,



Boston, Mass. It consists of a pair of 2-in. oak-plank wings, each 10 ft. 6 in. long, shod with road-grader steel blades and hinged to a nose casting at the front end, as shown in the accompanying photograph. Each oak wing or moldboard is flared at the top, the total height of the blade being 20 in. As the tractor travels at speeds of from 12 to 15 miles per hour, this flareboard is effective in catching the snow as it rises up on the moldboard and throwing it over toward the sides of the road.

The wings are adjustable, by means of a trip latch and pin, and may be set to clear any width of roadway from 8 to 16 ft. One of the advantages of the V-shaped plow, its manufacturers point out, is the elimination of side thrust, making possible the clearing of a wider strip at one operation and a higher traveling speed. The equipment is designed so that in a heavy storm a route may be covered quickly, clearing the whole width on the outward journey and repeating on the inbound trip before the snow becomes too deep to handle.

To the tractor chassis are bolted two U-shaped hoisting frames rigged with block and tackle for raising and lowering the plow. The rear end of the tractor is equipped with a platform for an operator. The weight of the plow attachment is 1,200 lb. While designed primarily for tractor operation, the plow can be adjusted for use on a motor truck. In practice it has been found that the best results are secured by equipping the tractor with weighted wheels with 10-in. solid rubber tires equipped with chains.

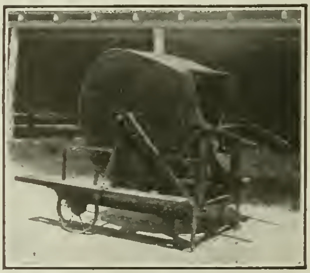
New Rust-Proofing for Wire

A new process termed "Galvannealing" for the application of a protective zinc coating to steel wire and wire fencing is being introduced by the Keystone Steel & Wire Co., Peoria, Ill., as an improvement upon ordinary galvanizing. The special advantage claimed is in permitting an extra heavy coat of zinc to be applied without fear of its flaking or peeling off. If such a heavy coating is applied by ordinary methods it is likely to separate from the steel when the wire is bent sharply, as in the weaving of fencing. In the new process, instead of employing pressure as usual to cause the zinc to adhere to the steel, the coated wire is given a heat treatment by which the zinc becomes amalgamated with the surface of the steel so that it will not crack or flake off when the wire is bent or twisted. It is claimed that steel wire and woven fencing thus made have fully twice the life of ordinary galvanized material.

Light, Compact Concrete Mixer Is Hand Operated

Operated by hand and weighing only 400 lb., a concrete mixer with a capacity of 6 cu.ft., known as the "Shaker," has been developed and placed on the market by G. W. Adams, concrete contractor, San Antonio, Tex. The equipment is designed particularly for mixer jobs that have heretofore been done by the shovel and board method or where a large gang is not justified for operating a larger and more expensive power mixer. Simplicity is the keynote in the design of the hand-operated machine which has been made compact, light, and portable.

As shown in the accompanying illustration, the device consists of a steel drum pivoted on ball bearings to a steel frame carried on a two-wheeled carriage. The mixer is charged directly from wheelbarrows and is frequently mounted directly over the forms so that it may discharge into them. In operation, after the charge has been introduced, the drum is rotated by hand,



back and forth in a semicircle. Blades on the interior of the drum throw the material to and from the sides and through two grates located about 5 in. on either side of the axis of the drum. The manufacturer of this equipment states that about a dozen revolutions or "shakes" of the drum are sufficient to produce a satisfactory mixture. The charge is emptied by revolving the drum about its axis until its mouth points downward. It is claimed that with a gang of four or five men the output of the machine will range from 20 to 30 cu.yd. daily.

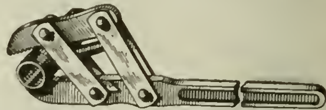
Crane Handles 98-Ton Girder

At a highway bridge crossing over the main line of the Boston & Albany R. R. at Beacon St., Boston, a 98-ton steel plate girder was received on flat cars, unloaded and raised to place between train schedules, the operation beginning at 10 p.m. and ending at 1:55 a.m. The work was done by the Phoenix Bridge Co., which employed a crane manufactured by the Industrial Works, Bay City, Mich., for handling the large girder. It is claimed that this is the largest girder ever handled by a single locomotive crane.

A Self-Adjusting Wrench

A self-adjusting wrench requiring no screwing up or down to make it "bite" or fit an object is being marketed by the Greater Service Co., Newark, N. J. By the use of a ratchet leverage system the teeth are inclined to each other, causing the grip to be stronger as the pull is increased. The wrench, which is known as the Robert, is equipped with a spring, as shown in the accompanying illustration, and its operation requires the use of only one hand.

The wrench is made of drop-forged carbon steel in only one size, a 12-in. length, which weighs 1½ lb. This size



will handle objects ranging from small nuts to 1½-in. pipe. The manufacturer is planning shortly to put on the market additional sizes, from 6 in. to 16 in.

Publications from the Construction Industry

Kerosene Engines—FULLER & JOHNSON MANUFACTURING CO., Madison, Wis., has published a 40-p. illustrated catalog on its throttling governor kerosene engines in sizes from 3 to 25 hp. The text deals with both stationary and portable units.

Hammer Drills—SULLIVAN MACHINERY CO., Chicago, has issued a 32-p. revised illustrated bulletin on its Rotator hammer drills. The new models described include the lightweight and auger patterns, as well as the standard drills with solid or hollow pistons and air and water-jet attachments. The drills are one-man hammer drills, weighing from 29 to 40 lb., designed to drill holes from 8 to 12 ft. deep for 1¼-in. powder. They may be used as hand tools or on mountings.

Industrial Locomotives—BLOOMSBURG LOCOMOTIVE WORKS, Bloomsburg, Pa., has issued a 28-p. bulletin on its industrial locomotives of three types, a gasoline-engine-driven and two types of steam-engine-driven units. A feature of the gasoline locomotive is a mechanical speed control device working in connection with friction disk transmission. These units are built in sizes of 3, 4, and 6½ tons. The steam locomotives use oil fuel and the burners on the two models are of the vaporizing and the atomizing type. The oil-burning steam locomotives are particularly adapted to work where smoke and exhaust gases from internal combustion engines are objectionable, as in mines or tunnels.

Water for Swimming Pools—GRAVER CORP., East Chicago, Ind., in a 16-p illustrated pamphlet presents data on its filtration equipment for supplying pure water to swimming pools. The equipment for recirculating, filtering and sterilizing the water permits the same supply to be used over and over again. Actual layouts of typical swimming pools are presented. The Graver filters are of the mechanical pressure type.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Fifty Big Contracts Since March Total $157,460,646

Each week *Engineering News-Record* publishes a separate list of the large contracts awarded for the current issue. The accompanying table shows fifty large projects placed under contract during the period March 1 to Oct. 1, 1923. The list is composed of the largest awards taken from the various construction headings during these seven months and covers work in the United States and Canada.

This table gives the percentage of the various operations as follows: Buildings, 57%; Railroads, 9%; Streets and Roads, 4%; Waterworks, 3%; Sewers, 6%; Excavation and Dredging, 0.2%; Bridges, 2.7%; Dams, 5%; Power Plants, 13%.

The award for the railroad and telegraph system consisting of 330 mi. of track, a complete telegraph system and 660 mi. of fencing, amounting to $12,000,000 was given to the firm of Peterson, Shirley & Gunther, Omaha, Neb. A 30-story telephone exchange building in New York was awarded to Marc Eidlitz & Son, Inc., of New York City, for the sum of $11,250,000. The third largest contract is for the 16-story office and sales building at Chicago, Ill., and is being constructed by Wells Bros. Contruction Co. of Chicago for $8,000,000.

During this period the following number of contracts as reported in Construction News were awarded at the following prices (the amount quoted is the minimum taken as a base): 129 at $10,000; 2,771 at $25,000; 341 at $50,000; 2,044 at $100,000; 310 at $200,000; 184 at $500,000; 174 at $1,000,000; 14 at $5,000,000.

Business Briefs

Call money easy; rate 4@4½ per cent.

Time loans shows little variation during the last few weeks; 30, 60@90 day loans, to 6 months, 5@5¼ per cent.

Painting costs for the $868,529,000 worth of industrial and commercial building contracts noted in *Engineering News-Record* from Jan. 1 to Oct. 1 amount to $20,000,000, of which $8,000,000 is for paint materials. If one painter did all this work it would take him 2,740 years and he would receive $12 per day during that time.

British steel output up. September ingot production, 695,100 tons, against 567,500 in August. Pig-iron output, 558,600 tons, compared with 599,800 during preceding month.

American steel output drops. September production of steel ingots, 3,159,283 tons, against 3,506,755 in August. Daily pig-iron output, 104,184 tons, compared with 111,274, during preceding month.

Duty free building materials allowed by Turkish Government, to construction companies granted concessions for reconstruction of cities destroyed in Western Asia Minor.

ESSENTIAL DATA ON LARGE CONTRACTS AWARDED SINCE MARCH

Place	Work	Size	Price	Successful Contractors
Calif., San Francisco	Pipe line		$2,231,661	Western Pipe & Steel Co., 444 Market St., San Francisco, Calif.
Calif., Sacramento	Incinerator	150 ton	195,000	F. L. De Carie, Portland, Ore.
California	Bridge	11,731 tons struc. steel; 2,150 cu.yd. con. floor; 362,000 lbs. rein. steel for floor; 27,300 cu.yd. con. piers; 177,600 lb. rein. steel piers	4,500,000	Duncanson-Harrelson, Chronicle Bldg., San Francisco, Calif.
Calif., Los Angeles	Office	8 story	2,200,000	C. J. Kubach, 701 Merchants National Bank Bldg., Los Angeles, Calif
Ill., Chicago	Sewer	Sewage treatment works	5,602,636	J. Griffiths & Son Co., 112 West Adams St., Chicago, Ill.
Ill., Chicago	Office and sales	16 story	8,000,000	Wells Bros. Construction Co., 53 West Jackson St., Chicago, Ill.
Ill., Chicago	Apartment	10 story, 124 x 269 ft	3,500,000	B.-W. Construction Co., 720 Cass St., Chicago, Ill.
Ill., Chicago	Hotel	8 story, 200 x 216 ft	2,000,000	Shank & Co., 30 North La Salle St., Chicago, Ill.
Ill., Chicago	Bank and office	21 story	5,500,000	H. Erickson Co., 139 North Clark St., Chicago, Ill.
Ill., Chicago	Office	20 story, 100 x 300 ft	7,000,000	R. C. Wieboldt Co., 1534 West Van Buren St., Chicago, Ill.
Ind., Newburg	Lock		1,494,494	National Contracting Co., Citizens Bank Bldg., Evansville, Ind.
Ky., Danville	Dam	260 ft	4,000,000	L. E. Meyer, Monadnock Bldg., Chicago, Ill.
Kentucky	Railroad	Grading, masonry for 16.63 mi. second track	1,799,579	Nichols Contracting Co., Georgia Bldg., Atlanta, Ga
La., New Orleans	Dredging		350,200	Atlantic Gulf & Pacific Co., Park Row Bldg., New York City
Md., Baltimore	Filtration plant		1,070,000	Carozza-Rowe Construction Co., 624 North Gilmore St., Baltimore, Md.
Md., Baltimore	Grain elevator	206 x 61 x 240 ft	3,000,000	M. A. Long Co., Guilford Ave. & Fayette St., Baltimore, Md.
Mich., Ann Arbor	Law school		2,000,000	Starrett Bros., Inc., 101 Park Ave., New York City
Mich., Battle Creek	Hospital		2,174,680	A. Bentley & Sons, 201 Belmont Ave., Toledo, Ohio
Missouri	Dyke		570,007	Kansas City Bridge Co., 510 Orear-Leslie Bldg., Kansas City, Mo.
Mo., Kansas City	Office	12 story, 132 x 143 ft	2,225,000	Cherdron Construction Co., 603 McIntyre Bldg., Salt Lake City, Utah
Mo., St. Louis	Grain elevator	2,000,000 bu. cap	2,000,000	Laclede Steel Co., Arcade Bldg., St. Louis, Mo.
Mo., St. Louis	Temple	5 story (equal to 14 story) 160 x 300 ft	3,000,000	Westlake Construction Co., Ry. Exch. Bldg., St. Louis, Mo.
N. J., Camden	R.R. Terminal Bldg		2,000,000	New York Shipbuilding Corp., Bway & Fairview St., Camden, N. J.
N. Y., Brooklyn	Conduits		2,338,805	T. A. Gillespie Co., 7 Dey St., New York City
N. Y., Brooklyn	Siphon		1,523,136	Merritt, Chapman & Scott Corp., 17 Battery Place, New York City
N. Y., Long Island City	Sewer		528,002	Booth and Flinn, Ltd., Green and Tompkins Aves., Brooklyn, N. Y.
N. Y., Buffalo	Sewers		1,379,233	F. L. Cohen, Inc., Prudential Bldg., Buffalo, N. Y.
N. Y., New York	Subway		5,976,000	P. McGovern, Inc., 50 East 43rd St., New York City
N. Y., Brooklyn	School		2,492,000	G. A. Fuller, 175 Fifth Ave., New York City
N. Y., New York	School		2,057,950	G. Dekempie, 30 Church St., New York City
N. Y., New York	Telephone Exchange	30 story	11,250,000	Marceidlitz & Sons Inc., 42 East 42nd St., New York City
N. Y., New York	Office	24 story, 62 x 22 ft	5,000,000	S. S. Roth & Bros., 130 West 42nd St., New York City
N. Y., Glens Falls	Dam	Dam and power house	1,000,000	Parklap Construction Co., Glens Falls, N. Y.
O., Cleveland	Coagulation basin		1,365,425	Stange-Walsh Constr. Co., 2315 Fairmont Rd., Cleveland, O.
O., Cleveland	Road work	56,450 sq.yd. grading and asphalt paving	311,059	Cleveland Trinidad Paving Co., The Arcade, Cleveland, O.
O., Cleveland	Hotel	16 story, 132 x 200 ft	3,000,000	Crafts Construction Co., Sloan Bldg., Cleveland, O.
O., Cleveland	Library	4 story, 199 x 216 ft	4,000,000	Lundoff-Bicknell Co., 5716 Euclid Ave., Cleveland, O.
Okla., Muskogee	Power plant	2 story	3,000,000	Oklahoma General Power Co., Muskogee, Okla.
Ont., Timmins	Hydro-electric plant		5,000,000	William Arrol & Sons, Ltd., St. Catharines, Timmins, Ont.
Pa., Springdale	Power plant		6,000,000	Sanderson & Porter, 52 William St., New York City
Pa., Pittsburgh	Piers and Abutments		854,692	H. C. Converse & Co., Devonshire St., Boston, Mass.
Pa., Philadelphia	Hotel	26 story, 100 x 260 ft	7,000,000	G. P. Pawling & Co., 1432 South Penn Sq., Philadelphia, Pa.
Quebec	Power plant		3,000,000	Morrow & Beatty, Peterboro, Ont.
Que., Montreal	Apartment	10 story, 214 x 252 ft	5,000,000	Anglin-Norcross Ltd., Victoria St., Montreal, Que.
R. I., Pawtucket	Transmission Line		1,400,000	Stone & Webster, Inc., 147 Milk St., Boston, Mass.
Tex., Ft. Worth	Sewers	2 filter beds	400,000	McKinzie Construction Co., 302 West Mulberry St., San Antonio, Tex
Wash., Seattle	Roadwork	23,050 sq.yd. 8 in. con.; 750,000 cu.yd. excav.; 646,000 cu.yd. earth excav.	571,087	Puget Sound Bridge & Dredging Co., Central Bldg., Seattle, Wash.
Wash., Seattle	Hotel		4,000,000	Grant-Smith & Co., Henry Bldg., Seattle, Wash.
Wyo., Rawlins	Waterworks	40 mi. 16 in gravity pipe	600,000	Continental Pipe Mfg. Co., 4519 14th St., N. W. Seattle, Wash.
Wyoming	Railroad & telegraph	330 mi. R.R. telegraph system, 660 mi. of fencing	12,000,000	Peterson-Shirley & Gunther, 1411 Woodmen of World Bldg., Omaha Neb.
Total			$157,460,646	

Storm and flood are the chief causes for the decline in crude oil output. Production for week of Oct. 13 was 2,125,350 bbl. against 2,157,400 bbl. of previous week.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 227 to 238, are the following:

Capitol, Charleston, W. Va., $2,500,000.

Water Plant, St. Louis, Mo., $2,500,000.

Hospital, San Francisco, Calif., city and county, $1,750,000.

Hotel, Louisville, Ky., Citizens Hotel Co., $2,300,000.

Hotel, Memphis, Tenn., Southern Hotel Co., Inc., $3,000,000.

Theatre and Office, Indianapolis, Ind., Monument Circle Realty Co., $1,500,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 227 to 238, are the following:

Hospital, Louisville, Ky., to Struck Construction Co., $1,500,000.

Bank and Office, Los Angeles, Calif., to Scofield Eng. & Constr. Co., about $1,250,000.

Hospital, New York, N. Y., to Nat. Constructors & Engineers, $1,000,000.

Warehouse, Chicago, Ill., to J. Bhedden & Co., $1,000,000.

Factory, Jacksonville, Tenn., Du Pont Fibre Silk Co., $4,000,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the the issue of Oct. 4; the next, on Nov. 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.00
Structural rivets, 100 lb.	4.40	4 75	4.90	3.75	4.25	5.30	5.00	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	—3.38	3.20	3.45	3.85	3.65	4.10	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	53%	43%	47%	53–5%	36%	33.2@42.2%	35%	47.43
Cast-iron pipe, 6 in. and over, ton	63.60	54.00	—61.00	60.20	60.50	69.00	62.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.70@2.80	2 60	2.05	2.20	2.50	2.84	2.61	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	1 85	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	2.00	2.00	—1.00	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	62 00	39.00	52.25	58.50	44.75@45.75	48.00	41.00	29.50	70.00
Lime, finishing, hydrated, ton	18.20	25.00	+23 50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3 00@3.25	1.60	+2.00	1.50	1.50	2.70	2.10	2.80	9.50
Common brick, delivered, 1,000	22.40@23.65	11.00	11.60	11.00	17@19	12.00	15.00	15.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	.115	.0724	.0816	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1179	.102	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.98	1.00	1.08	1.14	1.02	1.12	+1.11	.86	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.50@.55	.35@.50	.50	.56¼@.62½	+.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.58). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in., $119.

Changes Since Last Week

While there has been a perceptible falling off in demand for iron, steel and textiles, activity continues in other materials with but little tendency toward an upward turn in prices.

Fabricated structural steel bookings fell off nearly 12 per cent and steel castings, 6 per cent, during September. Confidence in the trend of business, however, is evidenced by the recent heavy demand for railroad materials. The Baltimore and Ohio Railroad Co. has placed orders for 50,000 tons of steel rails to be delivered during 1924. Including track fastenings, etc., the cost of this material will approximate $4,300,000. This tonnage has been distributed as follows: Carnegie Steel Co., Pittsburgh, Pa., 25,000 tons; Illinois Steel Co., Gary, Ind., 4,000 tons; Cambria Steel Co., Johnstown, Pa., 10,000 tons; Inland Steel Co., Indiana Harbor, Ind., 3,000 tons; Bethlehem Steel Co., Steelton, Pa., 8,000 tons.

Building materials prices show little tendency to change. Of the nine cities reporting weekly to *Engineering News-Record*, but three show any revisions. Dallas reports a decline of 62c. per 100 lb. in reinforcing bars and $2 per ton in cast-iron pipe. An advance of $3.50 per ton, however, is quoted in hydrated lime and 25c. per bbl. in common lump lime. A slight tendency to quote lower cement prices is prevalent in San Francisco and other points on the West Coast, due mostly to importations of foreign cement. Linseed oil rose 4c. per gal. in San Francisco during the week. Montreal shows a tendency toward higher rates for common labor; and firmness in black steel pipe.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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Light Ahead in Europe

WORLD politics, like a running stream, can be dammed to a certain height. Sooner or later the dam bursts or is overtopped. Last week the European muddle reached the overtopping stage. Whether or not there was more than mere coincidence in the timing of the Baldwin, Harvey and Smuts speeches and the Hughes-Curzon correspondence, it is quite evident that neither Great Britain nor the United States can stand idly by and see a foundation for future wars laid in a dismembered Germany and an international industrial compact between Lorraine iron and Ruhr coal. France is obsessed with her notions of current security and cannot be trusted to foresee the future. The less wounded nations must see ahead for her. If the proposed Hughes conference does nothing else it will at least make public the economic possibilities of the reparations settlement, which have hitherto been obscured by the cloud of international and domestic politics. The economic basis once established the path to agreement and means to insure it will be much easier.

A Unique Personality

CHARLES PROTEUS STEINMETZ was the greatest example in our generation of the triumph of mind over matter. No one who ever saw him will forget that gnomelike figure which had it been clothed in grotesque dress might have stepped out of fairy tale or ancient masque. But the mind was there behind this superficial covering and it carried its possessor to the heights. He was an inspiration to the theorist, because in his chosen line he was the supreme theorist in the world and yet so practical was his theory that for years he remained the technical mainstay of an intensely practical organization. Engineering lost a leader, industry one of its most ardent workers and social science one of its most devoted students when Steinmetz died.

Two Court Decisions

THE courts last week made initial decisions in two cases that have great interest to engineers and the construction industry. In Ohio Judge Sater, in one of the cantonment contract suits, made it clearly evident that the government must specify the exact losses it claims it suffered from the so-called wasteful camp construction during the war. Obscured as it is by the legal distinctions between the agency and the contract relations the camp contractors bore the government, the decision nevertheless indicates that the Department of Justice is to be forced to a more specific definition of the fraud it so vociferously has alleged against the engineers and contractors who helped win the war at the cantonment sites. The other case was the decision of Judge Knox in New York City that the Eastern open-price cement manufacturers association is a combination in restraint of trade and therefore illegal. In view of the earlier decisions in the hardwood and tile case this one was to be expected. It is interesting to note, however, that Judge Knox is by no means convinced that the price and contract interchange methods under attack resulted in an exorbitant price of cement, and this, as we have pointed out before, is the question that engineers and contractors want most to have settled.

A Remarkable Runoff Record

NO BETTER example of the vagaries of rainfall and its consequent runoff could be found than the experience of Oklahoma City this summer. A river which had been dammed for water supply had a record flow up to May of this year of 11,000 sec.ft. In that month this was surpassed by 1,000 ft., not at all surprising considering the relatively short period over which the records of flow in this comparatively new country extend. But in the six months thereafter there were three successive floods, first 33,000 sec.ft., then 12,000 sec.ft. and now the last one, described in this issue, of 60,000 sec.ft. This is breaking records with a vengeance. Full data regarding the last remarkable runoff will be looked for by all interested in water storage and control.

Function of Contracting

SUBCONTRACTING perhaps receives its most complete modern expression in building construction. Years ago when railway construction was at its peak it might have claimed precedence as being most practiced in the multiplication of contracts. Then, on occasion, the subcontractor sublet parts of his contract and the sub-subcontractors relet their work to station men. Out of modern building practice has grown, as there once grew out of railway construction, a class of contractors who are more financiers and co-ordinators of construction operations than they are actual constructors. The reaction is a demand by some of the building trades that separate contracts be awarded them for the work for which ordinarily, now, they must seek subcontracts. A specific instance is the memorial to the Interdepartmental Board of Contracts and Adjustments urging separate contracts for the "mechanical elements," of federal buildings. Neither the claim nor the argument against it need concern us at this time. It will be noted merely that building construction practice furnishes a particularly clear illustration of a function of contracting that is commonly overlooked; this function is management of construction. In brief, contrary to common acceptance, the most important function of the general contractor is not to erect steel or brick or concrete, but to co-ordinate and synchronize construction operations and to assume responsibility for the owner. The contractor does not merely construct; he

furnishes a management and financing service and an insurance against risk. If we keep these truths clear, that if the contractor does not perform these functions there must be some other agency employed, we shall escape many of the false conclusions about cheapening construction by eliminating contractors' profits.

Why Not a Construction Show?

AN ENGINEERING and business congress of highway industries, which has true magnitude, has been developed around the annual meeting of the American Road Builders' Association. In Chicago in January each year the exhibition of road building materials and machines and the technical proceedings of the road builders' convention represent about the highest effort that has been attained in gathering together for business and education all the elements of a leading activity in the construction world. Because it is outstanding, indeed almost alone, as a construction exhibition, the road show draws visitors from all lines of the construction industry. The circumstance suggests the thought of the creation of a general construction-industries exhibition around which the associations of that industry can arrange their annual business and technical conventions. Is the idea practical? One sees no convincing reasons why it is not. Truly there are visible difficulties of exhibition space, hotel accommodations and convention scheduling, but they appear small when set against the time and money saved by exhibitors and visitors. The present road show is a nucleus to grow around. Contractors particularly would like to see it become, by extension of time, space and exhibits, a construction show. Indeed it is with this possibility in mind that this year the Associated General Contractors are entering partly into joint convention work with the American Road Builders Association. Why not a single annual construction show with a tributary business and technical congress of construction associations?

When to Use a Trestle

RECENT floods in the Middle West, notably those with which the Burlington Ry. has been afflicted, call attention again to the importance of the timber trestle in railway construction. An expedient of the early days of railroading, the trestle remains a necessary structure at many locations where economy is governing. But in the "cloudburst" country where a dry run may be converted once a year into a raging torrent the trestle is a dangerous element in operation. It may be questioned whether the use of the trestle has not been carried to extremes by perfunctory adoption of this type, with low cost as the primary consideration and with insufficient study of its suitability for such use. If in the engineer's judgment the trestle is the proper type of structure to be adopted he should give careful attention not only to substantial design of its superstructure but especially to its foundations and abutments. A guiding rule to be followed as far as conditions may permit or warrant in each particular case is contained in the following statement quoted from *Engineering News*, Sept. 29, 1910, p. 337: "Occasional washouts of trestles crossing small creeks or dry runs direct attention to trestle piling. Every year several failures of this class occur, and though not all produce train wrecks yet several of the worst wrecks of the last decade were due to such failures. It is fair to conclude that in planning structures in the territory from the Missouri River to the Coast a dry run should always be regarded as a bank-full torrent. Since these ravines usually have a steep slope they offer the possibility of great scouring power, so that foundations of the most resistant type should be provided."

Protecting Trains From Washouts

THE failure of the Cole Creek trestle on the Burlington some weeks ago draws attention to the problem of the protection of trains in case of a washout. Automatic warning signals to indicate damage or destruction of trestles by fire and flood have been suggested and even tried experimentally. But the operation of such devices depends usually upon the movement or failure of some part of the structure. It is not unlikely that in many cases all parts may remain intact, though undermined, until the weight of a train causes collapse. Furthermore, the chances are against the reliability and observance of a signal or a series of signals at small structures where floods are infrequent and where the signal might remain unoperated for long periods. Automatic block signals with track circuits would afford little protection except in case of complete washout, since the track is usually the last part to fail. Inspection at low water may show a safe and stable structure, but when the water has risen and a torrent is flowing it is difficult to determine conditions of scour or undermining, while as a rule the bridges are too numerous and the storms too sudden to permit of thorough investigation at the critical time. With sudden storms the engineman may have no warning of conditions ahead of him. The structures may show him no sign of weakness and at night or in stormy weather he probably would not notice every small trestle. The problem, in fact, has not been satisfactorily solved.

Transverse Fissures in Steel Rails

NO MORE serious problem has ever confronted the rail manufacturers and users than that of preventing failures due to transverse fissures, a peculiarly dangerous type of failure because of the fact that it almost invariably occurs before the fissure reaches the surface of the rail. The transverse fissure as a specific type of rail failure was recognized twelve years ago during the investigation by the Interstate Commerce Commission of a serious railroad accident at Manchester, N. Y. Twelve years of study have not brought us much nearer determining the cause of this baffling type of failure. Instead, we are faced with an ever-increasing number of rail failures from this cause and a mass of contradictory evidence as to the cause.

But the rail users have been fortunate in one respect, for the man who first recognized the transverse fissure, the engineer-physicist of the Interstate Commerce Commission, has continued in that capacity and has persisted in the study which he started twelve years ago. From time to time during the past twelve years he has issued reports of his progress. The latest one, prepared some months ago, is abstracted elsewhere in this issue. In this report he brings forth more evidence to substantiate the theory which he has held for some years, as to the cause of transverse fissures, namely, that transverse fissures are caused and developed from their incipiency by the cold rolling action of the car wheels.

Most of the evidence does indeed favor this theory, but in view of some of the contradictory evidence it is

difficult to accept it absolutely. A safer position would be to consider the cold rolling as the cause of the development of the fissures from their incipiency, and the cause of the incipient fissure still undetermined. Two features of the evidence, brought out in this latest report more clearly than ever before, lead to this belief. The first is that certain heats are more subject to transverse fissures than others, and the second that rails rolled by certain mills in certain years are more subject to transverse fissures than rails rolled in other years or by other mills when laid in the same track. So convinced are some railroad officials that certain rollings or certain heats are superior to others that they remove all the rails of any heat from the track when the second failure occurs in that heat, and in some cases whole stretches of rail rolled in certain years have been removed from the track when still otherwise serviceable because of repeated failures by transverse fissures.

Another curious, though possibly unimportant, feature of the situation is the grouping of transverse fissures at certain geographical locations. Probably the increasing ability on the part of section foremen to recognize a transverse fissure and more knowledge of the conditions contributing to their development will eliminate this feature.

Undoubtedly the cold rolling of the rails under heavy axle loads used in this country has developed the transverse fissures from its incipiency to ultimate failure, but as long as rails of the same section but of different manufacture or even different heats continue to give different results under the same traffic we are convinced that the *cause* will be found in some defect in the manufacture of the rail.

For a Federal Contract Law

AFTER some eighteen months' work, and the time taken has been no longer than the task required, a standard form of building and construction contract has been tentatively adopted by the Interdepartmental Board of Contracts and Adjustments. This contract is now before the construction industry for discussion and constructive criticism. Many changes both in fundamental practice and in technical details have already been suggested. Consideration of these changes need not occupy us. They will be adopted or disregarded as the board decides and a final contract form will be approved. This is the thing of substantial importance in all the work which has been done and is to come: a standard construction contract for federal public works is immediately ahead. There should follow a general federal contract law.

It is not possible here to consider the reasons, either political or technical, which stimulated present legislation governing federal contracts. Let us consider merely the number of laws which are the accumulation of years of legislation. In a compilation made by the board there are listed 224 separate statutes. Of these 40 apply to all government departments, 12 apply to two or more departments and 172 apply to only one department. Incidentally the proposed standard contract of necessity complies with all these laws. Herein has rested much of the difficulty in drafting it. It may be the reason why in making the final draft suggested revisions will not be made.

Law controls government contract procedure. It is important to hold this fact in mind. The government is an abstract entity. It expresses itself concretely in contractual relations only by the statutes affecting contracts. It speaks and acts only through agents who can take no action that does not express the law. And the law is 224 separate statutes. All the forms of contracts of all the federal departments, which it is the purpose of the standard form to eliminate, are not a tithe as many. If a general contract form is needed, then, a general contract law is more needed.

Such a general act is contemplated by the board. In brief this act will repeal all conflicting and obsolete statutes and make uniform all provisions in one short law. If the board follows its procedure in drafting the standard contract form to invite aid in arriving at decisions from the whole construction industry, engineers and contractors can play a useful part in formulating the general federal contract law. There are few employers of which they have more loudly complained in the past. Let them be as ready to help put away the causes of complaint.

Arkansas Roads Redivivus

ARKANSAS has placed itself squarely in the roster of states having state highway systems and centralized direction of highway improvement. It is no longer the incorrigible member of the family of road building commonwealths. Uncle Sam can again let it share in federal aid which it alone of all 48 states has been denied during the year. Although the highway world will be a duller place lacking the southern state's fiery assaults on sundry and all who have ventured an intruding finger into its ways of managing its public roads, the change will be altogether good for Arkansas highway affairs.

Briefly a state highway law has been enacted. It creates a highway commission, establishes a system of state roads and provides a fund for constructing and maintaining these roads. Part of the funds raised will pay old road-district debts. No more road-improvement districts can be created and no more road-district bonds may be issued except under close restrictions. These provisions remove the cause of most of the highway tribulations which the state has suffered in the past. Motor vehicle owners wil provide the money. There is a 4c. tax on gasoline, the highest gasoline tax in any state. Motor oil is taxed 10c., and license fees are virtually doubled. The new highway commission has true responsibility and real authority. Altogether Arkansas has a commendable road law. By its honest enforcement most of the past errors in highway management can be redeemed.

In recording this advance it is due Arkansas to remember that its errors in highway improvement have been faults of understanding rather than of enterprise. There are few states in the Union which have in the last five years shown a more determined spirit in lifting their highways out of the mud. The people have voted $60,000,000 of bonds for road building and there are completed some 28,700 miles of improved road of which 3,871 miles are surfaced or paved roads. These are accomplishments which stand out even in comparison with the road building of the states of the North. Arkansas may well feel proud of its high enterprise in road building. That it has frequenty been so greatly misdirected is a reason for regret. Uncontrolled local management of road improvement has no blacker page in its records.

Hollow Dam with Notable Design Features

Storage Dam at Cisco, Texas, Has Cutoff Wall Integral with Deck—Corrugated Footings Resist Sliding—Four-Mile Railway Constructed—Forms for Deck Used Thirty Times

By Frank W. Chappell
Elrod Engineering Co., Dallas, Tex.

and

E. M. Urban
H. F. Friestedt Co., Contractors, Chicago, Ill.

DAM BUILDING of unusual magnitude for so small a city is just drawing to a close at Cisco, Tex., as an insurance against drought and fire. Rainfall is uncertain in west-central Texas, where Cisco is located, and droughts are frequent and, sometimes, of long duration. Storage is the only safeguard against water famine and so the Cisco dam is being built to form a reservoir of some 30,000 acre-feet capacity on Sandy Creek about four miles north of the city. This dam presents interesting practice, both in design and construction, which deserves mention.

Design and Structure

By Frank W. Chappell

About 1,000 acres are contained in the Cisco reservoir, which has an average depth of 30 ft. and a maximum depth of 85 ft., and is formed by a hollow, reinforced-concrete dam 85 ft. high. Figs. 1, 2 and 3 give the essential dimensions and show the general structure.

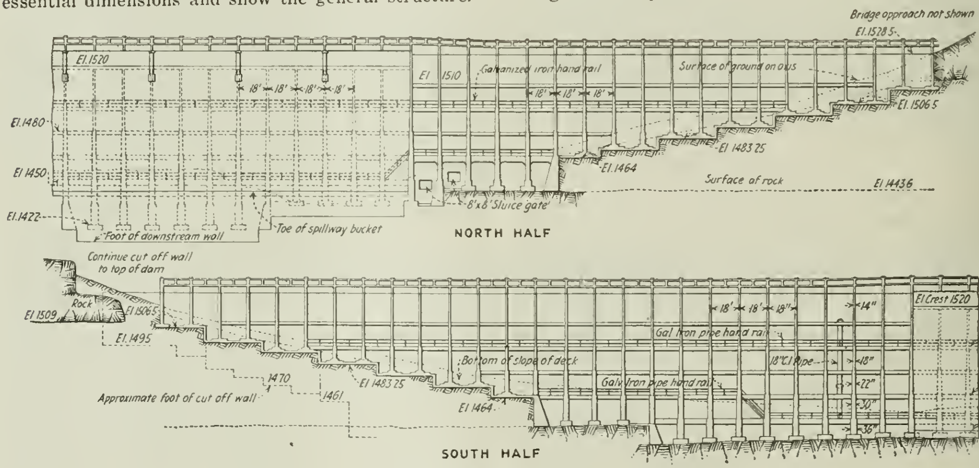

FIG. 1—DOWNSTREAM ELEVATION OF CISCO DAM

Underlying the dam are various sorts of clays, shale and thin limestone ledges. The lowest footings, as shown by Fig. 1, are in hard blue shale at El. 1,420, or about 15 ft. below the creek bed. Twenty-seven buttresses rest on limestone ledges at or about El. 1,435 and 1,445. This stratum varies in thickness from 3 to 6 ft., and is hard and fissured. Under it is hard clay and shale so its bearing power is satisfactory for any reasonable load. The 13 buttresses on each end of the dam have footings on clay. Of these formations only the limestone would allow the passage of water; all the clay and shale is dense, homogeneous and quite impervious.

Substructure—All footings, excepting those on clay, are simple, separate, unreinforced concrete slabs. The greatest pressure on any part of the rock foundation, including hard shale, will be 7 tons per square foot. Where steps are required from one foundation material to another, the footing becomes a gravity section retaining wall. It is necessary to provide positive support for the adjacent clay walls, even though these might be covered with stone or concrete.

Buttresses supported on clay have footings of a rather unusual design. Reinforced-concrete mats carrying two buttresses each, Fig. 1, are arranged in two series, one on each side of the valley. A thin reinforced slab, built with the upper step and anchored behind the lower one, retains the foundation clay and protects it from disintegration. These footings are being covered with earth as the dam is completed to such heights as to give drainage away from the dam.

This footing arrangement is clearly indicated by Fig. 1. As shown by Figs. 2 and 3, a cutoff wall of varying depth and thickness extends from end to end of the dam and into the abutting hills. It is reinforced throughout and doweled into the footings and the deck. Its greatest depth is 55 ft. below the natural ground surface. Contrary to the practice, established on some dams of similar type, of making the cutoff wall a thin, unreinforced section, this part of the Cisco dam is regarded as a vital part of the structure and it was designed as a continuation of the deck and is being built with equal care and attention to detail.

Its deficiency in resistance to sliding is the most serious weakness of the hollow type concrete dam. Three types of anchorage were adopted.

On the clay foundation bed there were poured heavy ribs of plain concrete in trenches dug parallel to the axis of the dam, the ribs being monolithic with the footing slab. Fig. 4 indicates this saw-tooth construction, and also how the cutoff walls were reinforced and tied to both the footing and the deck slabs.

No artificial roughening could be attempted on the thin limestone ledges. They were considered as being

as good merely as so much plain concrete of ordinary quality and only their weight was utilized. While the surface is somewhat wave-worn and fissured it is smooth in comparison to the areas involved. For safety it was taken as being perfectly smooth and the coefficient of friction as that for concrete on limestone. The deficiency was made up by inserting steel dowels at an angle of 45 deg., or practically parallel to the deck.

Buttresses resting on the thick mass of shale at El. 1,420 were anchored against sliding by simply

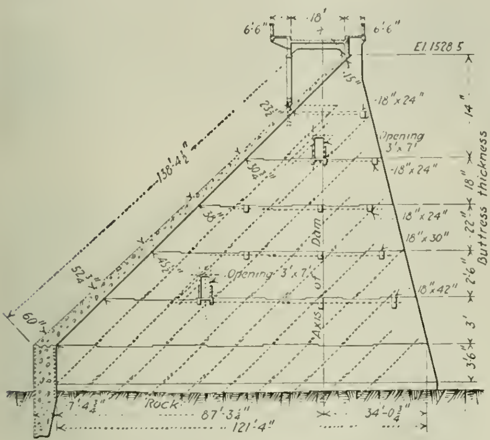

FIG. 2—BULKHEAD SECTION OF CISCO DAM

blasting out cavities under the footings. These were filled with concrete, poured monolithic with the footings.

Superstructure—The buttress thicknesses are so proportioned that the greatest shearing stress in a horizontal plane will be 100 lb. per square inch. Some steel was inserted parallel to the deck to counterbalance defects in construction joints. Beams and slabs were designed for a compressive stress in concrete of 600 lb. per square inch, and steel in tension, 16,000 lb. per square inch. In proportioning and reinforcing the deck slab, all shear up to 50 lb. per square inch was assumed as being taken by concrete. Horizontal reinforcement is bent up to assume the excess of shearing stress above 50 lb. This design introduces into the lower reaches of the slab more horizontal steel than is required for tension, but this is unavoidable unless stirrups are used.

The deck is being poured in continuous sections of 72 ft., making each panel to extend over four buttress spans. Unusual care is being taken to make the slab watertight at expansion joints (Fig. 5). U-shaped strips of No. 11 copper, which have flanges cast into adjoining sections, allow of expansion without leakage. The slabs are separated by "elastite" strips placed against the face of the one first poured. Longitudinal construction joints are made with double keys and the surface of the previous day's work is cleaned and washed. Each section of deck is poured from top to bottom with the shortest possible intervals between the placing of successive batches. The engineers and the contractor considered the advisability of continuous pouring for each section of deck and concluded that the advantages were not sufficient to offset the uncertain quality of night work.

All concrete, except that in heavy retaining walls, is of a 1:2:4 mix; retaining walls are of 1:3:6 mix. Coarse aggregate consists of crushed local limestone, ¼ to 2½ in. Fine aggregate is creek sand up to ½-in. particles. The first concrete poured was mixed with crusher screenings as sand. No means were provided for removing dust and 16 per cent of the screenings passed a 200-mesh sieve. The resulting mortar was high in strength, 1:3 briquettes showing 25 per cent higher tensile strength than the same mix of standard Ottawa sand. A great deal of trouble, however, was experienced with a heavy layer of laitance on each buttress lift. The fear that some of this chalky material might be left in the structure, together with the possibility of the dissolution of minute, uncoated particles under long submergence, led to the abandonment of screenings as sand.

Spillway Design—The area of lands draining into the reservoir is 30 square miles. The country is rugged, sparsely settled and covered with growths of black jack oak and mesquite. The reservoir banks are generally precipitous and there is little cultivated land on the watershed. No records of stream flow have been kept and an attempt was made to collect testimony of persons living in the neighborhood, for determining flood flow. This was found to be conflicting and uncertain.

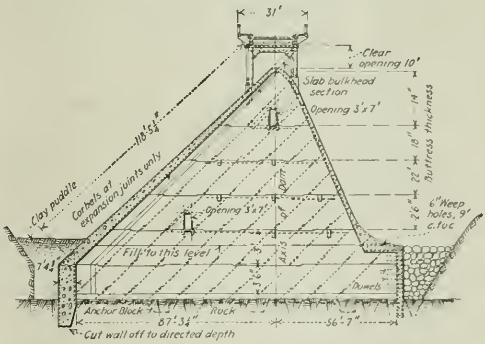

FIG. 3—SPILLWAY SECTION OF CISCO DAM

Calculations based on highwater marks designated by different individuals indicated a discharge varying from 8,000 to 15,000 sec.-ft.

In view of the excessive floods noted in various parts of Texas during the past, it was thought best to disregard all of the data collected on this particular stream as being incomplete and unreliable. Although it is extremely improbable that any intense tropical storm will ever break as far inland as Cisco, the total discharge capacity through and over the dam was made 36,000 sec.-ft., or 1,200 sec.-ft. per square mile.

Flood waters will be disposed of over a spillway 270 ft. long by 10 ft. deep and through two sluice gates. Since the greatest flood to be expected, excepting those great cloudbursts at intervals of fifty years or more, will be less than half the total discharge capacity, the spillway crest was designed for a 5-ft. depth of flow. The short duration of extraordinary stages makes it uneconomical and unnecessary to widen the crest to accommodate them. In addition the wide crest would form a broad-crested wier for low heads, with less discharge capacity than the sharper section and for local reasons it is desired to hold the fluctuations of water-level within

the lowest possible limits. The spillway apron will have a uniform thickness of 20 in. The discharge will be partly upon a limestone ledge and partly over the shale. In the latter case the apron is extended vertically for a distance of 10 ft. into the shale.

Two sluice gates, each having a clear opening 8 ft. square will be installed just north of the spillway. They will be electrically operated with remote control switches from the pump station or from the hilltop at the south end of the dam, at the pleasure of the operator. As above explained the sluice gates have been included in providing for the discharge of the creek. But in addition to this consideration, they are deemed necessary as emergency outlets.

Quantities and Cost—The estimated quantities are: concrete 43,000 cu.yd.; steel, 1,000 tons; excavation, 95,000 cu.yd., and copper, 25,000 lb. A pumping station will be built within the dam, between buttresses 25 and 26, and a filtration plant will be built on the hillside below the dam. The total cost of the project will be approximately $1,300,000.

The Elrod Engineering Co. of Dallas are consulting engineers for the city of Cisco, and prepared all plans for the dam and supervised its construction. The writer acted as chief designing engineer, and is responsible for the details. T. A. Hodges and J. G. Reagan have been resident engineers in charge of construction. The general contractor is the H. F. Friestedt Co. of Chicago.

Construction Plant and Methods

By E. M. Urban

Transportation was the primary problem in building the Cisco dam. The site was in an eroded and broken district four miles from the railway and there was no passable road to it. A railway was the first requirement, and it had to be built in a rough, rocky canyon following the meandering course of a small stream which it crossed three times on wooden bridges. This short railway was the sole means of transporting first the construction plant units and, then, all of the materials used in the construction of the dam. Over 1,000 tons of reinforcing steel, 600,000 ft. b.m. of lumber, 21,500 cu.yd. of sand, 43,000 cu.yd. of crushed stone and many carloads of miscellaneous supplies and materials were hauled over this road.

Plant Layout—As the line of the railway was downstream to the dam it was necessary to locate the plant on the upstream side. A very simple and convenient arrangement, as shown by Fig. 6, was practicable. The

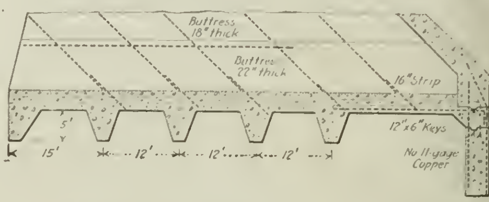

FIG. 4—SECTIONAL ELEVATION OF BUTTRESS FOOTING ON CLAY

plant consisted of a 300-ton gyratory crushing unit, a 400-cu.yd. concrete mixing unit, a sawmill for heavy cutting, an engine house with one 50-hp. engine and a 75-hp. electric hoist, a machine shop, and a 40-hp. gas engine to operate rigging and an overhead cableway. The rock crushing and concrete mixing units were operated by electric motors and the bucket in No. 2 tower was handled by the electric hoist. Distribution of concrete was by towers and chutes. Two towers were required to chute to all parts of the dam, one at the mixing plant 160 ft. high and one on the dam 140 ft. high above the dam top. Fig. 7 is a view of the dam showing the towers. With this tower and chute system, concrete was delivered 500 ft. at the rate of a yard a minute.

Excavation and Handling Material—The excavation was chiefly difficult because a great portion consisted of trenches in clay, shale and rock and had to be done by hand. In the deep trenches bracing had to be handled with care. The bulk excavation was performed by steam shovels and trains with some slip and Fresno scraper work.

All materials were brought to the dam over the construction railway down the canyon and were stored in yards, bins and sheds as indicated by Fig. 6. After the lumber was framed it was carried to the foot of the dam and then set in place by the overhead cableway. The reinforcing units were fabricated in the yard and

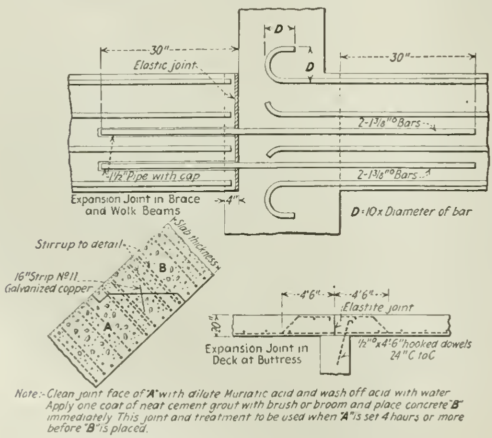

FIG. 5—DETAILS OF EXPANSION JOINTS

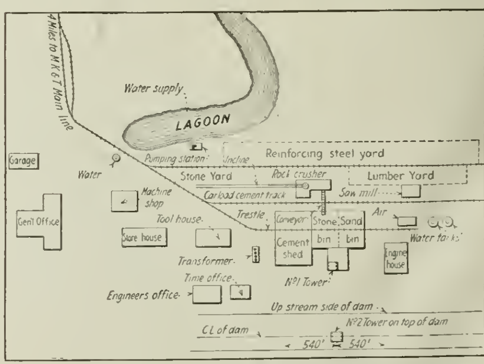

FIG. 6—GENERAL ARRANGEMENT OF CONSTRUCTION PLANT

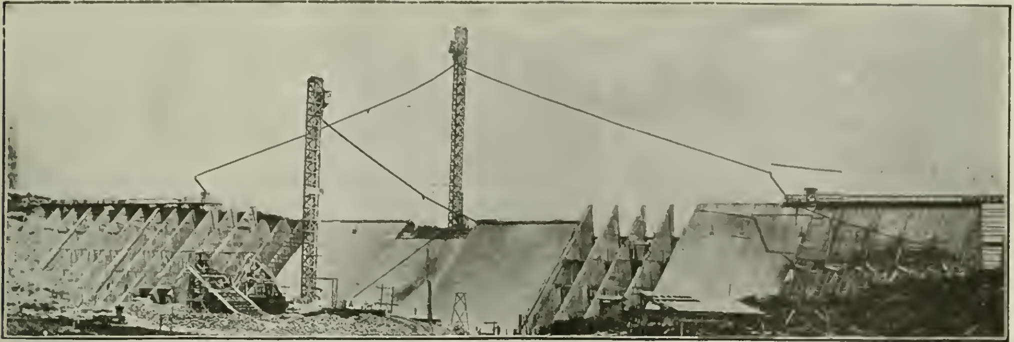

FIG. 7—DAM UNDER CONSTRUCTION SHOWING CONCRETE DISTRIBUTING TOWERS

then handled as was the form lumber. Cement was chuted from the cars directly into a 2,200-bbl. cement house. All carloads of sand and crushed stone were unloaded by a clamshell derrick near the connection of the construction railway with the M.-K.-T. R.R., and then loaded into 16-cu.yd. dump cars which unloaded into the bins of the mixing plant. Most of the crushed stone, however, was quarried within a mile or two of the work and teamed to the crusher plant shown by Fig. 6.

Form Construction—Beams and buttresses being alike, forms were built in sections or panels. They were 2 x 8-in. sheathing on 4 x 6-in. timbers spaced 2 ft. on centers. The panels were tied together through the concrete by tie rods and form clamps. These panels were used from 20 to 30 times and some of them lasted through the construction work. The serious problem was the design and handling of the form panels for the deck slab face.

As shown by the plans (Fig. 1) the dam buttresses were 18 ft. apart on centers. The expansion joints in the deck slab were 72 ft. apart, or over every fourth buttress, and the deck was required to be concreted in a succession of lifts continuous between expansion joints. As shown by Fig. 8 and the view Fig. 9, the form for the back of the deck slab was sheathing on beams spanning between buttresses. A very rigid panel was required to form the face of the deck slab as the span was 18 ft. and there could be no tie rods through the slab between buttresses. Ease of handling had also to be considered. A panel 2 ft. wide and 18 ft. long (Fig. 8) was designed by the authors. The rigid construction of the panel will be noted. After being set side by side up the deck as shown in Fig. 10, the ends of the panels were fastened down by the T-rails as shown by Fig. 8. Then they were clamped between ends by waling timbers held by truss rods as shown by Fig. 8.

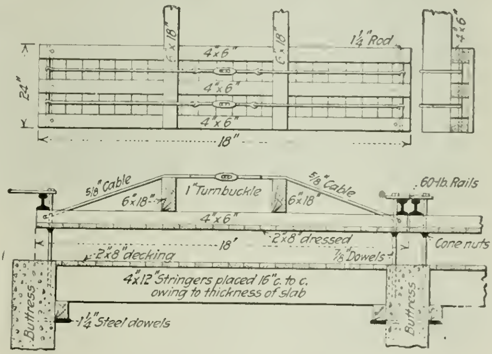

FIG. 8—DETAILS OF DECK SLAB FACE FORM PANELS

FIG. 9—SHEATHING FORM FOR BACK OF DECK SLAB

Four bays of the deck between expansion joints were concreted at once in lifts several form panels high. This is clearly shown by Fig. 10. A 1:2:4 concrete was chuted directly into the forms by the chute arrangement, shown by Fig. 11. The method as described proved very successful. The panel forms were reasonable in cost, could be easily shifted and could be removed repeatedly without damage and used over again.

Construction Organization — The organization with E. M. Urban as superintendent in complete charge of all work consisted, besides workmen, of: 1 general carpenter foreman, 5 sub-foremen, 1 rigger foreman, 3 sub-foremen, 1 concrete foreman, 1 sub-foreman, 1

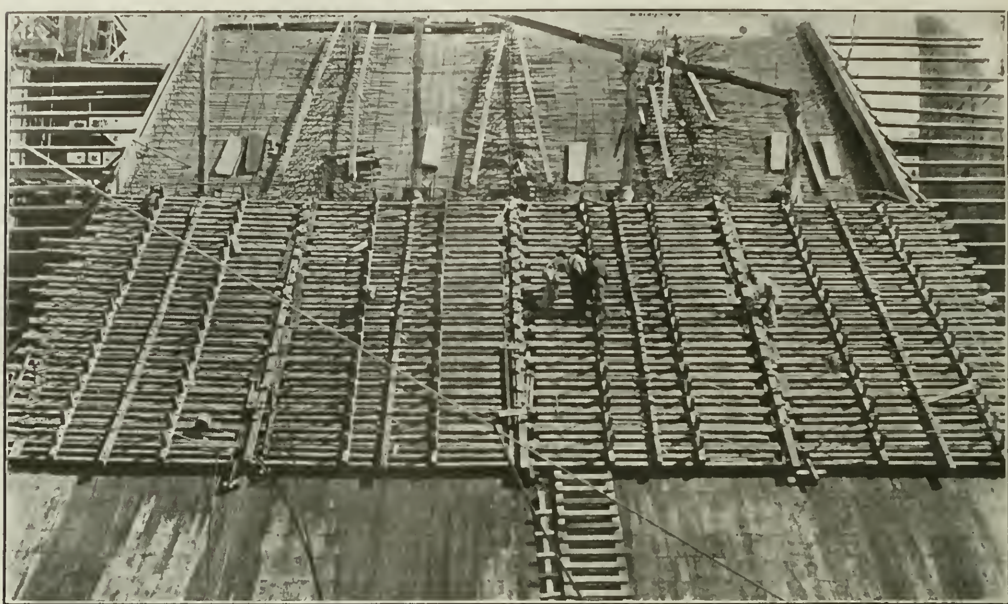

FIG. 10—CONCRETING DECK SLAB UNIT BETWEEN EXPANSION JOINTS
Using 2x18-ft. panels the sloping deck was concreted from bottom to top, in sections 72 ft. wide between expansion joints, by direct spouting into the forms.

crusher foreman, 1 steel foreman. 1 sub-foreman, 1 clamshell derrick engineer, 1 master mechanic and 5 labor foremen, directing various kinds of work. There were approximately 450 men employed, consisting of carpenters, riggers, iron workers, cement finishers, common laborers, hoisting engineers and mechanics for maintenance of equipment and machinery.

The working hours were from 7 a.m. to 6 p.m., making a ten-hour day. The living quarters consisted of a large headquarters building, with large airy offices on the second floor, and sleeping and living rooms on the first floor Comfortable cottages, fully equipped with water, electric light, etc., were furnished to families of foremen. A large mess hall and bunk house accommodated about 200 men. There was also a mess hall for Negro and Mexican labor, equipped with shower baths and lights. In fact everything possible was done to afford comfort and good and clean wholesome food for all employed on the job.

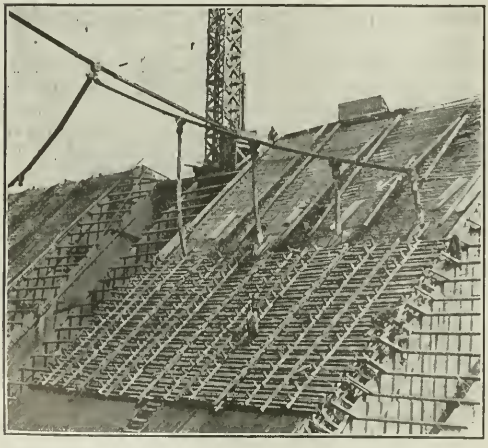

FIG. 11—CHUTE ARRANGEMENT FOR CONCRETING DECK SLAB

A North Sea Car Ferry

The successful operation of car ferry steamers across the channel between England and France during the war has led to establishing a car ferry across the North Sea from Harwich, England, to Zeebrugge, Belgium, to be operated in connection with the London & Northeastern Ry. and the Belgian State Railways. The advantages claimed are in economical and rapid transport, owing to the elimination of handling at the ports; also the saving of time, reduced cost of handling, small risk of breakage and pilferage, and saving in the cost of packing. A large business is expected in perishable goods, rolling-stock, locomotives and heavy machinery which otherwise could only be transported when dismantled and packed. Special facilities are granted by the customs authorities. The Great Eastern Train Ferries Co., of London, has purchased three steamers, each having capacity for fifty-six 10-ton freight cars on four tracks. One of the transfer bridges for connecting the dock with the steamer was lost at sea while being towed from Southampton to Harwich. It was supported on two barges, one of which sank owing to rough weather, and in going down it pulled the other barge over. It was expected that the bridge could be raised.

Concrete Road Built of Precast Slabs As Experiment

Slabs of Three Sizes Were Used in One Mile of 18-Ft. Pavement Laid on Adobe Marsh Land Near Suisun, Calif.

AN EXPERIMENTAL road of precast reinforced-concrete slabs has been constructed by the California Highway Commission at Suisun about midway between San Francisco and Sacramento. The purpose is to study methods of construction and costs as well as behavior in service, using three sizes of slabs and building some of the road of concrete in place for purposes of comparison.

The pavement was made 18 ft. wide and 6 in. thick throughout the job. Approximately one mile was constructed of precast slabs and about one-half mile was cast in place using concrete mixed at a central mixing plant and hauled to the site in trucks. Most of the slabs laid are 9x9 ft. in size, but two short stretches are of slabs 6x9 and 3x9 ft., respectively. All slabs were handled by means of lifting chains and hooks engaging cross rods of reinforcing steel in small holes cast in the slab. The 9x9-ft. and 6x9-ft. slabs have four holes each, a pair being located near each end at approximately the quarter point on the transverse dimension. The 3x9-ft. slabs were provided with two holes each.

The casting yard comprised four acres bordering on a spur track in the outskirts of the city of Suisun. The yard was laid out so that slabs could be cast flat in parallel rows, the rows being separated 2 to 5 ft. to afford space for runways. Side forms were placed and the subgrade in the casting yard was prepared as when pavement is to be cast in place on the road. Cross forms, however, were placed in order to make the slabs of the desired dimensions. In each row alternate slabs were cast and allowed to set for 24 hours after which the cross forms were removed, and after oiling the exposed concrete edges the remaining slabs were cast. After casting the ground layer, additional tiers were cast on top of one another to a total height of three tiers, single-ply roofing paper being used between tiers to prevent bond. The mix used was 1:2:4, and the slabs weighed approximately 1, 2, and 3 tons, respectively for the 3x9-ft., 6x9-ft. and 9x9-ft. sizes. Work of casting the three different sizes was carried on simultaneously.

Various types of reinforcing were used; some slabs have both mesh and rods, some contain rods alone and in others no steel other than the rods at the lifting eyes was used. The slabs were not moved until the concrete had been fully cured. The slabs were cast first, and while they were curing concrete from the mixing plant in the casting yard was hauled the two miles to the road and the cast-in-place pavement was completed. Of this half-mile, approximately one-third was constructed without expansion joints, one-third with elastite joints at intervals of 30 and 40 ft. alternately, and one-third was built with elastite joints similar to those last noted but with the addition of loose dowels passing through the elastite to prevent the pavement on one side of the joint from rising above the abutting section.

By the time the half-mile of pavement cast in place had been finished the precast slabs were cured and the operation of placing them was begun. The slabs at the end of the work nearer the casting yard were placed first, thereby permitting the use of the finished pavement over which to haul the slabs and avoiding any disturbance of the prepared subgrade.

Side forms were used in preparing the subgrade for the present slab section of the road as if the pavement were to be cast in place. The soil was first removed to a depth of 1 or 2 in. below subgrade and 1 or 2 in. of clean dry sand was placed and struck off to a true grade just in advance of the placing of the slabs. The pavement was laid on an old road bed which is a thin crust over marsh mud. The road traverses marsh lands at this point and the pavement itself is but slightly above the extreme high tides, hence the water table is very close to the subgrade.

The slabs were loaded, by means of a crane at the casting yard, onto the bed of the delivery truck. On arrival at the work the truck backed under a gantry crane spanning the pavement just over the last slabs placed. This crane picked up the slabs from the truck bed and delivered them to place on the subgrade. Three men were employed at the yard loading slabs and three men and a foreman in the road placing them. In addition one man was employed spreading the sand cushion and one man part time in setting forms. The maximum number of 9x9-ft. slabs laid in

THREE SIZES OF PRECAST CONCRETE SLABS ON SUISUN PAVING JOB IN CALIFORNIA

Two rows of the largest size slabs 9 ft. square, were used to make the 18-ft. roadway. The 6x9-ft. slabs were placed with the 6-ft. dimension across the road, thus requiring three rows, and the 3x6-ft. slabs longitudinally in six rows.

a single day was 39, but due to lost time by rainy weather, wet subgrade, etc., the average day's run was only 23. The maximum run for the 6x9-ft. slabs was 37 and the average was 31 and the maximum for 3x9-ft. slabs was 60 and the average 48.

In the matter of placing, the 6x9-ft. slabs cost approximately 10 per cent more per linear foot of road than did the 9x9-ft. slabs. Had the work been more extensive, equipment better suited to the job might have been supplied, state highway officials stated, and the slab laying would have proceeded faster.

The slabs cost more than the cast-in-place concrete for the following reasons: (1) Slabs were reinforced and cast-in-place concrete was plain. (2) Slabs required extra formwork per cubic yard. (3) Slabs required practically two subgrades, one in the casting yard and the other at the road. (4) Slabs required a sand cushion, and were provided with elastite joints. These items, together with the hauling and placing of the slabs, made the cost of the slab pavement about $10 per cubic yard more than for cast-in-place pavement.

SLAB BEING LOWERED TO PLACE BY GANTRY

The truck backed up under the gantry, workmen standing on the slab lifted it by means of the chain block and by the same means lowered it after the truck moved away. The 6x9-ft. slabs were handled by one man. The gantry crane was pulled ahead by one of the trucks using lines passed through blocks.

Slabs were cast three deep in the yard. The upper two tiers were found to have thicknesses of sufficient uniformity so that simply lowering the slabs onto the sand cushion gave a smooth, continuous surface. The lower tier, which was cast on the ground, varied somewhat in thickness. After they had been lowered to place on the sand cushion it was occasionally necessary to raise them again and rework the sand.

Heavy loads have not been frequent over this road heretofore, but extensions now planned for the canneries at Suisun will probably cause it to be subjected to heavy loads of produce in the future.

Bank Foundation Designed to Resist Flood Uplift

Sub-basement of Mellon Bank, Pittsburgh, Built as Floating Box—Heavy Floor Transmits Upward Water Pressure to Columns

By John W. Pickworth
Welskopf & Pickworth, Consulting Engineers, New York City

PERIODICAL floods of the Monongahela and the Allegheny rivers at Pittsburgh led to certain difficulties in the design of foundations for buildings in the low-lying business district of the city. Much of the soil being a heavy gravel, the flood waters quickly spread to a considerable distance beyond the actual river banks, and where deep and dry basements are desired it is necessary to make adequate provision against the hydrostatic pressure in floods. This condition gave rise to a number of interesting problems in the design of the Mellon National Bank Building, now nearing completion. This solution is outlined briefly in the following.

The building, which is to be used solely for banking purposes, is about 232 ft. long on Smithfield St. and 120 ft. wide on Oliver Ave. and on Fifth Ave. It has four stories above street level, and two basements, the lower one being 9.61 ft. below the highest water level on record. A large portion of the floor in the rear of the building is 2 ft. lower and in various pits the hydrostatic head is still greater. The building is supported on concrete piers which go down to rock, 15 ft. below the sub-basement.

It will be seen from the cross-section, Fig. 1, that in addition to the side pressure on its basement walls the building must resist the upward pressure of the water on its base, amounting to over 700 lb. per square foot for the main part of the sub-basement. This appears a formidable condition when it is realized that except around the walls, which are far apart, the upward forces are greater than the normal dead-loads.

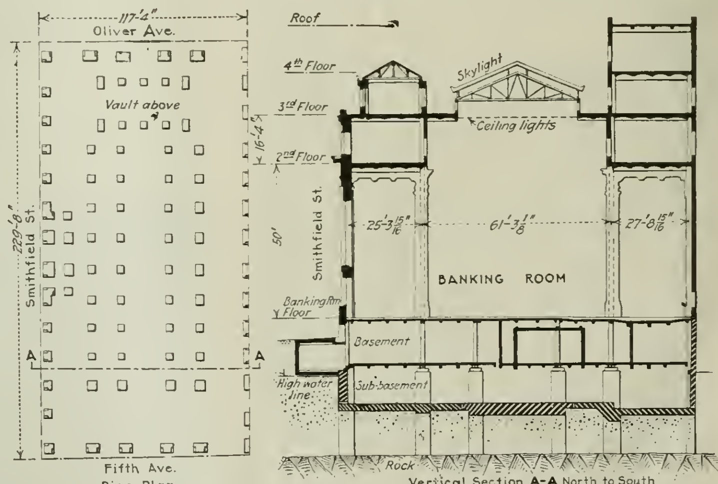

FIG. 1—NORTH-SOUTH SECTION AND PIER PLAN OF MELLON BANK

The floating-box construction of the sub-basement required on account of floods was complicated by the wide spacing of the columns. The banking room occupies the entire ground floor.

Foundations and Floor Anchorage — The security vault at the Oliver Ave. end of the bank rests on independent piers. The vault was constructed first, and enough of the permanent structure was built to house the vault and permit its use. Four wall piers and four interior piers of the main building were put in at the time the vault foundations were constructed, and, as it was then planned to carry all interior columns down to the sub-basement level, these four were constructed accordingly, as shown in Fig. 2. Hooked projecting rods were embedded in the piers, to engage the sub-basement floor and transmit the upward reaction from the floor slab to the piers.

Later it was decided to put in the rest of the foundations before tearing down the occupied buildings on the site. As the basements for these old structures

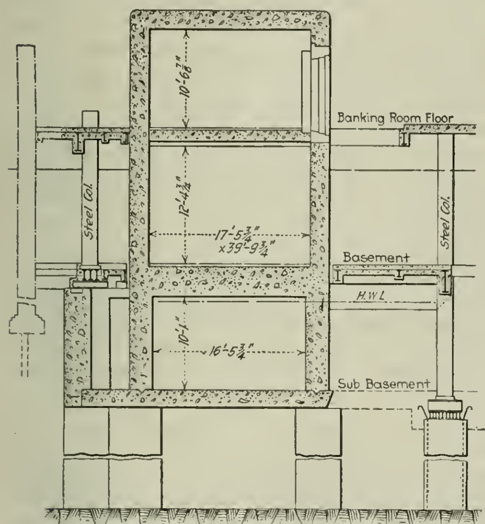

FIG. 2—INDEPENDENT VAULT IN EAST END OF BANK

At right is shown one of four building piers built at the time the vault was constructed, while the old building was still in use. The pier extends up to sub-basement floor level only. Hooked bars were built into the pier to anchor the floor slab, built later. All other interior piers of the building were carried up to the next floor above, giving more weight for resisting hydrostatic uplift; the sub-basement floor, built later, engages notches molded in these piers.

were not as deep as those planned for the new bank, the column grillages were designed to go in at basement level, and the sides of the piers were notched to receive the sub-basement floor, as shown in Fig. 3. Vertical reinforcing brings into action the full weight of the pier, as well as the column load above, as a reaction against the water pressure.

Sub-basement Floor—The sub-basement floor, of reinforced concrete, is designed to carry the upward forces in the most direct manner to the various points of load concentration from above. There is little dead weight in the central portion of the building, by virtue of the architectural layout of the banking room, which has but two main lines of interior columns, 62½ ft. apart. The banking room floor and the first basement floor were made of 6-in. stone-concrete slabs supported by steel framing, to add to the dead weight; concrete thus added is more effective than that used to thicken

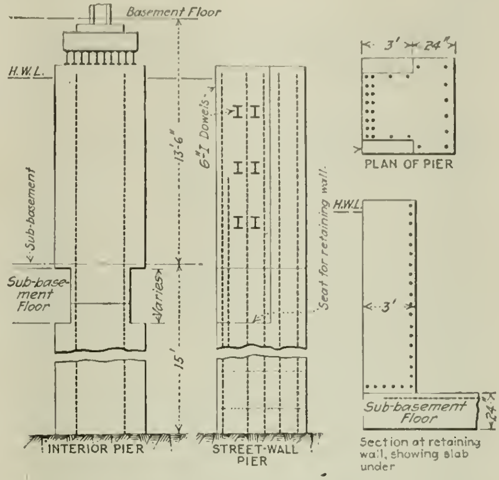

FIG. 3—CONNECTION OF SUB-BASEMENT FLOOR TO PIERS AND RETAINING WALL

the sub-basement floor, because in the case of the latter every foot added increases the hydrostatic head by the same amount, and the only gain is the difference between the weight of the concrete and the weight of the water. Nevertheless it was necessary to make the central part of the sub-basement floor 4 ft. thick.

This part of the floor is designed with a cantilever extension of 3 ft., as indicated in Fig. 1, and the floor of the side bays is cantilevered out beyond the main interior columns to meet this first mentioned portion. The slab extends under the retaining wall, or else reacts against the notches left in the face of the wall piers. Concrete girders cast monolithic with the slab carry the upward reactions to the notches in the interior piers. At either end of the building the slab has a clear span of about 36 ft. and is 3 ft. thick.

Special slab, beam and girder construction is designed to take care of the elevator pits and the sump pit, which goes down to a depth of 7 ft. below the low

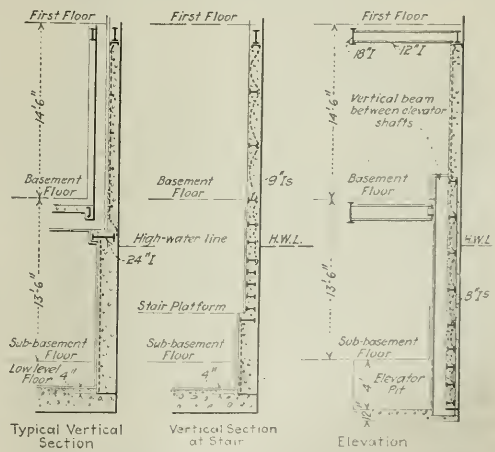

FIG. 4—THIN RETAINING WALL AT REAR OF BANK

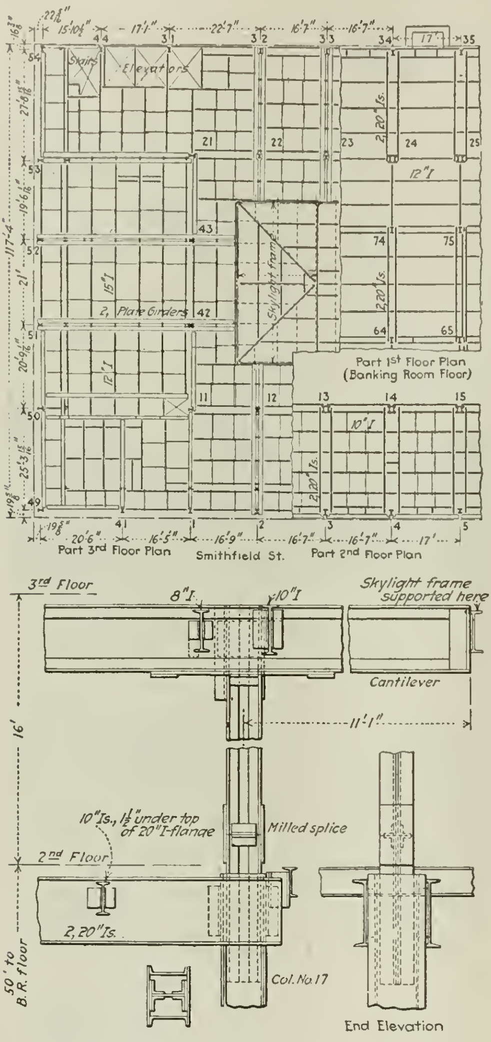

FIG. 5—STEEL FRAMING AND SOME DETAILS
Banking-room column splice at third floor, and skylight supported on cantilever girders.

portion of the floor. The hydrostatic head calculated at the bottom of this pit is 19.61 ft., which means that the upward pressure exceeds 1,200 lb. per square foot.

The entire design of this floor lent itself to the establishment of good and proper lines on which to stop the pouring. The concrete contractor was asked to lay out the lines and areas that would best suit his convenience, and these were submitted to the engineers for approval. The various areas being entirely independent of each other, it was immaterial which portion was selected to be poured first, or how long it was necessary to delay the pouring of the adjacent section.

Retaining Walls—On the three street sides of the building the retaining walls in the sub-basement story are 3 ft. thick, and are designed to span as beams between the piers that carry the wall columns; 10-in. seats are left in the piers for this purpose. The upward reaction of the sub-basement floor is in most instances more than balanced by the wall load, but where because of the sidewalk vault the weight is insufficient the retaining wall was doweled into the piers with 18-in. lengths of 6-in. I-beams, which make good dowels for shear and to which it is easy to fit the forms.

Along the rear lot line the retaining wall had to be kept much thinner. The typical section for the two basement stories is shown in Fig. 4. The wall is a vertical reinforced-concrete slab which throws its reaction against the sub-basement and banking-room floor levels. The 24-in. I-beam laid flat is so placed to allow passage for the ducts above, and it frames into the steel column shaft just above the level of the grillage. The accumulated horizontal pressure is then transmitted through the column and the girder connection to the whole of the floor system. Back of the stair and elevator shafts the wall had to be kept exceptionally thin; here structural steel framing was used.

Pier Design—Special care had to be taken in the design and detail of the concrete piers. On the three street sides the piers have to carry, in addition to their vertical loads, the horizontal reactions of the retaining walls and the forces on the outside faces of the piers themselves. To do this they are designed as cantilevers, using the heavy, sub-basement floor as a fulcrum point. Fig. 3 shows typical conditions.

Waterproofing—All the concrete for the sub-basement floor and the walls up to the curb level contains integral waterproofing compound. In addition to this, an inside coating of Cow Bay waterproof cement mortar is carefully applied under special specifications. This hydrolithic coating is ⅝ in. thick on the walls and 1 in. thick on the floors.

Superstructure—The most interesting engineering features of the building superstructure (Fig. 5) are banking-room columns, which have an unbraced height of 50 ft., and the third floor framing, which cantilevers out to support the roof and skylight over the central portion. The high columns are of box section, made up of two 12-in. channels and 18-in. cover plates. To avoid having this large section run through the second floor to the splice line, which would necessitate extra furring and occupy valuable floor space, a special detail was made for this point, as shown in Fig. 5.

The 40x130-ft. skylight is supported on the ends of the 11-ft. cantilevers of the third floor; it has a heavy protective screen over it.

In construction, no difficulty was experienced from water. Had a high flood occurred before there was sufficient weight on the foundations to withstand the pressure, it would of course have been necessary to admit the water freely and let it flood the sub-basement.

Trowbridge & Livingston and E. P. Mellon are the associated architects for the bank. The vault and the first section of the building and the piers were constructed by the Hughes-Foulkrod Co., with the McClintic-Marshall Co. as subcontractors for the structural steel. The main building is being put up by the Mellon-Stuart Co. The Carlem Engineering Co. is the subcontractor for the reinforced-concrete work, and the American Bridge Co. for the structural steel. The design was made and the engineering services were rendered by the firm of Weiskopf & Pickworth.

Federal Land Reclamation: A National Problem

2. The Development of the West Under Irrigation

By C. E. GRUNSKY
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The Second of a Series of Articles on the History and Performance of the Great Government Adventure in Irrigation of the Arid Lands of the West.

PROGRESS in the West under irrigation has been truly remarkable. Let us take a few concrete examples beginning with one of the most recent developments, the Imperial Valley. Perhaps the reader may not recall that the region now covered by the Imperial Irrigation District was known to the pioneer as the New River country, taking its name from one of the channels in which flood waters of the Colorado River occasionally flowed north into the Salton Basin. These waters came from the delta region of the river where, in Lower California, they submerged and wetted thousands of acres, where the rank vegetation showed that the desert of the Southwest could be converted into arable land if water could be brought to it. The scheme of Dr. Wozencraft and his associates in 1859 to have the U. S. Government give California 3,000,000 acres of lands in the southeastern part of the state for reclamation having been blocked—and perhaps wisely, because it would have been a premature enterprise—the desert areas of the Salton Basin, included in the region designated on the old maps as the Colorado desert, remained for many years a barren waste, treeless, without grass and repellent to every form of life. The project to irrigate this almost rainless area was revised in the last years of the last century and irrigation water became available there in 1902. Without dwelling upon the difficulties that had to be overcome, let it suffice to say that there are now about 450,000 acres of land under cultivation in Imperial Irrigation District, every acre of which requires water from the irrigation ditch; and, south of California in Mexico from the same canal system which brings Colorado River water into California, an additional area of about 200,000 acres is now being irrigated. The property value created in California by this one enterprise exceeds $100,000,000. The annual crop output has a marketable value, not including the products of lands in Mexico, of more than $50,000,000. The population of Imperial Valley has reached 60,000—an asset to our country that is certainly worth while.

San Joaquin Valley—Going further back contrast for a moment the situation in the San Joaquin Valley, also in California, as it was 60 years ago and as it is today. Here and there under natural conditions with rain generally 5 to 10 in. in a year there was grass for sheep and stock. In favored localities the early settler would even attempt to grow grain. The occasional year with moisture sufficient to produce a crop would prompt other attempts, but dry farming was not successful except to a moderate extent along the base of the Sierra Nevada at the eastern margin of the valley and northward from the Stanislaus River where there was a more dependable rainfall. The waters of Kern, Tule, Kaweah, Kings, San Joaquin, Tuolumne and Stanislaus rivers were at that time flowing unused to the sea. The population consisted of a few blacksmiths, the crossroads saloonkeeper, here and there the staff of a country hotel and the sparse population of the frontier region centering in the widely scattered cattle ranches with pre-emptors and homesteaders in favored spots seeking some gullible speculator who would take their holdings off their hands. And now one finds prosperous communities from end to end of the valley made possible by irrigation. Of course, the irrigation commenced in a haphazard way with small ditches here and there, at points where diversions could be made from the stream with inexpensive works. But results were encouraging; the small individual ditch was soon replaced by larger ditches serving a number of irrigators. Commercial enterprises such as the great San Joaquin and Kings River Canal were started, though often, as in the case of this canal, they proved financial failures while in the hands of the original projectors. Later came co-operative enterprises with consolidation of irrigation systems with better, more dependable service, and finally the irrigation district, based on the sound doctrine of community enterprise, and ownership of the water rights by the land on which the water is used. To be a little more specific, Bakersfield, Tulare, Porterville, Visalia, Hanford, Corcoran, Lindsay, Dinuba, Reedley, Sanger, Fresno, Madera, Merced, Los Banos, Tracy, Manteca; Oakdale and many other communities owe their development and growth to the use of water by the irrigator. This growth can perhaps best be illustrated in figures.

There were invested in the irrigation enterprises of the San Joaquin Valley southward from Stockton in 1920, according to the U. S. Census, about $69,000,000. The land under cultivation by irrigation in this part of the valley in the same year had an aggregate area of over 2,000,000 acres. The population of this region already exceeds 250,000.

Southern California—Still greater is the progress made under and due to irrigation, in that part of California generally referred to as Southern California. The need of irrigation in this semi-arid region was early recognized. The development thereof as noted in the citrus industry, the growth of San Bernardino, Riverside, Redlands, Pasadena, Los Angeles and San Diego, which may be cited as typical, would not have been possible without the utilization for irrigation of the water resources of the southern section of the state. In the central and northern portion of California the value of irrigation was not so early recognized because nature furnishes to these more northerly areas a more bounteous rainfall. But now the advantage of applying water to the land by artificial means to supply deficiencies and to prolong the growing season is apparent to all, and the demand for irrigation water is constantly on the increase. The natural flow of even so mighty a stream as the Sacramento River no longer suffices. Regulation of flow by storage is becoming imperative.

As in California, so elsewhere in the West, in Washington, in Eastern and Southern portions of Oregon, in Idaho and Montana, in Wyoming and Colorado, in Utah

and Nevada, in Arizona and New Mexico, in all of these states the development under irrigation has been little short of marvelous—to say nothing of the growing of rice in the Gulf States.

Government Aid in Irrigation

The early irrigation works were of the simplest type, easily constructed at trifling expense. When the water had to be taken to points remote from its source, to lands less favorably located than those covered by the first canals, co-operation became essential. Mutual water companies were organized and many commercial or speculative ventures were undertaken. Presently it was found that the natural low water flow of the streams would not longer suffice to meet the demand of the growing irrigated area. Recourse must be had to storage in order to regulate the stream flow and to conserve the waste at the flood stages. Government aid was enlisted. The states began a study of their water resources. The formation of irrigation districts was authorized. The Congress of the United States, too, saw the need of encouraging the reclamation of desert areas and made provision for the same in the Carey Act. As a final means of stimulating home-building on the irrigated farm, government aid has been extended throughout the West under the provisions of the United States Reclamation Act passed in 1902. Over $135,000,000 has been expended by the U. S. Reclamation Service in the construction of works many of which could not have been undertaken without government aid. All of this has been a powerful factor toward the development of a part of the world ideally adapted to support in comfort a dense population.

Stimulating Effect of Irrigation—The examples above cited are crudely illustrative. Perhaps a few figures relating to the growth of the West under the stimulating influence of irrigation will give a better picture of past achievements and of the progress still being made (Table I). The states included as irrigation states in the summary presented in this table are: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon and California.

From such statistics as presented in this table, compiled from the U. S. Census, it appears that while the value of the farms in the entire United States was four times greater in 1920 than in 1900 the value of the farms in the Mountain and Pacific states was six times greater in 1920 than in 1900. The value of the farm products in the entire country was four times greater in 1920 than in 1900 while in the Mountain and Pacific Coast states under the stimulating influence of irrigation the value of the output of the farms was eight times greater in 1920 than in 1900. The population in the entire United States increased in the twenty years under consideration about 40 per cent while in the Mountain and Pacific states, as shown in the table, the population more than doubled.

TABLE I—DEVELOPMENT OF THE FARMING INDUSTRY, 1860-1920: MOUNTAIN AND PACIFIC COAST STATES (IRRIGATION STATES) COMPARED WITH UNITED STATES AS A WHOLE

	1860	1900	1910	1920
United States				
Population	31,443,321	75,994,575	91,972,266	105,710,620
Number of farms	2,044,077	5,737,372	6,361,502	6,448,343
Area of farms, acres	407,212,538	838,591,774	878,798,325	955,883,715
Improved land, acres	163,110,720	414,498,487	478,451,750	503,073,007
Value of farms, (land and buildings)	$6,645,045,007	$16,614,647,491	$34,801,125,697	$66,316,002,602
Value of all crops*	....	$3,496,700,000	$5,231,850,000	$14,755,365,000
Mountain and Pacific Coast States				
Population	618,976	4,091,349	6,825,821	8,802,872
Number of farms	34,664	242,908	373,337	478,273
Acreage of farms	12,717,667	93,796,860	110,862,209	173,489,941
Acreage of improved land	3,686,942	27,155,681	37,953,010	54,027,401
Value of farms (lands and buildings)	$70,488,320	$1,294,479,856	$3,797,543,127	$7,832,604,517
Value of all crops*	....	$197,435,000	$445,975,000	$1,611,000,000

* These figures are given for the year preceding the census year. They do not include live-stock products.

The figures in the second table, also taken from Census statistics, will show that irrigation is widely practiced and has contributed in large measure to the marvelous prosperity of the country already shown by the figures in the first table.

Financial Benefit of Irrigation—In the 19 most westerly states including Arkansas and Louisiana there had been invested in irrigation enterprises over $321,000,000 in 1910 and over $697,000,000 in 1920. In these states, considered together, about 9 per cent of the improved farm area was irrigated. In Arizona about 65 per cent of the improved land is irrigated. For California this percentage is approximately 35, for Colorado 33, Idaho 55, Montana 15, Nebraska 2, Nevada 95. New Mexico 31, Oregon 20, Utah 80, Washington 7, and Wyoming 58.

The value of the principal crops produced in 1919 on the irrigated lands of the eleven Western states is given in the United States Census as $702,441,166. Through the farmer this sum finds its way to the transportation agencies, to merchants and professional men, to educational institutions, to amusement places and some goes for taxes. It is fair to assume that what the second man gets goes to a third within a month, and so on, making the volume of business that results in a year from the activity of the irrigators in these states appear at many times this amount. Here, then, is a clear indication of the influence of irrigation upon the development of the West.

Future Extension of Irrigation

On the subject of the amount of water that remains available in the streams for new enterprises and the extension of irrigation systems already in service it is interesting to note what is said on this subject in the U. S. Census of 1920: "Taking the western part of the United States as a whole, with few exceptions, the low water flow of the streams is exhausted, but there is a very large supply of flood water available for storage. There is no lack of tillable land on which this water can be used. Future extension of irrigation depends on whether economic conditions are such that the value of the crops which can be produced will justify the expense of storing the flood waters."

It must not be forgotten, furthermore, that the permanency of the irrigator's business depends upon his being able to get more for his crop output than it costs him. Not, of course, all the time but dependably, based on average conditions. There is, therefore a cost limit, varying according to many factors such as character of crop, access to market, the hazards of produc-

tion and other elements beyond which he cannot go in providing irrigation works. It is not to be wondered at that he welcomed government aid in the extension of irrigation to projects that presented somewhat greater difficulties than had to be overcome by the early settlers who selected favored locations. Nor is it surprising that there are many who even with government aid have not been able to keep their farm and family expenses within the limit of crop returns and who in consequence would rather have the United States give them a still greater bonus, than admit defeat and surrender their holdings to some one better equipped to produce results. The bonus which it is intended should go to the irrigator under the U. S. Reclamation Act is given indirectly. It is the difference between what the irrigation works would cost if undertaken by the farmer as a private or community enterprise compared with a charge to him by the United States at cost without interest on the deferred payments. Estimated at 5 per cent interest, the irrigator is expected to pay only about 55 per cent as much under the Reclamation Act for his irrigation system as he would pay for the same if it were constructed without government aid. If interest during the construction period and interest on the investment during the development were taken into account the bonus would appear still higher than these figures show. It should be remembered in this connection that the intended bonus did not always go to the present owner of the land. Whatever increment of value was added by the construction of the government irrigation system would naturally be retained by the preceding owners, where there had been any, and this value was no doubt in many cases overestimated. The present owner, in such circumstances, may have an extra burden to carry which, however, he has voluntarily though sometimes unwisely assumed.

TABLE 11—NUMBER AND CAPACITY OF IRRIGATION WORKS

Drainage Basins	Main Ditches Number	Main Ditches Capacity Sec.-Ft.	Reservoirs Number	Reservoirs Capacity Acre-Ft.	Pumping Pumps Number	Pumping Capacity Sec.-Ft.
Missouri River and tributaries	12,784	167,891	1,220	4,860,616	689	1,790
Mississippi River and tributaries (not including Missouri River)	2,957	41,974	381	1,163,306	1,715	4,980
Gulf streams, other than Mississippi and Rio Grande	1,632	20,931	360	305,415	3,208	20,500
Rio Grande and tributaries	2,890	40,424	351	3,233,164	709	6,050
Colorado River and tributaries	7,098	66,249	798	1,675,988	881	2,380
Great Basin Drainage	5,545	57,717	935	2,395,379	1,270	2,760
Columbia River and tributaries	12,614	134,536	646	5,711,783	1,745	5,610
Pacific Ocean streams other than Colorado and Columbia Rivers	5,926	100,804	2,771	1,815,714	23,378	36,500

Overproduction and the Time Element—Periods of overproduction of farm products such as that through which we are now passing with resulting low prices, are discouraging to the farmer and we find in consequence that the question is asked with increasing frequency, Why extend irrigation still further? Why add still further to the surplus of farm products which cannot be disposed of? The answer is simple, though of course not entirely satisfactory, that the periods of overproduction, regardless of causes to which they may be due, are recurrent and that the farmer will again come into his own within a few years. It must not be forgotten that time is an important factor to take into account when the merits of any project for the further extension of arable and particularly of irrigable lands is under consideration. For the full development of a large irrigation project 10 to 30 years should be allowed. This time allowance, moreover, is reflected in the estimated cost and may become a material factor. In such large proposed projects as that of the Columbia Basin and that of the lower Colorado River where irrigated areas are talked of in millions of acres, this is particularly true. These are projects involving the regulation and control of streams which are of the interstate type. On such streams the United States should provide or should in any event control the works for the regulation of flow, and before undertaking or authorizing construction should be satisfied that the proposed projects are feasible, not alone from engineering considerations but also from the economic standpoint. Can the power and the water be disposed of at prices that will return fair interest on the investment? This is the test and this test cannot be fairly applied without a proper consideration of the time element.

Cost of Water Rights—And now a word as to what the irrigator can afford to pay for water. Some 30 or 40 years ago so-called water rights could be bought in various parts of California. These water rights entitled the holder to some fractional part of the water in a main or branch canal and were paid for at a fixed price per acre or per unit of the canal flow. In the San Joaquin Valley, California, the price of $10 per acre soon became almost standard, it later went to $20. It could be considered either as a bonus paid by the irrigator to the canal owner or as an advance payment of rates. The water right contract usually runs with the life of the canal company and is therefore limited in duration and usually carries with it an obligation to make annual operation and upkeep payments in definite amounts per acre. The price fixed by the canal company for the water right was generally intended to reimburse the company for its capital outlay, but sometimes, due to limited demands for water rights, this was very slow in coming in. In southern portions of California, where the need for water was greatest and benefits largest, the crop output being valuable, and where the natural flow of the stream in proportion to the available land was unusually small, the water rights were soon at $1,000 to $2,000 per miner's inch, or $50,000 to $100,000 per second-foot, representing an investment for water of $150 to $300 per acre.

The early practice of canal owners was to confine construction of the irrigation system to the main canal and principal branches, letting the farmers build as they might such laterals and distributing ditches as they needed. This fact is to be taken into account in comparing costs of systems as constructed early in the history of irrigation with recent costs for systems, complete, with delivery of water to each small holding.

It is not possible to give with any degree of precision the amount per acre which the land owner can afford to pay for irrigation water. Much depends in this connection on the location of the land, its adaptability to produce crops under irrigation, upon transportation facilities and similar factors and also upon the value of the land before irrigation water is made available. If arid land is in question which is almost without value until irrigated, the increment of value added by the irrigation canal may be relatively large. In the case of land already in use with sufficient rainfall to warrant the planting of grain crops the amount which the owner

can afford to pay for irrigation water may be considerably less than when arid land is to be irrigated. As a general proposition the irrigator of diversified crops can afford an annual outlay including interest on the investment of $5 to $10 per acre for irrigation water, the larger amount only, however, if the irrigated lands include a large proportion of vineyard, orchard or truck gardens. Where there is but little truck gardening and the area in orchards and vineyards is small an expenditure for a gravity system of irrigation works in excess of $80 per acre will be justified only in exceptional cases.

When irrigation is accomplished by pumping, interest on the first cost of the installation may be but a small fraction of the cost of the water. The main element of expense, depending upon the head against which the water is pumped, will be the power and attendance required at the pumping plant. Favorable conditions as to crops that can be grown and favorable market conditions may, of course, warrant a large annual outlay for the operation of such a pumping plant, but here again special studies should be made of each particular situation whenever the estimated cost of the service per acre including interest on the investment goes over $5 or $6.

Precast Concrete Cribbing for Retaining Walls

Units Placed Easily and Quickly—Drainage and Foundations Simplified—Extensive Use in Railway Work

CELLULAR retaining walls of precast concrete units, as an economical development of the common practice of using old ties and timber for temporary cribbing to restrain the slopes of fills, are being employed in a number of cases, since increasing cost of construction work has emphasized the economy of such permanent crib walls as compared with timber cribbing or even with solid retaining walls. Different types of concrete units have been developed and numerous structures installed under severe conditions have demonstrated both economy and satisfactory service. Concrete crib walls of the "Interlock" type, shown in Figs. 1 and 2, with details in Figs. 3 and 4, are being used by several railroads and industries.

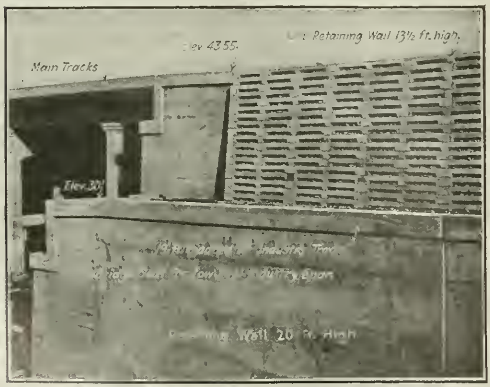


FIG. 1—CRIB RETAINING WALL ON ROCK ISLAND LINES; CHICAGO

Poured retaining wall 20 ft. high. Crib wall 13½ ft. high, set back 19 ft. from lower coping. Industry track at foot of cribbing and main tracks at top.

In this type of cribbing there are three forms of precast pieces, designated as headers, full-length stretchers and half-length stretchers (see Fig. 3). Ordinarily only the first two are used, the half-length stretcher being employed occasionally where a wing wall with plumb end is desired. Their steel reinforcement is furnished built-up ready for placing in the forms. These concrete units are installed with one or two parallel rows of longitudinal stretchers supported transversely by the headers, but for comparatively low walls only one row of stretchers is required. It will be noted that the longitudinal unit or stretcher is formed with a supporting member at the middle, thus

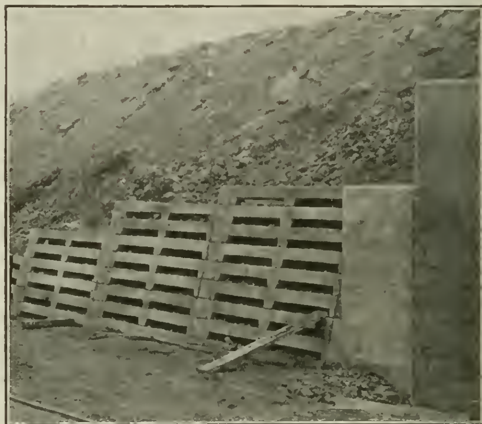


FIG. 2—CONCRETE CRIBBING RETAINS TOE OF FILL

allowing the vertical joints to be broken or staggered without the necessity of additional blocks or fillers. The ends of both stretcher units are recessed so as to interlock with the T-head headers.

The large crib wall shown in Fig. 1 forms a bench for an inclined industry track in the slope of a main track embankment about 33 ft. high, on the Chicago track elevation work of the Rock Island Lines. Here the cribbing, 10 to 13½ ft. high and with a face batter of 1 in 12, rests on a fill supported by a retaining wall approximately 20 ft. in height, which was built prior to the installation of the cribbing. Some of the half-stretchers will be noted in the end bay, between the headers and the bridge abutment. This crib wall built into the fill was adopted instead of a second retaining wall, since the latter would have involved great cost for a solid wall either on pile foundations or with masonry extending to the ground. The low-level bridge for the industry track was not in place when the view was taken. Similar construction has been employed on the Detroit track elevation of the Michigan Central R.R., but with both the upper and lower walls built of cribbing.

The Chicago installation, made under severe foundation conditions, has been in service more than seven years and it is reported that in addition to great saving in first cost the service results have justified its use. Although the embankment settled considerably during the first year after the wall was constructed, the flexibility or elasticity of the cribbing allowed the units to adjust themselves without detrimental effect to the stability of the wall. Other crib walls were built on the same project and with such success as to lead to

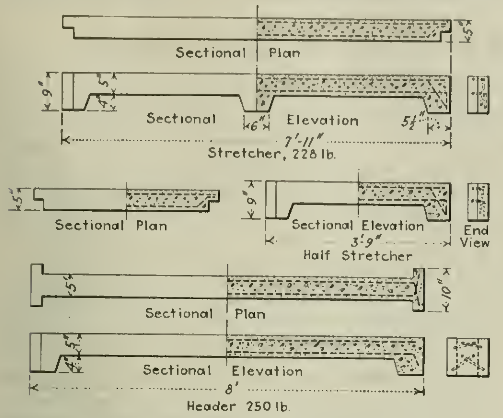


FIG. 3—UNITS FOR CONCRETE CRIBBING

the adoption of this system by engineers on other works. In general, the cribbing is used for retaining or restricting the slopes of fills, but it has been applied also along the toes of wet and sliding cuts. A crib toe wall on the Chicago track elevation work of the Illinois Central R.R., shown in Fig. 2, is at the Main St. bridge at Matteson. In this case, the headers are not staggered and no half-stretchers are employed, as in the arrangement shown in Fig. 1.

These precast units are of sufficient length to take care of the wall heights commonly required and can be handled by common labor without the use of special equipment. The high wall in Fig. 1 was built by a foreman with four laborers. The units are placed as the filling proceeds and are not built up to any considerable height in advance of the filling. By this method and by eliminating the usual period required for the placing and curing of poured concrete there is considerable saving in time. The theory and practice of design are similar to the case of solid walls, but owing to the uniformly distributed dead load and to the rectangular section causing the embankment pressures to be applied at a greater distance from the face of the wall, the toe pressure is reduced to a minimum and the latitude of uses for cribbing on relatively soft foundation soils is increased materially.

Advantages claimed for the concrete cribbing include: Low first cost of construction, speed of erection, use of unskilled labor, adaptation to congested territory, ample drainage of wet filling, freedom from frost troubles, distribution of load on soft ground, flexibility of design to allow of its use without foundation construction, small number of types of units, and salvage value in case of reconstruction or a change in height of wall. This type of structure is considered to be adapted particularly for temporary or permanent use on railway and highway work where reduction in cost and time of construction is important, or where it is desirable to avoid such interference with traffic as might be involved by poured concrete construction. It is applicable also in various other cases, as in walls at industrial plants, an example of such work being the construction of walls to retain a coal stockpile at a manufacturing plant. The concrete units may be made by contract or by railroad forces at any convenient point.

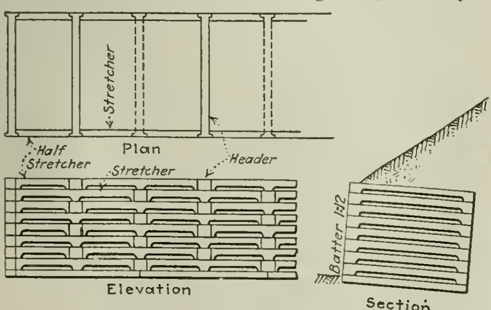


FIG. 4—CELLULAR CRIBBING OF CONCRETE UNITS

Conveyors Handle Clay at British Port

BELT conveyors for handling china-clay and loading it into steamers are a feature of a new pier at Fowey, on the south coast of England, which is an important shipping port for this material. In 1922 more than 600,000 tons of clay were shipped, largely to the United States. The pier or jetty extends at a sharp angle from the river bank, so that it has a berth 300 ft. long on one side only. Steel cylinders sunk to rock and filled with concrete support a frame of steel girders having brick arches between them and a concrete deck 50 ft. wide. Freight cars of 10 and 12 tons capacity, having the ends hinged at top, are run upon a tilting table at the shore end of the pier and dump the clay into a circular chamber 34½ ft. in inside diameter and 23 ft. deep. As this chamber, supported on foundation cylinders, extends below the water, it is made with a 33-in. concrete wall between two steel shells.

A hopper in this chamber feeds the clay upon an inclined conveyor belt traveling at 125 ft. per minute and rising to a height of 35 ft. above the pier. At the top, the clay is delivered by a transverse belt to a horizontal belt extending the full length of the pier. This belt serves a loading tower which travels along the berth side of the pier and has an inclined adjustable chute to deliver the clay into the ship's hatches. A revolving shoe or spout at the end of the chute spreads the falling clay and reduces the amount of hand trimming of the cargo in the hold. The conveyor galleries and the tower provide for duplicate equipment of belts and chutes when required. To handle clay shipped in barrels and sacks there is a 3-ton revolving crane traversing the top of a gantry traveling on the berth side of the pier and between the shipping tower and outer end of pier. Storage for twenty cars is provided on a side-track and the cars are moved to and from the pier by cables and capstans. The dumping table, conveyors, tower, crane and capstans are all electrically operated This shipping plant was designed under the direction of W. W. Grierson, chief engineer of the Great Western Ry., and was built by the Cleveland Bridge & Engineering Co.

Los Angeles Holds Out for Breakwater

Los Angeles interests already are taking steps looking to congressional sanction for their plan to construct a breakwater to provide shelter for Terminal Island. It is regarded as unlikely, however, that Congress will override the Chief of Engineers and the Board of Engineers for Rivers and Harbors, who have reported emphatically against the breakwater plan.

Formation of Transverse Fissures in Steel Rails

An Abstract of James E. Howard's Latest Report to the Interstate Commerce Commission Together with a Discussion by C. A. Morse, J. L. Campbell, C. R. Harding, and J. M. R. Fairbairn

Since the transverse fissure was first identified in 1911 as a specific type of fracture, railroad engineers and steel-rail manufacturers have been endeavoring to discover the cause and to find some means of preventing its development. James E. Howard, engineer physicist of the Bureau of Safety of the Interstate Commerce Commission, has probably done more than anyone else toward discovering the cause of this perplexing type of fracture. His latest report sets forth his views as to the cause. Knowing that many men do not hold the same views an abstract of his report was sent to a number of engineers with request for an expression of opinion. The replies from four of them, from widely scattered parts of the country, and an abstract of Mr. Howard's report are given below.

Transverse Fissures in Steel Rails and Their Prevalence on Certain Railroads

THE REPORT of Mr. Howard summarizes available data and gives illustrations of transverse fissures and a number of diagrams made from a tabulation of the rail failure reports of various railroads in this country. The new data brought out by Mr. Howard show: The location of rails which fail by transverse fissures according to mileage, on certain sections of railroads, the heat numbers of such rails and the number in each heat, the position in the track (such as the high or low rail on curves), the number of fissures displayed according to years and months, according to ingot position, and according to year rolled.

The known facts concerning transverse fissures which the report brings out are: Transverse fissures have an interior origin starting from a nucleus a few hundredths of an inch in diameter. A silvery crescent next forms, concentric with the nucleus, which increases in size until the periphery of the rail is reached. The surfaces of the fissures present a silvery luster until air is admitted. They occur in both Bessemer and open-hearth rail and in all weights of rail up to the heaviest rolled. They have been found in rails from every rail mill in the country. Fissures always occur in the head of the rail and in larger numbers on the gage side. On curves they occur more frequently on the inside rail, and on railroads having both light and heavy tonnage tracks they occur more frequently in the heavy tonnage track. In fact, on one railroad a large number have occurred in the heavy tonnage track and none have occurred in the light tonnage track. They occur in new rails and in rails thirty years old, in rails rolled in every year for which records have been kept, and in all ingot positions. Some of the earliest failures have occurred in rails coming from parts of the ingot generally conceded to be the best. Nor do bending stresses appear to cause the fissures, for incipient fissures have been found 1⅛ in. from the end of a rail and fully developed fissures 7½ in. from the end. They have occurred in some of the best track in the country and in some of the poorest, and at all seasons of the year.

So-called shattered zones have been found in rails of the harder grades of steel, located in the central part of the head or base or at junction of the base and web, but these zones do not extend to the hot-sawn end of the rails. A definite relation between these shattered zones and transverse fissures has not been established, but transverse fissures have been found with their nuclei located in the sound metal between such shattered zones.

In addition to the known facts reviewed in the text of the report the diagrams bring out three things which have not been so clearly indicated before. They are: (1) That certain heats seem to be more subject to failures by transverse fissures than others. (2) That on practically every railroad submitting reports on this type of failure, the failures seem to be grouped in certain geographical positions, so that in any one piece of track the failures will occur at certain mileages in considerable number while at other mileages there will be few or no failures. (3) That rails rolled by certain mills in certain years are much more subject to failure by transverse fissure than rails rolled in other years. This latter condition is emphasized by the fact that the reports from different railroads show similar conditions for corresponding years. For example, for the year 1910 Bethlehem rails on both the New York Central and the D. L. & W. show an unusually large number of failures.

Year of Rolling—As to failure of rails in the same year, the author says that at least in the case of the Great Northern Ry. the rails which displayed transverse fissures in large numbers were very hard rails in respect to chemical composition and were intended to offer great resistance against abrasion. He adds that: "Notwithstanding the doubt which has been expressed in regard to certain years' rollings, no identification of defects has been announced upon which the belief is founded. In due course of time it will be of interest to see whether those years of mistrust occupy a certain place in regard to the calendar, or whether they advance and maintain a more tangible relation to traffic conditions."

No deductions are made by the author from the fact that failures by transverse fissures are concentrated at certain locations in the track on the sections of railroads used for the tabulation. Nor does he add any data to show whether this feature is merely the result of physical conditions such as might occur on the inside of sharp curves with high elevations, or whether the personal factor is responsible, or whether rails from heats which seem to be subject to transverse fissures were concentrated at those points.

In his review of the facts concerning transverse fissures the author discusses each one in its relation to the various hypotheses of their formation which have been advanced since his discovery and discussion of this peculiar type of failure in his report on the Man-

chester wreck in 1911. The ingot position of the rail as a primary cause is eliminated by the fact that failures occur in rails from all parts of the ingot; age is eliminated by the fact that transverse fissures have developed in rails a few months and many years old. He questions the evidence that rails rolled in certain years are more subject to transverse fissures, and says that the evidence is not sufficient to show that the fissures are due to other than unusually hard steel or to density of traffic.

Causes—Mr. Howard states that certain heats display greater durability than others. He points out that the internal strains due to cooling and gagging are shown to have little possible effect on the formation of transverse fissures, that the so-called shattered zones are probably the result of cooling strains, and that although there may be some connection between transverse fissures and shattered zones the fact that transverse fissures have been found in the sound metal between two shattered zones would seem to indicate that they were due to some other cause. The cause of transverse fissures is, he thinks, the internal strains set up in service by the cold-rolling effect of the wheels. The result of this cold rolling is to set up intense strains of compression in the shallow zone of metal at the top of the rail which develop a counterbalancing tension on the central part of the head. The strains of tension find relief in the formation of transverse fissures, but this is temporary, and as the cold rolling continues similar strains are built up in the adjoining metal until other fissures occur. This formation of two fissures in close proximity would be impossible under the action of bending stresses alone. The author then proceeds to show how in laboratory tests transverse fissures have been produced under conditions approximating field conditions. Track stresses as a primary cause are also eliminated by the fact that transverse fissures have occurred in all weights of rail and on all kinds of track.

The report draws attention to the fact that transverse fissures are practically unknown on English and Continental railways and points out that from what is known of the manufacture of foreign rails and the conditions of their acceptance, it does not seem probable that the practical immunity from transverse fissures is due to superiority of the metal used. The moderate wheel loads are a significant factor.

In his concluding remarks the author says:

Three features constitute the rail problem: (1) Girder strength; (2) Abrasive resistance to the action of wheels; (3) Cold-rolling effect of wheels on the head of the rail. If the third feature was eliminated, there would be no rail problem, since the requirements of the first and second can be met without difficulty. The third feature is the vital one, and admits of solution in one way—by the proper regulation of wheel loads. The effect of wheel pressures, as they are received by the zone of metal at the top of the head, constitutes the essence of the rail problem. Internal strains which tend toward the formation of transverse fissures are acquired by all rails. Selection of the proper grade of steel and the regulation of wheel loads constitute factors for meeting their influence.

Inasmuch as the adjustment of wheel loads, according to the ability of steel to endure them, is not a flexible matter, it is left to ascertain what grades of steel possess maximum durability under current track conditions.

It is reasonable to believe that a specific and remediable cause may be found for the failure of some rails, notably those which fail prematurely, revealing whether abnormality resides in the steel, in the tracks, or in the wheel pressure. It is questionable whether increased weight of rail, far beyond the heaviest now being rolled, would overcome the destructive effect of these fissures.

* * *

Rock Island Results Not In Entire Accord

By C. A. Morse

Chief Engineer, The Chicago, Rock Island & Pacific Railway Co.

IN ORDER to study transverse fissure rail failures on the Chicago, Rock Island & Pacific Ry. in their relation to traffic density and to axle loads, we have superimposed the data concerning transverse rail failures upon a tonnage diagram.

A study of this diagram shows that the transverse fissures have predominated with us on 100-lb. rail in our heaviest traffic territory, but it also shows 19 transverse fissures, four heats of which had three or more transverse fissures develop, occurred on our Arkansas Division in a territory where we have single track and where the combined east and westbound traffic is a little more than 9,000 tons a day. It also shows on that same division two transverse fissures where we had about 8,000 tons per day, but the point where we had 34 transverse fissures was on our westbound track with 18,000 tons a day; 25 fissures on our eastbound track where we had 22,000 tons a day, and 16 fissures on a single track where we had nearly 23,000 tons a day on one track, yet just adjoining this last piece was a stretch of 32 miles, 22 miles of which were single track, on which we had nearly 25,000 tons passing over the one track with no failures.

This would indicate possibly what Mr. Howard contends —that the majority of the transverse fissures are on heavy traffic lines and that heavy rail does not prevent them; but I do not think that the diagram substantiates Mr. Howard's claim with reference to heavy wheel loads as our lines between Chicago and Rock Island, where we have the most business and the most transverse fissures, has a lighter axle load than much of the territory west of that where we have developed transverse fissures, and on our Arkansas Division east from Memphis, where we show 21 transverse fissures, one section having an axle load of 53,000 lb. and the other 45,750.

* * *

Density-of-Traffic Theory Not Supported on El Paso & Southwestern

By J. L. Campbell

Chief Engineer, El Paso & Southwestern System

THE THEORY that the transverse fissure or its incipiency is not in the rail when laid but is made in its incipiency and its development by the rolling of the wheels on the rail, is unsupported by satisfactory evidence. Mr. Howard says that the number of transverse fissures is greatest on those roads where the traffic is heaviest, and appears to conclude from that that the theory above described is correct. Is this theory supported by observation of the fact, if it exists, that the greatest number of rail failures through transverse fissures observed to occur on tracks carrying maximum traffic are uniformly distributed throughout the length of such track and as between all kinds of rails on that track? The theory needs the support of observation.

On the El Paso & Southwestern, a line of comparatively light tonnage but approaching the maximum in speed and axle loads, we have had only one definite instance of pronounced trouble with the transverse fissure. This occurred on 25 miles of 85-lb. open hearth Bethlehem rail laid in 1908 and removed in 1921 on acount of continued rail failures, all of which showed the transverse fissure normally located in the center of the head. The first failure occurred shortly after the rail was laid, derailing a light special train running 50 miles an hour, the rail breaking into six pieces and all fractures showing the fissure. The last failure was a

few months before the removal of the rail began. Except as the rails removed may have had incipient or developed transverse fissures, of which there was no indication on the surface, they were all in excellent condition and adequate for continued service.

East and west of and connecting to this 85-lb. rail was rail laid on the east in 1909 and 85-lb. rail laid on the west in 1912. From these dates until the 85-lb. rail failing through transverse fissure was removed from the track, all of the 85-lb. rail on that district carried identically the same traffic but no trouble from transverse fissures developed in the rail laid in 1909 and 1912. The latter rail is still in the track and in good condition.

* * *

Should Improve Rail to Meet Present Requirements

By C. R. Harding
Consulting Engineer, Southern Pacific Co.

JAMES E. HOWARD'S latest contribution to our knowledge of interior transverse fissures in steel rail is a remarkable step toward the final solution of this old and baffling problem.

One thing which has gone far toward maintenance of railway service at low rates in this country is the operation of heavy units of power and long heavily loaded trains. The material at present available for steel rails is in some way deficient, when it comes to resisting cold rolling strains due to heavy wheel loads.

There will probably be larger and better units of power and equipment developed in the future, but it would seem prudent to pause for a while, in the matter of unit weights, to permit rail steel to catch up with present-day requirements.

The field is wide open for our metallurgists, to discover a material, method of manufacture or method of heat treatment which will provide proper resistance to cold rolling effects without detriment to other functions demanded of steel rails. The Southern Pacific Co., for one, following its practice of long standing, would undoubtedly purchase liberal amounts of rail of a material which seemed to promise the above results. As a large user of rails this company would thus encourage the manufacturers to help toward the desired end.

* * *

Geographical Distribution on the Canadian Pacific

By J. M. R. Fairbairn
Chief Engineer, Canadian Pacific Railway Co.

AS THE 39 transverse fissures on the Canadian Pacific were distributed over all the districts on both Eastern and Western Lines and came from 17 different divisions, 20 different subdivisions, and 32 sections it is apparent that they are not seriously bunched geographically and that our campaign to educate the section foremen to recognize a transverse fissures has been effective. The information is not offered as a refutation of the statement that transverse fissures are bunched geographically on other railways, but is simply a statement of the facts as they have so far developed on the Canadian Pacific Ry.

I am convinced that if we are not now securing reports on all of our transverse fissure failures we are at least securing reports on the great majority of them and that no considerable number escape identification. We are, however, continuing our educational campaign.

Columbia River Bridge Tolls

Tolls from the bridge over the Columbia River between Portland, Ore., and Vancouver, Wash., totaled $224,223 for the first nine months of 1923, according to a report of the Interstate Bridge Commission. This exceeds the figures for the corresponding period last year by about $49,000.

Through the Reclamation Country

By F. E. Schmitt
Associate Editor, *Engineering News-Record*

A SERIES OF ARTICLES on Federal Land Reclamation is now running in *Engineering News-Record* the second article appearing in this issue.

The purpose of the series is to give a history of the twenty-one years of government irrigation, state the many problems of operation—engineering, agricultural and financial—analyze the various complaints that are being so emphasized by those who are seeking a reform of the current law and methods and seek to present some views as to a constructive policy in the future. Through it all will run the evident theme that irrigation, from planning, through construction to operation, is a continuing engineering problem.

As a part of the preparation of the series Mr. Schmitt is now traveling through the West, visiting irrigation projects, studying developments and interviewing builders, operators and settlers. He is writing this series of letters of running comment on the situation as he sees it on the ground. These are not the final result of his trip but they will serve to acquaint our readers with the actualities of reclamation as revealed to an unprejudiced investigator.

This is the fifth letter. The first appeared in the issue of October 4.—*Editor.*

San Francisco

INTERVIEWS with bankers and other men informed about financial conditions among the farmers on reclamation projects bring out the fact that these farmers have money troubles. They are heavily in debt, have not been finding it easy to pay interest, and want more credit.

Financial Difficulties—On several northern projects the mortgage indebtedness on the farms averages $40 to $70 per irrigable acre of the whole project. Most of this is in real estate mortgages at 8 to 10 per cent; the rest is in chattel mortgages at rates up to 12 per cent. There are also crop obligations every season, not included in the above. Thus a yearly interest charge of $5 to $7 has to be paid out of the earnings of each acre. The average gross production of the projects, however, is sometimes as low as $25 per acre, and does not exceed $50 under favorable conditions; in fact, the best one of these northern projects produced only $48 per acre as the average of the last seven years, and only $27 in 1922, a year of abnormally low prices. Out of such earnings as this the farmer must pay all costs of production and in addition must pay $2½ for taxes, $1½ to $2 for water, $5 to $7 for mortgage interest and $1 to $4 for construction-cost installment; and he ought to have enough left to pay him a wage for his labor.

One might figure that the farmer doesn't need a wage, that he gets a living out of his farm over and above the reported crop production. Doubtless many farmers do; but on one project, at least, town store people have remarked with surprise on the number of farmers who buy eggs, milk and other food supplies that they should raise on the farm—and of course this means more money to be taken out of the crop sales.

With such a narrow margin between income and outgo as these data indicate, the farmer is pinched in the ups and downs of crops and prices. When heavy crops and good prices come together he can make some money. but unless he is prudent enough to save for

future losses, the lean years may ruin him. All the time it is mainly the mortgage debt burden that keeps him down in the mire.

Farm finance is one of the biggest elements of the reclamation problem, in fact. The Congressional relief acts and departmental postponements of charges, where they have been of any use at all, have not touched the matter of getting and keeping the farmer out of debt, or (on the principle that a certain number of fleas are good for a dog) down to the desirable amount of debt.

The expense of pioneering has largely been worked out on the reclamation projects. The heavy debt burden did not come from this expense but from the ballooning of land values four or five years ago and the resulting land speculation. The poorest projects were least hit by this inflation, and are least in debt now.

Bankers admit quite freely that they were carried away in the short post-war boom; they admit that they loaned far too freely, loaned too much per acre, and helped along the value-inflation. There were shoestring purchases of land, where most of the small cash payment was raised at the bank on first mortgages and the seller took a second mortgage for the bulk of the price, a proceeding which imperiled all three parties. Much land changed hands at valuations on which it could never pay except with abnormally high prices for crops and these prices collapsed soon after the boom in values. The bankers' ideas of land values were quite as optimistic as those of the farmers. Bankers as well as farmers have been paying the penalty during the last three years.

Land Values and Government Equity—One might suspect some fundamental flaw in the habits of mind that allowed these effects to come about, and such a flaw appears to exist, in fact. There is a peculiar thing about land values on reclamation projects: they take no account of the government's equity in the property. The unpaid construction charge is simply disregarded. Farmers buy and sell without regard to this equity, tax assessors make their valuations in the same way, and bankers loan in the same way. Only the Federal Land Banks deduct the government equity from appraised clear value (and then loan up to half the remainder). Though they have been operating for only about a year on the reclamation projects, they are helping to make other bankers' ideas sound. But even now a certain bank that is called conservative has loaned without question nearly twice as much per acre as the Federal Land Bank limit for the particular reclamation farms concerned, and this in cases where the Land Bank absolutely rejected the loan on account of its moral hazard.

One natural result of basing credit operations on such loose-thinking is that the government equity comes to be considered unreal, or is forgotten; and a secret feeling springs up that in all fairness the Reclamation Service ought to forget it also. But another result, and perhaps a more serious one, is that the settler is enabled to cash in on the full land value, and thinks he is justified in doing so, despite the fact that he is appropriating an element of value which the nation at large created, a loan not yet paid. In thus putting the government equity into his own pocket when he sells, he burdens the purchaser with an extra debt, usually on top of an already inflated land value.

The individual settler cannot be blamed greatly for such actions, since they are in line with the general practice in his community. The blame properly rests on the system of the law or its administration. If the main objective of reclamation is the development of stable farm-home communities, the farmer should have full right to the productive value which his labor develops in the land, but he should be prevented from trafficking in the value created by the government's irrigation enterprise until after he has paid for it. The California State Settlement rules contain safeguards for accomplishing this but federal reclamation practice lacks them. I understand that a first attempt in this direction is about to be made in a new contract form devised for the Yakima project.

Speculative Selling and Settling—Besides the speculative element in selling and loaning on the reclamation projects, there seems to be a large speculative factor in the original settling. Farmers, bankers and irrigation operators in private as well as in government service have told me that a large number of the settlers, probably more than half, come originally with the main idea of getting something for nothing. Some of these speculative settlers farm, some few farm well; but many become absentee landlords, and either let their land lie idle or have it farmed, after a fashion, by renters. Some projects are spotted with such idle or poorly farmed units, and it is not specially comforting to learn that this piece is held as a speculation by a former United States senator, or that one by a slipshod town garage man, neither of whom will ever get into the farm-home class. If resale were hindered until after the government equity is paid for, possibly there would be fewer speculative settlers.

From the figures given as to the farmer's debt and payments it can be seen very clearly that the water charge and the construction charge are *not* the things that make or break him, as might be thought from some of the grumbling at these charges. No feasible reduction of these charges would save the farmer who by lack of skill or unthriftiness is going down, and no ordinary increase would wreck the one that is making a success. But the farmer sinking under the excessive weight of his debts will grasp at the straw of the government charge.

A Continuously Moving Railway

A "never-stop" railway, a new type of line for local passenger traffic, in which a number of small independent cars are moved by a longitudinal screw with varying pitch of thread, is being exploited in England and is a development of a scheme invented in the United States many years ago. At stations the pitch is small so that the cars move slowly and passengers can step in and out; beyond the stations the pitch increases gradually to the maximum for high speed. A short line has been built in an amusement park at Southend by the Never-Stop Transit Co., Sardinia House, London. The cars are operated independently instead of in trains, and each has beneath it an attachment with rollers engaging the thread of the screw between the rails. This screw or shaft is carried in ball-bearings and is rotated at constant speed by means of motors which may be as much as 1,200 ft. apart. For this system it is claimed that it requires no signals, brakes or trainmen.

Water-Works Dam Withstands Record Flood

Oklahoma City Structure Passes Almost Five Times Designed Capacity, Though 250 Ft. of Corewall Fails

FLOOD waters that reached a peak toward midnight of Oct. 15 and which, it is estimated, more than doubled the June record flow in the North Canadian River at Oklahoma City, Okla. (see *Engineering News-Record*, Aug. 23, p. 292), poured over the city water-works dam with a maximum height of 27 in. over the dam crest, inundated all the surrounding country, and finally scoured the downstream face of the corewall until a section about 250 ft. failed, emptying the reservoir without damage to the dam, except slight injury to the handrail in one or two bays, replacement of which cost about $50. It is estimated that at least 65,000 sec.-ft. of water passed over the dam and through the control works, though the designed spillway facilities, depending upon the head, are from 12,000 to 15,000 sec.-ft. Other damage to the water-works, all of which it is estimated will cost $1,200,000 to repair, include the loss of gunite slope paving to the reservoir of two 500-ft. sections and the carrying away of about 500 ft. of the bypass embankment at the upper end of the bypass canal.

The general property damage to Oklahoma City through the flood, caused by excessive rains, will approximate $2,500,000, not including the damage to the water-works. Report of the flood and damage to the water-works is given by V. V. Long, consulting engineer of Oklahoma City, who made an examination of the works and prepared a report at the request of *Engineering News-Record.* His report follows:

SURFACE CAR TRACK TORN UP

The year 1923 has made flood history for Oklahoma City. The yearly rainfall has been to date 42.5 in., while the average yearly rainfall is 31.5 in. Yet during this year there have been four floods of the North Canadian River, with stage heights and estimated maximum flow as follows:

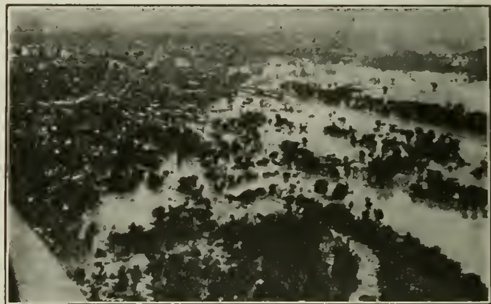
May, 15,000 cu.ft. per second; June 13, 33,000 cu.ft. per second; September, 12,000 cu.ft. per second (height 14 ft.); and Oct. 15, estimated, 60,000 cu.ft. per second. The maximum flood of record previous to this year was 11,000 cu.ft. per second, in October, 1920.

The North Canadian River has a long, narrow valley with a tributary drainage area of 10,000 square miles above Oklahoma City. Preceding the recent flood, the rains began Friday, Oct. 12 and lasted through Monday, Oct. 15, during which time 5.29 in. had fallen in Oklahoma City. The rainfall west of Oklahoma City, up the river valley, was even heavier than at Oklahoma City.

The flood crest first manifested itself at Woodward, Oklahoma, on Oct. 13, thence it passed rapidly down the valley, reaching El Reno, forty miles west of Oklahoma City, Sunday afternoon, Oct. 14, and the Oklahoma City reservoir, seven miles above Oklahoma City, before midnight, Oct. 15. At 9:25 o'clock p.m. the earthen embankment at the west end of the dam gave way and the resulting flood wave crest passed through Oklahoma City from 11 p.m., Oct. 15, to 3 o'clock a.m., Oct. 16.

General Damage—The damage to railroads, street railway and highway can be best appreciated by the fact that no traffic of any kind was able to cross the North Canadian River from midnight, Oct. 15, until Robinson Avenue was re-opened at 4 o'clock p.m., Oct. 18.

The street railway lost all three of its bridges, together with probably two miles of track and fills. The bridges were all pile trestles, one of which had been carefully replaced after the June flood.



AIRPLANE VIEW OF OKLAHOMA CITY AFTER FLOOD
Water had fallen about 3 ft. when this view was taken.

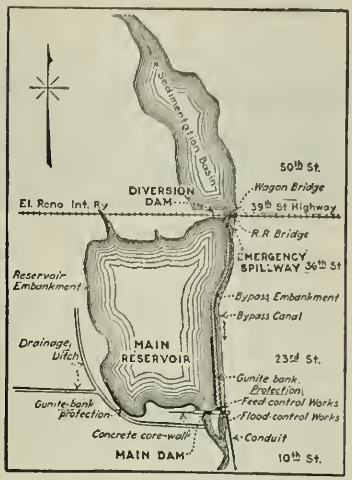
The Santa Fe R.R. bridge, a steel span with pile trestle approaches, stood the flood with water several feet over the track, but the railroad embankment at both ends went out for a total length of approximately one mile.

The Frisco R.R. lost two pile trestle bridges and several miles of track as the heavy current of the flood passed through their east yards.

The Rock Island Railroad lost its pile trestle bridge west of the city, but the steel spans of both the Rock Island and M., K. & T. railroads east of the city stood the flood, although considerable track of both lines went out.

Damage to Water-Works—The Oklahoma City water supply suffered probably the largest damage; however, there has been no interruption of service. The water lacked only 6 in. of reaching the pump and boiler room floor levels.

The Oklahoma City water reservoir covers 1,700 acres with a storage capacity of 7,000,000,000 gal. and is formed by an Ambursen dam 54 ft. high above shale, across the North Canadian River, about seven miles above Oklahoma City. At the west end of the dam, a concrete corewall resting on sheetpiling driven to shale, extended from the end of the Ambursen structure some 500 ft. westward. Around the south and west sides of the reservoir west from the dam an earthen fill varying from zero to probably 6 ft. in height was thrown up for a roadway to an elevation uniformly equal to at least 12 in. above the walkway on the Ambursen dam, which walkway is 6 ft. above spillway of the reservoir. For over 6,000 ft. west from the west end of the dam the reservoir banks are protected with gunite slope paving 3 in. thick, with a 4-in. gunite wall, the top of which comes up to an elevation 12 in. above the walkway on the dam. This same protection extends for over 4,000 ft. along the reservoir side of the



AIRPLANE VIEW (AFTER FLOOD) AND PLAN OF DAM, RESERVOIR AND BYPASS

bypass embankment which follows the east side of the main reservoir.

The bypass canal is 120 ft. wide at its base with 2:1 slopes and is approximately two miles long, with an 18-in. fall. The embankment between the canal and the main reservoir is protected with good 12-in. riprap on the bypass side, and with the gunite on a 2:1 slope on the reservoir side.

The bypass was originally intended to carry all flood waters by the reservoir through four gates 9 x 14 ft. and a spillway 72 ft. long by 5 ft. deep at the east end of the main dam. These are computed as having a carrying capacity of 12,000 cu.ft. per second. There is an emergency spillway from the bypass to the main reservoir near the upper end of the bypass, which together with the gates to the main reservoir at the lower end of the bypass have a normal capacity of 9,000 cu.ft. per second. Near the west end of the dam there are four gates 4 ft. by 5 ft. and a spillway 144 ft. by 6 ft. deep through the Ambursen dam out from the main reservoir to the river below. The total flood capacity through the dam from both bypass and reservoir is between 12,000 and 15,000 cu.ft. per second. The June flood of 33,000 cu.ft. per second topped the walkway of the dam, throughout its entire length of 1,200 ft., 6 in. deep, but the gunite slope protection west from the dam, being 12 in. above the walkway of the dam, held the flood waters, and very little damage was done.

Bypass Embankment Broken—The flood burst through the bypass embankment into the main lake at about 5 o'clock p.m. just below the emergency spillway, carrying away about 500 ft. of the bypass embankment and filling the reservoir. The water kept rising until at 9:25 p.m. it was flowing over the walkway of the dam 27 in. deep, and was therefore 15 in. over the gunite slope protection and earth embankment west of the dam. At 9:25 p.m. the break occurred in the corewall adjoining the west end of the dam, when approximately 250 ft. of the earthen bank and corewall gave way. While it is not known just how the break started, as it was dark and raining, it is thought that the water, flowing over the gunite and embankment, carried away the earth below the corewall, which then failed due to the pressure from above.

At about 5 p.m. both the street railway and the highway bridges at Thirty-ninth Street across the upper end of the bypass went out, and while every effort possible was made to catch all the debris therefrom, a portion of these bridges came down the canal and lodged in the gates and bypass spillway under the walkway, thus cutting their capacity down to probably 40 per cent of their rated capacity. Another portion passed into the main reservoir through the break in the embankment, and coming on through the reservoir, lodged in the main reservoir spillway under the walkway.

Failure of Gunite Protection—The gunite slope protection has stood the test with two exceptions, both of which are on the bypass embankment. At one place it is evident that something has hit the top of the wall, possibly a part of the bridges coming down from Thirty-ninth Street, this crushed some 500 ft. of wall. Near the dam, about 500 ft. of the gunite on the bypass embankment slid down after the water drained out of the main reservoir. It is quite evident that this was caused by the saturated bypass embankment which was not stable on a 2:1 slope.

It is not known how much the reservoir capacity has been cut down by silting up due to the flood passing through, as this can only be determined by soundings and surveys.

These floods have shown that the bypass canal and the spillway and gate capacity of the dam are woefully inadequate.

BREAK IN COREWALL; NOTE POINT AT WHICH IT JOINED DAM, WHICH WAS UNDAMAGED

UPPER END OF BYPASS CANAL

Both highway and interurban bridges, latter the El Reno Int., were washed out.

The writer is indebted to C. E. Bretz, water superintendent of the Oklahoma City water-works, for the water-works pictures, and a large part of the information relative to the floods and reservoir failure. Mr. Bretz was personally in charge of the work of attempting to save the reservoir and worked heroically, almost without rest, from Saturday to Tuesday, and by his untiring efforts the water service in Oklahoma City continued without interruption. The writer is also indebted to Warren E. Moore, Commissioner of Public Works of Oklahoma City, for the information relative to the situation in the city.

Mr. Stewart's Report—Spencer W. Stewart, president of the Ambursen Construction Co., engineers and builders of the Oklahoma City water-works dam, arrived in New York Oct. 29 after a special trip to Oklahoma City to inspect the dam. At the time of the flood his company was engaged upon a redesign of the dam, made after the June flood, which was to take care of a maximum flow of 63,000 sec.-ft. over spillways and through flood-control gates. The contract for this extension was made Sept. 15. The increased flowage was to be secured by opening eight bays in the dam at about a third of the way from the east end of the dam and placing crest gates, and by lowering the crest level in the existing ones. Four more gates of the same size as will be placed in the dam will be placed in the bypass spillways, thereby allowing for a maximum flood discharge there of 18,000 sec.-ft. The gate-controlled pass at the upper end of the bypass will be opened to pass into the main reservoir a maximum of 50,000 sec.-ft. from the sedimentation basin. These improvements will be carried forward.

Closure of the gap, resulting from the failure of the corewall, will be made, asserts Mr. Stewart, by the construction of an Ambursen spillway section about 350 ft. in length turned downstream at an angle of about 20 deg. to the axis of the main dam. Besides large crest gates this section will contain two 12x12-ft. caterpillar gates which will allow the reservoir to be emptied quickly and in advance of any flood waters that may threaten the dam. This latter betterment is contained in a report to the city authorities by the engineers in charge of estimating reconstruction needs.

BYPASS SPILLWAY AND GATEHOUSE

Debris clogging spillway and gates is partly timber from bridges at upper end of bypass canal.

Mr. Stewart made an examination of the reservoir and dam after flood waters had receded and he asserted that the failure of the corewall was due to the scouring of earth downstream from the corewall. He also said that both the railroad and highway bridges at 39th St., above the dam, were underscoured, part of the highway bridge hitting the dam near the flood-control house being in a single section about 250 ft. in length. This length of bridge was practically intact when it reached the dam, the pile bents, decking and flooring all remaining as one self-contained section. As it hit the dam part of it rose in the air and turned over on the dam crest. Mr. Stewart said the failure of the gunite was perhaps due to the fact that with the reservoir water level much lower than that in the bypass canal after the corewall failed, seepage through the bypass embankment tore the gunite out, the hydrostatic pressure being too great for it to resist.

Dissolves Cement Manufacturers Protective Association

Judge in New York District Court Says Open Price Association in Eastern District Was in Restraint of Trade

JUDGE John C. Knox, of the United States District Court, Southern District of New York, on Oct. 23 ordered dissolved the Cement Manufacturers Protective Association as an illegal combination in restraint of trade. This was a decision in a suit in equity, brought by the United States requesting a decree dissolving the association.

The Cement Manufacturers Protective Association was formed in January, 1916, with a membership of eighteen portland cement companies operating in the Eastern states. Similar associations were also formed in different sections of the country. It should be noted, however, that none of these associations has any connection whatever with the Portland Cement Association, which is an association of practically all the cement companies in the country for technical purposes. According to Judge Knox's statement in the case, the Eastern association was formed with the following clause in its constitution:

> The objects of the association are the collection and dissemination of such accurate information as may serve to protect each manufacturer against misrepresentation, deception and imposition, and enable him to conduct his business exactly as he pleases in every respect and particular, free from misdirection by false or insufficient information concerning the matters following, to wit—(a) information concerning credits; (b) information concerning contracts which have been made for the delivery of cement, sufficiently complete to enable the manufacturer to protect himself against spurious contracts and like transactions induced by misrepresentation; (c) information concerning freight rates on cement; (d) statistical information as to production, stocks of cement and clinker on hand, and shipments.

Association Activities—The judge then goes on to outline the operations of the association. He states that it undertook the collection and distribution of information on accounts outstanding, bills receivable, accounts in attorney's hands for collection, contracts made and in effect, contracts cancelled, a statistical statement of production and shipments during the preceding month and stock of cement and clinker on hand, and finally the preparation and distribution among members of a complete schedule of freight rates on cement, giving rates for rail, water, and rail and water shipments. Judge Knox then calls attention to the so-called "specific job" contracts, which are agreements whereby a manufacturer is to deliver in the future the cement to be used in a specific work, such as a particular building or road, and the obligation is that the manufacturer shall furnish, and the contractor shall take, only such cement as is required for or used for the specified purpose. In the year 1921, such contracts covered about 30 per cent of the annual cement production of all the defendant corporations.

Reference is then made to the bag-refund practice common among all cement companies and to the practice of basing all prices on a common mill basis.

In commenting upon the various procedures, the judge calls attention to the use of the freight rate books. He said that the publication of freight rates is obviously harmless, but that their vice resides in the fact that there is a concert of action upon the part of defendants in so using them that all prices quoted are for delivery at the point required by the purchaser, and that no cement will be sold in such manner as will permit a purchaser to take advantage of cheaper transportation charges than are required to be paid for the shipment of cement by rail. In extenuation of the practice, it was claimed that this method of marketing cement is a trade custom which came into being before the formation of the association, and is in no way to be attributed to agreement or any activity of the association.

Similarity to Early Association—The Judge says: "Very probably there is no agreement now in force by which such practice is to be followed. The custom, however, was at one time the subject of an agreement to which thirteen of the corporate defendants were parties, namely, the Articles of Association of Licensed Cement Manufacturers, dated June 30, 1909. This agreement, whatever may have been the justification for its existence, obligated each licensed dealer named therein to observe certain practices, which if they were now the subject of contract, would without doubt entitle the government to the relief sought. It is not without interest to note the similarity existing between the uniformities and facilities now availed of by defendant corporations, and the practices observed by a number of them under the license agreement, which seem to have then been regarded as helpful, if not essential, in an endeavor to maintain prices and to apportion territory."

Judge Knox then cites a number of extracts from the proceedings of the association which, in his mind, tend to show that the object of the statistics was to provide each manufacturer with information regarding the business of the other manufacturer so that there would not be any wide variation in prices. The companies wanted to know the prices that the other companies paid for returned bags, which seemed to the judge to be an indication of the possibility of rebate in this system which the association was anxious to prevent. He criticises further, somewhat mildly, the specific job contract prices, which he thinks were mainly to make assurance doubly sure that over any future time there would be no "free cement."

He devotes some attention to the contention of the defendant that in such a commodity as cement, uniformity of price is bound to result in an open market, but he contends that in the cement industry, where there is a marked difference in production cost, in the financial necessities of manufacturers, in the location of mills as respects active markets, and where there is less than a capacity production by all manufacturers who desire to sell cement, it is reasonably to be expected that there will be a difference in the inducements to be offered to prospective purchasers. He said that in a purely competitive market, producers would not be content with a situation wherein the field of competition was limited to the personality of the salesman, which is, the judge believed, the case in the cement business today.

Judge Knox admits the contention of the defendant that ignorance is not a virtue and knowledge and information are not a crime, but he says that in this case the sources of wisdom and knowledge are not open to all interested persons upon more or less equal terms, and that the customers were not possessed of the same information as the producers were.

Summary of Ruling—Finally the judge concludes in the following words:

> There is, I take it, no need to find that the prices at which defendants sold cement during the period over which the association has functioned, were excessive. Indeed, as compared with the rise in the prices of other basic commodities, it is possible to say that the quotations of cement advanced less than others. Nor can it be said that the association overcame and destroyed all competition between the defendant manufacturers; upon many occasions, they were active in an endeavor to take business from companies associated with them. In some instances, they undoubtedly offered inducements to purchasers and thus secured orders that otherwise would not have been obtained.
>
> But, upon the whole, and without further discussion of the great mass of evidence which goes to make up this record, I think that real competitive effort tended to become more and more feeble, that manufacturers by reason of the exchange of statistics, were equipped to regulate their production, and by common consent and a concert of action, did so, to the end that the cement supply would at all times be a lap or two behind the demand, and thus created higher prices. In enabling this to be done, the association, its officers and agents, together with its membership, materially limited the full and free operation of the contending forces of competition to which the public, under the Sherman Law, is entitled, and unreasonably affected interstate trade and commerce.

In conclusion then Judge Knox states: "The government may have the decree for which it asks."

Changes Made in Washington Warehouse

The reference to the refrigeration in the article on the Terminal Refrigerating & Warehousing Co.'s warehouse in Washington, on p. 633 of the Oct. 18 issue of *Engineering News-Record*, should read "Refrigeration is provided by four compound motor-driven ammonia compressors which produce 450 tons of refrigeration; 1,100 hp. is required to operate the plant when running at full capacity, including elevators and all miscellaneous machinery." Plaster was applied to the insulation work with a trowel instead of a cement gun as originally proposed.

Structural Lessons Learned from Survey of Steel-Frame Buildings After Japan's Earthquake

Wilbur S. Sample, Engineer for Fuller Co., Inspects and Reports on Condition of American-Built Structures in Tokyo—Recommends Design to Resist Shocks

JAPAN'S earthquake of Sept. 1 failed to destroy—although it damaged slightly—the three large steel-frame office buildings which the George A. Fuller Co. of the Orient, a subsidiary of the New York firm of the same name, built in Tokyo a year or two ago. After the quake Wilbur S. Sample, engineer for the Fuller organization in Dairen, Manchuria, went to Tokyo and on Sept. 19 and 20, in company with Japanese architects and engineers, he inspected the N. Y. K., the Japan Oil and the Marunouchi buildings, all steel-frame structures seven to eight stories high. A thorough examination was made of the damage resulting from the earthquake, extending to every part of each building, from basement to roof inclusive, that could be seen without further demolition of standing work. The following report covers Mr. Sample's findings and recommendations for the first two buildings above named, a separate report on the Marunouchi building being substantially the same as the one below quoted. Additional data from the Marunouchi report are included in brackets. Otherwise the text below applies to all three structures:

Structural Steel—The steel frame in every case seems to have been of sufficient strength to withstand the dead loads and the sudden application of any superimposed loads due to vibrations caused by the earthquake and also seems to have shown a sufficiently high elastic limit to have returned to its original position in every case. That there was undoubtedly a marked momentary deflection laterally in the columns is evidenced by the shattering of a large percentage of the masonry piers surrounding or enclosing the exterior wall columns and of the plastered partitions between the steel columns of the interior. While the momentary and violent deflection of the columns laterally, particularly in the second and third stories, was of sufficient strength to shatter the enclosing or contiguous masonry, the agitation was not sufficient permanently to distort the columns in any case.

[In the Marunouchi Building the report notes "the distortion or destruction of the steel cross bracings which were added to the structure after the earthquake of 1922."]

Reinforced Concrete—Except where the principal bays or sections of the parts of each building joined together, such as the front wings or the side wings, there was no evidence of any destruction or distortion of the reinforced-concrete floor slabs. At the joints between the front and side wings there were some minor cracks in the floor construction showing through the corridor floor surfacing, and indicating that the several sections of the building vibrated independently from each other, the cracks being undoubtedly due to a very severe shearing stress at these points.

Where gravel reinforced-concrete walls were used on the interior and on spandrel walls there was a minimum amount of damage.

[In the Marunouchi Building "there does not appear to be any marked or serious damage to the reinforced--concrete floor slabs or beam coverings. Where reinforced-concrete walls were used on the interior there was a minimum amount of damage except at certain points on stairway walls near the west side of the building. This damage was probably due to the lack of continuity of these walls in a straight line."]

Masonry Piers—In practically 90 per cent of the exterior piers of the second and third [and "fourth," in case of Marunouchi] stories there was evidence of a violent lateral motion or vibration of the entire structure; this extended to a slighter degree to the piers of the first story and of the fourth ["upper," in case of Marunouchi] story. Above the fourth story there appears more or less destruction of exterior masonry but not nearly so pronounced as in the lower stories.

There appears to be no particular kind of facing material outstanding as successfully resisting the crushing and distorting effects of the lateral movement. Architectural terra cotta, cut stone, granite, stucco and tiles showed varying degrees of stability in the order given, the most successful being the last named.

Interior Partitions—The interior partitions in general are constructed of hollow clay tiles, metal lath on steel furring, concrete or reinforced concrete, all plastered on both sides. The hollow tile seems utterly unable to withstand the crushing effect of the lateral movement of columns, as evidenced by the crushing and falling of this class of partitions where the vibration was greatest or in the lower stories. In certain locations where metal lath partitions were used there was more or less damage but this damage was not nearly so pronounced as in the hollow clay tile partitions.

The concrete partitions behaved in a little better manner and the reinforced concrete partitions seemed to be the best of all, but there were some cases of a shattering of these by shearing horizontally along the center line of height, this occurring in partitions built of slag concrete.

Lighting Fixtures—The lighting fixtures in general were of brass canopies with opalescent glass globes, suspended from the ceilings by chain about 2 ft. long. The majority of the glass globes were destroyed by oscillating to such an extent as to strike the ceilings.

Marble Trim and Wainscoting—A portion of the marble finish of walls and columns in the first story was dislodged and destroyed, but as this work was done in the usually accepted manner there can be no thought of faulty workmanship.

In Conclusion

After the San Francisco earthquake of 1906 I attended many meetings of architects and contractors held to discuss various building materials and methods of construction with a view of adopting such as seemed to be the best suited for stability. Practically all of the reconstruction work in that locality was based on designs and materials similar to or the same as those used in Tokyo in recent years, and I believe the Tokyo buildings constructed by your company would have withstood the shocks of an earthquake of the same degree of severity as the San Francisco earthquake, with a minimum amount of damage.

Now comes the Japan earthquake of 1923 with such unprecedented severity and such a tenacity of violence that it becomes necessary for us all to readjust our ideas of construction methods and to adopt such designs and take such precaution as in our belief will provide a greater measure of stability for future structures and a consequent added security for the lives of those occupying them.

With this thought in mind I beg leave to submit for your consideration the following recommendations as to the design of buildings to be erected in locations subject to earthquake shocks:

Recommendations

Foundations—A close observation of the effects of the recent earthquake in Tokyo induces the belief that all foundations should be of friction piles capped with reinforced concrete, isolated pier spread footings, or a solid concrete mat without piles.

In the case of friction piles a number of test piles should be driven of different lengths and in several locations on the lot, each pile tested as to its bearing capacity and each foundation computed from the data thus obtained, allowing

a safety factor of 6 or 7. In no case should the piles be driven to hardpan or to refusal. Each cluster of piles should be capped with reinforced concrete and these caps connected at the top in each direction with reinforced-concrete struts.

In the case of isolated pier spread footings load tests should be taken in several parts of the lot at the proposed level of the footings and the size of each footing computed from the data thus obtained, allowing a safety factor of at least 5. These footings should be connected in each direction with reinforced-concrete struts.

In computing the loads to be carried by either the pile footings or the isolated pier spread footings only the actual dead-load of the structure should be used. No live-load should be figured, or at the least only a very small percentage. Care should also be taken to have the bottoms of all footings at the same level, and deep basements should be avoided.

In the case of a solid concrete mat foundation the mat should be of sufficient thickness and figured for reinforcement to withstand the actual pressure on the ground as determined by computation of dead-loads, and should project sufficiently beyond the outside columns to avoid eccentric loading.

The foregoing recommendations are due to a belief that the soil underlying Tokyo will act as a sort of shock absorber as evidenced by the behavior of such buildings as Seiyukai Building, the Imperial Hotel, and the several other office buildings in Marunouchi. If the foundations or the piling under them are of such length as to reach solid strata then the full severity of the earthquake shock is transmitted through the foundations to the entire structure, while if the foundations rest on a soil of somewhat resilient nature the transmission of shock will be very much less.

Structural Steel—Columns should be placed in straight lines in each direction so that at every panel there will be a maximum number of points of resistance. The sections of columns should be as wide as possible in each direction and should be connected at each floor by girders as deep as the requirements for head room will permit. Both columns and girders should be latticed if the computation of stresses does not require solid web plates. If solid webs are required then the webs should be punched at frequent intervals to permit of the proper application of reinforcing steel as will be hereinafter discussed. Between the girders at each floor will be necessary steel beams for carrying the reinforced-concrete floor slabs.

In cases where head room or clear interior spaces are absolutely necessary then resort must be had to knee braces. It is recommended however that such rooms as absolutely require great height or clear interior be placed on the top story or as near thereto as possible. Rivets for connection of girders to columns should be in shear, wherever possible. Rivets in tension should be studiously avoided.

Reinforced Concrete—In all cases the specification for the mixture for reinforced concrete should be made after a study of the screen analysis of the coarse and fine aggregates available for use. No assurance of success can be had by the adoption of arbitrary proportions for the materials to be used. The water content should also be carefully considered and only a sufficient amount of water used to enable the practical working of the concrete into the forms.

Exterior piers around steel columns should be of reinforced concrete and as large as possible, extending from the frames of openings on each side and from the heads of window frames below to the sills of window frames above.

Interior columns and connecting girders should be entirely covered with concrete, thoroughly reinforced around and through the columns and longitudinally.

Build solid reinforced-concrete walls wherever possible between columns in the interior and also around such places as elevator shafts, stair wells, pipe shafts and vent shafts.

Wherever possible build solid reinforced-concrete walls from basement to roof and from outside to outside walls of building, leaving only such openings as are absolutely necessary for ingress and egress and reinforce the perimeters of such openings in a thorough manner.

Exterior Facing—Avoid the use of brick or stone veneer if possible, using only stucco work or thin tiles. Forming the outlines of projecting cornices, belt courses, etc., as largely as possible in reinforced concrete.

Partitions—If impracticable to use reinforced-concrete partitions the next best in the order named are metal lath on steel studs, solid brick, hollow brick, hollow clay tile. Reinforced concrete is, of course, recommended because of the additional stiffness thereby awarded to the structure as a whole, but if this seems to be impracticable then use metal lath.

Lighting Fixtures—Lighting fixtures should be either indirect system secured flat against the ceiling or should have stiff suspension.

Marble—Use a minimum amount of marble slabs if the marble is to be attached to walls or columns.

Separate Roadways for Commercial Trucks

By Alexander Howard Nelson
Engineer for Atlantic County, Atlantic City, N. J.

On account of the interstate feature of automobile traffic, and probably because of discrimination through the variation in the fees being charged by different states, the whole matter of motor-car license fees might very well be taken over by the federal government and the net receipts distributed among the various states in direct proportion to license values.

Determination of the actual damage done by trucks can very accurately be arrived at by methods somewhat similar to those employed last year in the Bates experimental road tests in Illinois. Having determined damage and used it as the maximum fee, it would be a comparatively simple matter to plot a mathematically correct curve that would disclose, on inspection, the proper license fee to be charged any other truck on solid tires whose capacity and maximum speed were known.

In a similar way, the maximum license fee for trucks equipped with pneumatic tires could be determined and a similar curve plotted that would immediately disclose the proper license fee to be charged any other truck of that class.

The general proposition of having a roadway for trucks separate from the roadway used by pleasure traffic, constructed and maintained from the license fees to be paid on commercial trucks, is practical but it necessarily involves a considerable period of time to bring about, and what is necessary at the present time is immediate relief from the condition in which we find ourselves. The simple expedient is to increase commercial truck license fees, immediately widen most of the present main arteries of travel used by commercial trucks and, at the same time, commence the construction of parallel lines that will be devoted to the exclusive use of truck traffic and such limited, local pleasure traffic as may be necessary.

If it cannot be brought about that the federal government takes over the licensing, controlling and providing for commercial truck traffic, then by all means the various states should promptly determine, by appropriate joint action, a uniform and adequate system of license fees, maximum allowable weight, speed and size, together with an exactly uniform set of rules and regulations controlling all features of commercial truck traffic on public highways.

Commercial trucks which are devoted to strictly local traffic and not in direct competition with railroads should be licensed on a different basis from those which are engaged in long-distance hauling that is in direct competition.

Letters to the Editor

This department aims to be a farum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Eccentric Heel Joint

Sir—Summarizing the discussion on heel joints of roof trusses in your issues of Aug. 30, p. 339; Sept. 13, p. 447, and Oct. 4, p. 568, it is worth pointing out that your correspondents, while differing in methods, are practically agreed on results.

Edward Godfrey's solution will furnish accurate values for flat roofs, and it may be committed to memory. However, it will give the direct stresses in reversed direction. This, too, has to be remembered. Formulas, when available, will give quicker results.

Attention should be called to a typographical error in Mr. Godfrey's sketch. The sum of the shears at C and T is $R(p - l)/p$ instead of $R(p - l)/l$. To be consistent, arrow heads at C, T and O should be opposite to that of R.

The assumption, $l_1/I_1 = l_2/I_2$, which Mr. Weiskopf suggests, is a simplification at the expense of accuracy; but in a given case the error lies within control of the engineer.

Bethlehem, Pa., Oct. 11, 1923.

Camillo Weiss, Structural Engineer.

Slump Tests, Religion, and Drinking Water

Sir—Recently the Engineers' Society of Western Pennsylvania took a trip to Detroit and viewed some engineering work in that city. We were entertained by the Engineers' Society of Detroit, and the entertainment was all that could be desired. We had luncheon in one of the largest office buildings in the world and inspected the largest filter plant in the world.

One of the most impressive things we saw was that apparently non-dividend-producing thing called housecleaning. It was evident in the plant where they squirt out the Fords, in the Detroit-Edison power plant, and in the water-works. Sweeping down the outside walls of a power plant, sweeping up the floors of a factory and a steel plant, painting with aluminum paint the bustle pipes of a blast furnace, to say nothing of burning coal economically and completely by using stokers outside, no doubt, of the smoke consuming zone: these things are worth while, but we could name localities where they do not mean anything, if we wanted to be disloyal.

It was only a few years ago that our leading doctors were telling us that it was useless to filter water, that a germ could squirm through any filter made, and that the only safe way is to boil the water 10 or 15 minutes.

Here is Detroit with a plant that is capable of converting 400,000,000 gal. of river or lake water into safe drinking water every day, and the proof of it is the great reduction in the death rate due to typhoid fever.

The church and its founder are often criticised because they have no social program, simply cleansing the fountain-head, the source of all evil and good, the individual heart, and these critics would, by mass psychology, correct the actions of men—boil the water at the faucet. This, of course, is religion, but even engineers can think and talk along religious lines if need be.

A thing that impressed me about the reinforced-concrete filter tanks is the fact that in large areas there is no provision for expansion and contraction other than the steel reinforcement. I asked about the method of waterproofing. No waterproofing—simply fluid concrete. Any leaks? No.

Investigators are making thousands of tests with the sole aim of discovering how to make concrete of the absolute maximum strength, and water content of the absolute minimum is all they can see. High compressive strength is of minor importance, and the attaining of it is very uncertain, because it requires extreme care and expert supervision.

Density and impermeability and ability of the concrete to flow readily around the reinforcing steel are of the utmost importance, and these can only be attained by the use of fluid concrete.

Men everywhere are ridiculing and condemning the slump test, and with reason. I should like to ask any advocate of the slump test, and the stiff concrete that the application of any slump test implies must be used, what slump test he would recommend for the enormous girders illustrated in your issue of July 5, 1923, p. 7, where the tremendous volume of steel in the balcony girder of a theater in Los Angeles allows room for not much more volume of concrete than that of the steel. This is massive concrete. The latest Joint Committee Report gives a slump test of 2 for this character of construction. Is there an engineer living who imagines that concrete of such consistency could be worked around this steel or that concrete remotely approaching this consistency would be appropriate here?

Edward Godfrey.

Pittsburgh, Pa., Oct. 9, 1923.

In Defense of the Cement Companies

Sir—I have read with much interest the letter from O. T. Reece, county engineer, Neosho County, Kansas, which appeared in *Engineering News-Record*, Oct. 4, 1923, and in which he refers to certain methods of marketing cement.

The cement company with which I am connected has its plant in the Lehigh Valley. I have no knowledge of the marketing methods of the cement companies to which Mr. Reece refers, but inasmuch as his letter apparently assumes that the marketing methods to which he objects are those of all cement companies in the United States, let me call attention to the fact that in this section of the country the situation to which he refers has not arisen in our dealings with our customers.

As a matter of fact, we are selling cement direct to the state highway department of Connecticut and have signified to at least one other state governor our willingness to sell direct to that state. In one very recent case we offered to sell direct to the state highway department of Pennsylvania but in that state the purchases of cement are made direct by the contractors doing the work.

It is true that we have sold these contractors generally through dealers but we have found no objection on their part to this custom. Apparently the dealers in this section can, with a reasonable margin of profit, cover services which they perform for the contractor.

I have never heard of such sums as Mr. Reece mentions, "from 25 to 60c. per barrel," going to any local representative of our mill or any dealer handling our product. On the contrary, dealers in Pennsylvania through whom we have received contracts for state highway work have taken a profit of as low as one, two or three cents per barrel. In one case with which I am familiar, and in which they received as high as 10c. per barrel, we were unwilling ourselves to handle the account direct on account of a question in our own minds as to the credit rating of the contractor concern. Nor have I ever heard in this district of any such "margin" as Mr. Reece refers to "in one case 76 cents per barrel and in another 87 cents per barrel."

Of course, the principal reason for our selling the large percentage of our cement through dealers is that it is apparently the desire of our customers in this section to do business in that way.

Mr. Reece also refers to "association rules" in connection with the marketing methods to which he objects. The only association of cement companies that I know of is the Portland Cement Association which has nothing whatever to do with marketing methods or the price at which cement is sold. It is an organization devoted entirely to the promotion of the use of cement; to technical research; and to the assistance in the proper use of cement in highway and building construction.

Joseph Brobston, Vice-president, Dexter Portland Cement Co.

Nazareth, Pa., Oct. 22, 1923.

Critical Tests for Earth Dams, With or Without Cores

Sir—The recent failures of earth dams and the variety of causes assigned bring us squarely to a consideration of the action that takes place when an earth embankment is subjected to its initial saturation, or to a renewed hydrostatic pressure after being allowed to dry out for a long period.

Observations taken during the initial test of 200 miles of canals and laterals, and more than twenty earth-fill dams, constructed during different seasons of the year, and involving various amounts of moisture and compacting, on dams up to 120 ft. in height, and on fills for embankments ranging up to 50 ft., have defined some critical periods which may or may not recur for the same structure.

A loose earth dyke on being first subjected to hydrostatic pressure will rapidly become saturated on the water face, and for varying depths within the mass, dependent upon the porosity and degree of compactness. As the surface of the reservoir rises, the plane of saturation progresses upward, coinciding with the hydraulic gradients for the given material at the various elevations. The portions will become saturated and subjected to settlement in the numerical order shown by Fig. 1. Resulting from the subsidence of any given section there is a tendency for caverns of arched tunnels to form, inviting a free flow of water

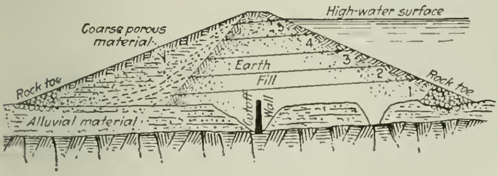


FIG. 1—SUCCESSIVE PLANES OF SATURATION

farther into the interior of the embankment, until the degree of saturation and weakening of the cohesion causes a caving of additional material from the roof section. A critical period arrives for the dyke every time one of the tunnels or caverns retains its roof intact for a considerable period, allowing free access of water flowing to the interior, and tending to form a blister or lens of liquid under pressure near the downstream face. If a well compacted stratum is encountered, such as would result from highway traffic across the fill during a lull in the construction, the roof of the cavern or tunnel may endure until an accumulation of water or a channel has been so thoroughly established as to cause the certain and rapid failure of the dam. However, the agitation of the body of water due to the falling masses from the roof, causing a sort of surge and water hammer action, usually insures the continuance of the caving process and thus prevents the formation of a long tunnel or a cavern of great dimensions.

All earth dams that function must undergo a similar test at least once, the saturation and subsidence and forming of vaulted caverns differing only in degree from the extreme case above described. The dry fills confining the sluiced materials of hydraulic-fill dams are subjected to the test during construction; and it is safe to assume that all recurring ones will be less severe. Dams provided with a complete cutoff and corewall (Fig. 2) or with durable and effective sheetpiling cutoff surmounted by the impervious diaphragm and adequately connected with the canyon walls, undergo saturation for only the upstream section. The downstream portion, constituting at least 60 per cent of the structure, is nearly constant in volume, and unless actually overtopped by floods it will remain indefinitely. The presence of the corewall prevents the movement of currents of water in the saturated upstream portion, and hence prevents the loss of the soluble elements.

Failure of Apishapa Dam, Colorado—From the various accounts of the construction, behavior, and failure of the Apishapa dam it appears evident that the initial saturation of the upper strata of this structure was attended by the formation of the tunnels and cavernous structures above described. No doubt this was accentuated by the loss of soluble materials. Mr. Mann's judgment concerning the probable settlement of 5 ft. after filling appears to be justified. If the roofs of the caverns and tunnels that caused the main leaks at Points A and B of the plan appearing in *Engineering News-Record*, Sept. 13, 1923, p. 419, could have been made to cave in and check the flow while the saturated material settled to its proper place to fill the sharp crevasses along the planes of cleavage, where the main fill evidently faulted due to its greater subsidence, it is quite probable that the structure would have remained intact. McMillan Dam on the Carlsbad Project, New Mexico ("United States Irrigation Works," by A. P. Davis), was saved under very similar conditions in 1914 by the prompt discovery of the well defined channel, and the temporary closure with sacks of earth.

The Avalon Dam, New Mexico—Prior to the adoption of the Carlsbad Project, New Mexico, by the U. S. Reclamation Service, the Avalon dam on the Pecos River had failed twice; the first time in 1893 by overtopping; the second time in 1904, probably from causes similar to those at the Apishapa dam and to the threatened failure of the McMillan dam above referred to. The U. S. Reclamation Service installed a combination of reinforced-concrete core-

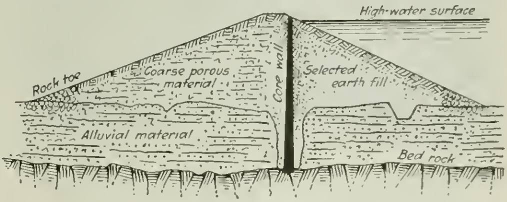


FIG. 2—CROSS-SECTION OF EARTH DAM WITH COREWALL

wall and steel sheetpiling surmounted by a riveted steel diaphragm.

Quoting from Mr. Davis's treatise, referred to above: "The provision of a corewall was an innovation upon the usual Western practice, and especially that of the Reclamation Service. Its necessity arises from the presence of a large percentage of soluble salts in the earth available for the embankment. In use, the slow percolation of water through such a bank gradually leaches out the soluble matter, leaving the bank more and more porous, and it soon becomes unreliable as a barrier against water. The corewall is thus made necessary, and also serves the purpose of preventing destruction through the ravages of burrowing animals."

Failure of the Schaeffer Reservoir Dam, Colorado—The great flood at Pueblo, Colo., June 3 to 6, 1921, was prolonged at a destructive stage by the failure of the Schaeffer reservoir dam suddenly on June 5. The freeboard from the floor of spillway to the crest of the dam was 10 ft., and failure occurred with only a 4.5-ft. depth on the spillway. To an observer who witnessed the failure, the water appeared to give a great surge that overtopped the central 75-ft. section, and the reservoir was empty in about half an hour. It will remain a question whether the water surged over the central portion as a great wave, or whether subsidence of the saturated maximum section reduced the crest below the water level. Another question for speculation is the effect that a complete corewall or diaphragm would have produced, at both the Schaeffer and the Apishapa dams. It is probable that 5 per cent of the cost of an earth dam will provide a complete diaphragm or corewall, especially where the cutoff walls are already installed and the core construction keeps pace with the earth fill.

Modern engineering practice, wherever earth dams are extensively used, has tacitly recognized that percolation will take place through such structures unless stopped by

such positive means as a corewall or a diaphragm. An eminent engineer who failed to accept this fact very naturally condemned a large dam then under construction because of the coarseness and lack of cohesion of the downstream section. He built another dam conforming to his idea that the downstream portion should be just as impervious and cohesive as the upstream face; this dam failed, probably due to inadequate drainage of the percolating water; while the dam condemned by his judgment on account of its coarse pervious downstream section is listed among the successful earth structures, in standard engineering works.

Dry earth embankments have been built during emergency conditions with a double-lap plank diaphragm; and when subjected to hydrostatic pressure which caused marked settlement and consolidation of the upstream section, the timber diaphragm functioned perfectly and retained its original alignment very closely.

The writer has been unable to discover a single case on record where an earth dam with complete corewall or

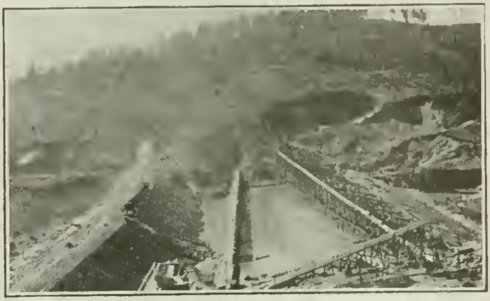


FIG. 3—HETCH HETCHY HYDRAULIC FILL DAM WITH COREWALL; UNDER CONSTRUCTION, OCT. 8, 1922

diaphragm has failed except through overtopping or a defective tunnel. It seems to be well established that the best insurance that can be provided against failure, either under the initial or the recurrent tests to which earth dams are subjected, is a complete cutoff and corewall or diaphragm from foundation to high-water level. The Hetch Hetchy Project for San Francisco's water supply includes a hydraulic-fill dam with corewall (Fig. 3) that represents the best practice for such construction.

Phoenix, Ariz., Sept. 27. C. S. JARVIS, Civil Engineer.

Highway Accidents at Railway Crossings

Sir—The abatement of automobile accidents at railroad grade crossings is a problem which deserves very intensive and extensive study by the greatest possible number of people. There is much need, however, that those who concern themselves with this problem should keep their judgment well balanced. They should realize that only a small percentage of automobile accidents occur at grade crossings, that proposed methods for their elimination should be such as to appeal to people as reasonable and sensible and that before enactment any proposed law should be tested in actual practice by representative automobile drivers from different parts of the state and under varying conditions. There is much need for uniform state automobile laws.

Some railroad executives and others propose as one method of prevention that all automobiles shall come to a full stop at all railroad grade crossings. A method which better appeals to the reason is contained in an opinion rendered by Justice Charles C. Van Kirk, of the Appellate Division of the Supreme Court of the state of New York. In this opinion Justice Van Kirk said, "The safe limit to speed in approaching a crossing is that speed at which the driver of an automobile, as he arrives at a point where he can see an on-coming train, when it is near enough to render crossing ahead dangerous, can stop his car if necessary before he reaches the track. If he cannot see without stopping he must stop."

It may be advisable to delegate to state public service commissions or similar bodies the power to post at blind crossings, notices requiring automobile drivers to stop their automobiles before making such crossings, but if thirteen million drivers in the United States should be required to come to a full stop every time that they make a crossing where an extended view of the track is available the greatest possible impetus would be given to the plan of separating at once all grade crossings.

More care should be exercised by state highway departments to eliminate grade crossings when practicable during the reconstruction of state highways. In one state two grade crossings at which there have been several deaths and two or three automobiles demolished could have been eliminated at a cost of but little more than the amount expended in improving the road connecting those crossings. A device which would save many lives would be to paint on the sign at a crossing the number of tracks at the crossing. People frequently see one train pass the crossing and, thinking it to be a single track and that there will be no more trains, run onto the crossing only to be struck by a train on another track.

It might be desirable also to empower a state public service commission after studying the conditions at a dangerous crossing to require the train to stop before proceeding over the crossing or to slow down so that it can stop to avert an accident providing that there are but few trains per day on the railroad at that point while there are many crossings per day by automobiles.

The whole endeavor should be to secure as much safety to the careful driver as practicable without enacting laws which needlessly impose burdensome restrictions upon him. The careless driver is hard to reach. In one state the law requiring all automobiles to come to a full stop before crossing a grade crossing seems to be about as effective as the non-tipping law. The constant effort should be to separate grade crossings as fast as is expedient.

More care should be exercised in the character of signs erected. On one state trunk line where the highway parallels the railroad and passes under the tracks by a right angle turn a large sign with circles like a target is erected with "STOP" painted in huge type. No one stops, it is not expected by those who erected the sign that anyone will stop. Thus the force of signs is weakened and the impression is created that the message on the sign need not be obeyed. CHARLES A. HOLDEN,
Director, Thayer School of Civil Engineering.

Hanover, N. H.,
Sept. 20, 1923.

Elimination of Plants from Reservoirs

Sir—In the course of my weekly perusal of your journal I have noted a reference to the trouble of one of your Colorado correspondents caused by water lilies (*Engineering News-Record*, Sept. 27, 1923, p. 509), and I venture to offer the results of my observations on this subject in the Far East, as they might possibly indicate another way out of the difficulty. In central China, where there are vast areas of waterlogged land, the natives collect the roots of the water lilies and dry them out to make a kind of flour, as you suggest. This food is appreciated only by the poorest of the inhabitants, so it is, apparently, of no great value. It is, however, quite noteworthy that the collection only goes on in water where the men reaping the harvest can stand on the bottom with the water just up to their arm-pits—say less than 5 ft. The men feel about for the roots with their feet and when they are discovered tear them up, to be taken away by the attendant sampan (native boat). Now it is noticeable that the lilies grow abundantly in water of the depth just mentioned; in other depths they do not flourish.

Might it not be possible, after allowing for climatic variations between Colorado and Hunan, to overcome your correspondent's trouble by either increasing or reducing the depth of water in which the lilies are growing?

London, England, Oct. 16, 1923. "PHILLIP"

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Highway Research Board to Hold Annual Meeting

National Research Council Body Will Meet in Washington November 8 and 9

The third annual meeting of the Advisory Board on Highway Research of the National Research Council is to be held at the headquarters of the Council in Washington, D. C., Nov. 8 and 9. The status of reasearch in the various fields of highway engineering and transport will be evaluated as the basis for further research in this element of highway transportation.

Besides routine matters which include approval of interim actions of the executive committee, appointment of committee on nomination of officers, and the report of the director, there will be reports of various committees as follows:

Report of Committee No. 1, on economic theory of highway improvement, chairman, T. R. Agg, Iowa State College.

Report of Committee No. 2, on structural design of roads, chairman, A. T. Goldbeck, U. S. Bureau of Public Roads.

Report of Committee No. 3, on character and use of road materials, chairman, H. S. Mattimore, Pennsylvania State Highway Department.

The above reports will be made on the morning of the first day's session and in the afternoon an inspection tour will be made of the new building of the National Research Council and the experimental farm of the Bureau of Public Roads at Arlington, Va. The evening session of Nov. 8 will include an address by Thomas H. MacDonald, chief, Bureau of Public Roads; a report upon highway research work of the American Association of Land Grant Colleges, by Dean Anson Marston, of Iowa State College; a report of Committee No. 6 on highway finance, of which Dr. J. G. McKay, U. S. Bureau of Public Roads, is chairman; and an explanation of the research program of the North Carolina State Highway Commission by Charles M. Upham, its chief engineer.

During the third session, to be held the morning of Nov. 9, a report of Committee No. 4, on highway traffic analysis, of which George E. Hamlin, of the Connecticut Highway Commission, is chairman, will be made. Committee No. 7, on maintenance, chairman, W. H. Root, will also report.

Aldred Lectures at M.I.T.

Massachusetts Institute of Technology has announced that the first of the twelve lectures under the course of lectures established by J. E. Aldred will be held on the afternoon of Nov. 9. Gerard Swope, president of the General Electric Co., will deliver this first lecture. A number of prominent men representing all branches of industry will address the following meetings, which are scheduled to cover the next five years.

Charles P. Steinmetz Dies

Dr. Charles P. Steinmetz, consulting engineer for the General Electric Co. and world famous electrophysicist and inventor, died suddenly at his home in Schenectady, N. Y., Oct. 26. He had returned but a week or two before his death from a tour of the Pacific Coast, and the exhaustion incident to the trip is presumed to have been indirectly responsible for his death.

Dr. Steinmetz came to the United States from Germany in 1889 at the age of 24, having been born in Breslau. He had received a thorough scientific training in his native city, in Berlin and in Zurich, Switzerland. His first employment in this country was with the Osterheld & Eichemeyer Manufacturing Co., Yonkers, N. Y., first as draftsman, then as electrical engineer and designer, and finally on research work in charge of the laboratory. With the absorption of the Eichemeyer interests by the General Electric Co. Dr. Steinmetz joined the latter organization, and for virtually the entire 30 years he was with that company, he was its chief consulting engineer.

Early in his career in America Dr. Steinmetz was made professor of electrical engineering at Union College. Later his title was changed to professor of electrophysics, and this chair he held until his death. He was granted an honorary Master of Arts degree by Harvard in 1902 and an honorary Doctor of Philosophy degree by Union the next year. He was a past president of both the American Institute of Electrical Engineers and of the Illuminating Engineering Society.

Dr. Steinmetz' 200-odd inventions were concerned largely with the transmission of power and the design of alternating current motors, though they also covered the magnetite-arc and other lamps, elevator motor appliances and electrically-propelled vehicles.

Coffin Medal Awarded

The Charles A. Coffin Gold Medal, created by the General Electric Co. for the best contribution to electric transportation, was awarded to the Chicago, North Shore & Milwaukee R.R. Co. at Atlantic City Oct. 11 at the annual convention of the American Electric Railway Association, the award being made on the basis of success in "giving service and telling the public its story."

Engineers See Coolidge on Federal Reorganization

Am. Soc. C. E. Committee Pleads for Unification of Non-Military Engineering Services

Washington Correspondence

President Coolidge evidenced great interest in securing the viewpoint of civil engineers concerning the question of government reorganization, particularly that having to do with public works, when Charles F. Loweth, president of the American Society of Civil Engineers, together with a special committee from that society, waited upon him Oct. 30 to present and explain a resolution adopted by the Board of Direction of the society. The President asked numerous questions and apparently was impressed by statements of the members of the committee that the creation of a Department of Public Works alone constitutes a plan of the greatest value in making possible numerous efficiencies in the conduct of the engineering and technical services of the federal government.

The President was assured of the civil engineers' interest as citizens in the general plan of reorganization. They pointed out, however, that members of their profession probably are qualified to advise most intelligently concerning that portion of the plan which affects reorganization of the Department of the Interior. The President expressed his appreciation of the tender by the engineers of any assistance, either to him or to his assistants, they could render in the development of the plan.

Letter Given Coolidge

The letter which the special committee handed to President Coolidge follows:

"As members of a committee appointed by the Board of Direction of the American Society of Civil Engineers, we come to present to you resolutions adopted by said Board endorsing and commending the recommendations of President Harding and his cabinet for the reorganization of the executive departments of the government, and more particularly those having to do with public works.

"For many years the engineers of this country have been keenly interested in the activities of the government in the field of public works. As a result of conditions developed during the war period an intensive study of governmental methods of administering public works was made by them.

"This and other efforts culminated in S. B. 2232 to create a Department of Public Works and define its powers and duties; and in bills before the House, H. J. Res. 339 and 390, to create a Joint Committee on the Reorganization of the Administrative Branch of the Government.

"Later, the engineers of the country were gratified by the recommendations of the President which were based upon

a careful study by the Joint Committee on the Reorganization of Government Departments authorized by the last-mentioned bill.

"The American Society of Civil Engineers is the oldest of the national engineering societies in this country. It has a membership of 11,000 from all parts of the country. Many of its members are thoroughly experienced in the administration of public works and affairs.

"This society bespeaks your active interest in this measure, particularly with respect to the provisions relating to the administration of public works, to the end that it may become law. The resolutions passed by its Board of Direction are attached hereto.

"The Board will be happy to be of service to you in this connection.

"Yours respectfully

"C. P. LOWETH, President and Chairman of Committee, Chicago

"WILLARD T. CHEVALIER New York City

"A. H. MARKWART San Francisco, Calif.

"LEONARD METCALF Boston, Mass.

"CHARLES H. PAUL Dayton, Ohio."

The resolution passed by the Board of Direction reads:

"RESOLVED: That the Board of Direction of the American Society of Civil Engineers endorses and commends the recommendations of the President of the United States and his cabinet, that the military and non-military engineering activities of the government be separated and that the design, construction and maintenance of non-military public works be assembled as far as practicable in one department, under one head, and that only those activities closely related thereto be included in that department. We also commend the effort to apply similar principles to all the departments, and to allocate the numerous independent offices to appropriate departments so far as possible. We believe such action will tend to eliminate duplication, to co-ordinate public activities, and in many ways to promote economy and efficiency in the public service.

"RESOLVED, That the president of this society be empowered to appoint a committee of five members of this society of which he shall be chairman, to present the above resolution to the President of the United States, and to appropriate officials of Congress, and of the executive departments, and to take such other action as it deems wise in furtherance of the principles above endorsed."

Highway Conference to Be Held at Michigan University

The tenth annual Michigan conference on highway engineering will be held Feb. 11-14 at Ann Arbor. The list of speakers will include engineers from the Michigan State Highway Department, county commissioners and engineers, municipal engineers, members of the faculty and prominent highway engineers from other states. The conference will be open to all highway commissioners, engineers, contractors and others interested in highway improvement. No fees will be charged by the University. The program will be issued in January, 1924.

Pueblo Soon to Receive Bids on Flood-Protection Work

Plans for flood-protection work in Pueblo, Colo., have progressed to such an extent that bids will be received within the next two months, according to advices from the Dayton Morgan Engineering Co., in charge of engineering. Work will involve the construction of a new channel for the Arkansas River through the city which shall carry 125,000 sec.-ft. of water; and building 34 miles of railroad track and a barrier dam 35 ft. high and 3,060 ft. long. The plan has been officially approved and benefits appraised upon which assessments will be levied. The total estimated cost of the project, including land and administration, is $4,000,000. The project was described in *Engineering News-Record* July 12, p. 48. Formal approval was given the plan by District Judge Park early in August. (*Engineering News-Record* Aug. 16, p. 280.)

New Bridge for Springfield

The city council of Springfield, Mass., has authorized the construction of a permanent bridge across the Connecticut River at a cost not to exceed $1,000,000, to replace the one destroyed by fire in September (*Engineering News-Record* Sept. 13, p. 449, Sept. 20 p. 488). The bridge is to be built jointly by the city of Springfield and the town of West Springfield, the first-named paying nine-tenths of the cost and the last-named one-tenth. Dr. J. A. L. Waddell, New York, has been chosen by the joint committee to prepare plans for a bridge, in which work he will not be restricted to any particular type and will submit plans for both steel and concrete structures. There has been no hard and fast decision as to cost, this being governed in a large degree by the material decided upon. On financial grounds a steel bridge is favored, but on the other hand there is considerable sentiment in favor of a structure that promises to be most durable, even though it shall cost more. Speed in the completion is also regarded as an important consideration. A tentative plan has been presented for a nine-span steel open-deck bridge, 1,126 ft. long and 66 ft. wide.

Los Angeles Considers Colorado River Water Supply

Acting under instructions from the Board of Public Service Commissioners William Mulholland, chief engineer of the Los Angeles Bureau of Water Works and Supply, has put surveying parties in the field to determine the feasibility of bringing water from the Colorado River to supplement the city's existing water supply. Mr. Mulholland, who suggested the possibility of a Colorado River source after a recent inspection trip, stated in reply to an inquiry from a member of the *Engineering News-Record* staff: "At the present per capita rate of consumption the city's water supply from Owens River sources is sufficient for 2,000,000 people but an influx of manufacturing enterprises may change that rate." The city has not yet obtained a government grant to divert Colorado River water.

Reclamation Conference for New Orleans

Forestry and Home-Making Topics Also Scheduled for Meeting Nov. 19-22

A conference on forestry, reclamation, and home making is to be held at the Hotel Grunewald, New Orleans, Nov. 19-22, under the auspices of the Southern Pine Association, the Florida Development Board, the Mississippi Development Board, and the New Orleans Association of Commerce. An exceptionally interesting program has been prepared with the discussion headed by the following principal topics:

Use of waste lands for creation as needed of opportunities for rural homes; best means for utilizing denuded and cut-over lands through reforestation, grazing and agriculture; a national and state policy for handling and taxing such lands; forestry problems—a systematic plan for better use of the forest resources of the country and for insuring a permanent and adequate timber supply for the nation; subsidizing settlers on reclaimed lands—need of aid furnished by national and state agencies to encourage permanent and prosperous settlement; revision of existing reclamation law to make it nationally applicable, instead of sectionally as at present, thus more effectively meeting the needs of the country in creating opportunities for homes; settlement methods—successful ways of securing and safeguarding desirable settlers who may utilize the lands now idle; grazing and development of the animal industry; selective immigration; and financing the rural home-maker.

RESOLUTIONS TO BE OFFERED

A series of resolutions has been prepared for discussion and possible adoption. Among the most interesting of these is the following:

"Resolved, that we request the Congress of the United States to consider the recasting of the entire reclamation law, making it applicable to all parts of the United States, eliminating conditions which make speculation easy and which have encouraged tenantry and promoted soil deterioration, at the same time extending the good features of the law so as to be applicable to the reclamation and best use of lands in whatever part of the country they may exist. Such development to take place at the time and in the manner to best promote the creation of opportunity for self-supporting farm homes. Also, that the organization of a reclamation service be provided for by law and be placed on a permanent basis. The reclamation act should be recast to provide a well considered bureau of service under a director or other officer selected for experience and ability, appointed by the President with the advice and consent of the Senate, and removable only for cause."

The executive committee has for its chairman C. S. Ucker, of Baltimore, Md. The headquarters of the conference are at 616 Real Estate Bank Building, New Orleans, La., or 904 International Building, Washington, D. C. The exact title is the Forestry, Reclamation, and Home-Making Conference.

Founder Societies Move Toward Co-operation

Joint Committee Agrees on Conference Committee Consisting of Presidents and Secretaries

A move toward more active co-operation of the four national engineering societies was made on Oct. 29 when a joint committee of the societies adopted a report recommending the formation of a Joint Conference of the four Founder Societies with a membership consisting of the presidents and secretaries of the societies. The report will be submitted to the governing bodies of the societies as soon as possible and when accepted by each will be put into force. It was adopted Oct. 29 by the Council of the Mechanical Engineers.

In anticipation that this report will be adopted by the other three Founder societies a meeting of the Joint Conference Committee has been called for Dec. 10 at the Engineering Societies Building, New York, to consider any business that may be brought before it and particularly to consider the possible enlargement of the activities of Engineering Foundation.

The report reads as follows:

"At the meeting April 16, 1923, of the Board of Direction of the American Society of Civil Engineers the appointment of a committee of five, the chairman to be the President, was authorized 'to confer with the officials of other national engineering societies with a view to formulating some permanent, workable method of joint co-operation on public matters and report its recommendations to the Board.' Invitations to appoint members of such a joint committee on co-operation were promptly accepted by the three other Founder Societies. At the first meeting of the joint committee July 24, 1923, a thorough discussion of co-operation was participated in by all sixteen members present. As a result a subcommittee, consisting of the presidents and the secretaries of the four Founder Societies, was authorized to report at the next meeting of the joint committee on two matters, as follows:

"1. The possible fields and means of joint co-operation of the four Founder Societies.

"2. Possible modifications in the Federated American Engineering Societies.

Means of Co-operation

"With reference to the first matter, your committee has given careful consideration to the possible fields and means of joint co-operation of the four Founder Societies. There are many activities on which the four Founder Societies have been co-operating for many years, and in regard to which they should continue to confer in order to exchange information, determine policies, and secure concert of effort in the execution of these policies. The following lists of such activities are submitted as representative only, and are not intended to be inclusive or exhaustive. It is recognized that the activities listed fall into two general classes; first, those which concern both the four Founder Societies and the whole engineering profession; and second, those which concern only the four Founder Societies. In the arrangement of the lists, no importance whatever should be attached to the order in which the activities are given.

Activities Which Concern Both the Four Founder Societies and the Whole Engineering Profession

1. Engineering education.
2. Professional ethics.
3. National and state legislation of interest both to the public and to the engineering profession.
4. Registration of engineers.
5. Co-operation with other organizations.
6. Preservation of efficiency in public offices requiring engineering knowledge, as exemplified by the office of Director of the United States Reclamation Service.
7. Local Sections. While at first thought it may appear that local sections are the concern of only the four Founder Societies, yet it should be remembered that the American Society of Automotive Engineers and several other societies have their local sections, and that furthermore, the activities of these local sections are closely related to the activities of many local and regional engineering clubs.
8. The Engineering Employment Service. While this service is at present restricted to the members of the four Founder Societies, it is anticipated that there is some possibility of the scope of the service being widened in the future.
9. Research.
10. Standardization.
11. Publicity.
12. Engineering abstracts and indexes.
13. International engineering congresses.
14. International relations.
    - (a) Foreign relations.
    - (b) The exchange of courtesies as in the case of exchange professors to the United States from foreign countries.
    - (c) The Kelvin Medal.
    - (d) Pan-American relations, such as those in the field of standardization.

Activities Which Concern Only the Four Founder Societies

15. Administration of the joint property by the United Engineering Society.
16. The Engineering Societies Library.
17. Engineering Foundation.
18. Joint professional meetings.
19. Arrangement of the yearly schedule of time and place for regional meetings and conventions.
20. The award of the John Fritz Medal.
21. Student branches.
22. The technical and professional divisions and committees of the four Founder Societies.
23. Joint committees, including both the technical committees and the non-technical committees, such as the Joint Finance Committee.

"In view of these and similar inter-society activities it is recommended that the policy of co-operation followed for many years past by the four Founder Societies be fostered in the future. As to the machinery necessary to bring about the proper co-ordination of effort of two or more of the societies, it is believed that at the outset a Joint Conference Committee consisting of the four presidents and the four secretaries would be an effective means of giving preliminary consideration to the various problems, of suggesting the policy to be followed in each case and of recommending the procedure for carrying out these policies, using as far as practicable existing agencies. The first chairman of the committee, for a term of one year, should be the president of the American Society of Civil Engineers, and thereafter the president of each of the four Founder Societies in order of seniority. Whenever a president or a secretary cannot attend a meeting of the committee he should appoint an alternate.

"In regard to the second matter upon which the subcommittee was asked to report, namely, possible modifications of the Federated American Engineering Societies, your subcommittee feels, since the representatives of some of the societies who are not, or may not be, members of the Federation might not wish to be placed in the position of recommending changes, that consideration of this phase of the problem should be postponed, particularly as a committee of the Federated American Engineering Societies is now considering this very thing.

Respectfully submitted,

American Society of Civil Engineers
Charles F. Loweth, President
John H. Dunlap, Secretary

American Institute of Mining and Metallurgical Engineers
E. P. Mathewson, President
F. F. Sharpless, Secretary.

American Society of Mechanical Engineers
John Lyle Harrington, President
Calvin W. Rice, Secretary

American Institute of Electrical Engineers
Dr. F. B. Jewett representing President Harris J. Ryan
Calvert Townley representing Secretary F. L. Hutchinson

Subcommittee of the Joint Committee on Co-operation"

Philadelphia Engineers Hear Talk on Japanese Earthquake

Interesting sidelights on the Japanese earthquake were presented before the Engineers' Club of Philadelphia on Oct. 23, by Dr. Judson Daland, who recently arrived home from Japan. Dr. Daland was in Tokyo on Sept. 1 when the earthquake occurred going from Tokyo to Kobe afterward.

Recovery from the earthquake, according to Dr. Daland, has been hampered by three things: first, a general hysteria that seized the people, and that roused up race hatred with the Koreans; second, a dazed condition of people in which they seemed unable to start about reconstruction work; and third, the action of the Japanese government in refusing to give information about the disaster.

In Tokyo, Dr. Daland said that no production had been started as long as six or seven days after the earthquake. The Japanese government has been persistent, he asserted, in withholding information about the extent of the disaster.

What's Ahead in Business, as Judge Gary Sees It

Extracts From Address of Steel Head at Iron and Steel Institute Meeting in New York

"It is doubtful if our government can at present be of much assistance in attempts to restore the equilibrium of Europe. Voluntary advice or sympathy just now would not be acceptable. Practically, we can be of benefit only by example.

"It would not be appropriate for us to take sides in European controversies nor to condemn individual attitudes or conduct; but we know the great seas are not wide enough to separate us from the influences of disaster in Europe. We are affected in our finances, our commerce, our industries, our civic, political and social life and our morals. Citizens of Europe are embarking for the United States whenever possible; not always the most worthy are included, which is a pity. Their ideas permeate our social and business life. The whole structure of civilization has been shaken.

An Independent Nation

"If the European atmosphere and conditions dominated our affairs, our business men might be depressed and somewhat doubtful of the future; but fortunately they do not. We are, or at least we may be, independent of all other countries so far as business progress and prosperity are concerned. If we properly conserve and utilize our natural resources and legitimately manage our private and public affairs, availing ourselves of the opportunities that are presented, we may and will continuously and adequately prosper.

"There will be temporary interruptions, recessions, and there will be fluctuations, but the man of business courage, with a reasonably clear vision of the long future, pays little attention to temporary hesitation in business progress. He knows that the current of prosperity in the United States is so strong that even though it may be occasionally modified by unnatural or unreasonable obstructions, this will result in accumulation of volume and force which will soon be overwhelming and stronger than ever before.

"What is the disposition of the President concerning the affairs of the country? This is shown by a statement recently made by one occupying a prominent official position as follows: 'It is very evidently the aim and effort of the administration to encourage in every way policies in both business and politics which will tend to the elimination of agitation. The very evident desire in all governmental quarters is to extend the fullest assistance to the constructive forces of the country. The removal of elements of uncertainty and of misgivings, and the stabilization of business conditions, are a constant aim, and the feeling among those most familiar with the reflections of the business situation is that substantial progress is being made along these lines.'

"It is also important to know the opinion of the Administration concerning the present trend of business. This likewise was referred to by the same authority already mentioned, as follows: 'The impression in Washington seems to be that industry throughout the country is proceeding on a commendably conservative basis, with avoidance, so far as possible, of unnecessary advances in prices, or avoidable expansions which would engender keen competition for labor. With a continuance of this general attitude, it is felt that business should continue generally good for the remainder of this year. While there is reticence about making prophecies for the future, the general opinion seems to be that if this attitude continues there can be reasonable assurance of a projection of generally satisfactory business conditions at least well into next year.' It is believed these statements represent the mind of President Coolidge.

Deeper Hudson Advocated

Special Correspondence

During the past three weeks there has been a revival of the boom for a deeper Hudson staged principally through the Albany newspapers.

This revival is said to emanate from those who want the Hudson dredged to a 27-ft. channel to Albany and eventually the Barge Canal deepened into a ship canal as an offset to Canadian projects.

The cities in the Capitol district have gone so far as to get together and form a committee; also to engage the Technical Advisory Corp., of New York City, to collate data regarding shipments of freight through Albany which is to be presented to the War Department and later to Congress with a request for an appropriation.

The dream of Albany is to become a seaport and bills will probably be introduced in the next legislature providing for a state appropriation for terminals and a law providing for a Greater Albany Port Authority.

There are those in Albany who cannot take the project seriously. They say that after the expenditure of forty or fifty millions boats 700 ft. long will come up to Albany direct from Liverpool and readily turn around in a 250-ft. channel. In the winter time the Hudson River will be heated with electricity generated in the St. Lawrence River so as to keep navigation open. Albany will become a seaport town with a population of 5,000,000; water front saloons with 5-cent whiskey and 3-cent beer will be established and New York City will be just a port of call. When help is scarce it will not be infrequent to see ocean going steamers go up onto Capitol Hill and shanghai a crew out of politicians.

Ohio Highways and Public Works Personnel Announced

L. A. Boulay, the new Ohio Director of Highways and Public Works, announces appointments, for the eleven divisions, of division engineers and assistant engineers, respectfully, as follows: Division 1, F. A. Daum and R. W. Fry; Division 2, M. I. Henahan and F. R. Bell; Division 3, T. S. Brindle and E. R. Graham; Division 4, F. E. Swineford and Q. A. Campbell; Division 5, W. G. Smith and C. B. Shaw; Division 6, R. S. Beightler and F. C. Higley; Division 7, H. C. Miller and G. D. Scheuneman; Division 8, H. A. Nunlist and H. W. Walsh; Division 9, J. W. Graham and R. Z. Myers; Division 10, G. E. Carr and O. W. Merrell; Division 11, W. C. Fawcett and H. R. McCoy.

Random Lines

On a Certain Condescension

He wore rather conspicuously the blue shield of the American Society of Civil Engineers and dangling from his watch chain was the gold badge of Tau Beta Pi. Quite obviously he had been trained and had worked as a civil engineer. But when some simple engineering question came up he smiled a deprecating smile and said, more proudly than otherwise, "Oh! I don't know anything about that. You know I'm in the selling end; I don't keep up on these engineering details." It wasn't the words that riled us; it was the condescending manner, the obvious superiority of one who had finally gotten out of the rut onto the broad highway of success. And we went away wondering how much of the engineer's complaint about his "status" was due to this all too common attitude of mind of the engineer himself. The world takes us at our own estimation—to a large extent, at least. If the engineer, taking him by and large, thinks he is rising in the world when he commences to sell things it will be a long time before the world stops paying him—and other salesmen—more money for selling things than for planning them and making them.

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"It is not fair, we remind clients, to write on small sheets of paper; use regular copy-paper size, for communications of any longitude; this often saves us much adhesive engineering."—Christopher Morley in the New York *Evening Post.*

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga., Nov. 12-16.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Meeting, Washington, D. C., Nov. 13-15.

AMERICAN ROADBUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 14-18, 1924.

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual Meeting, Washington, Jan. 10-11, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York, Jan. 16, 17.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich. Annual Meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Chicago, Ill., Jan. 21-23, 1924.

The Engineers' Club of Cincinnati had for its joint meeting with the Cincinnati chapter of the American Institute of Architects, on Oct. 18, a paper on "New Aspects of the Housing Problem" by Blecker Marquette, executive secretary of the Cincinnati Better Housing League.

The Illinois Municipal League will hold its annual meeting at Urbana, Ill., Nov. 1 to 3. The subjects of papers and addresses include the following: (1) Uniform traffic regulations; (2) inspection and purchasing methods for municipalities; (3) street resurfacing methods in Illinois; (4) publicity methods by which officials can keep citizens informed as to municipal activities; (5) city planning and zoning; (6) superhydro-electric power and its relation to municipal development. Prof. R. M. Story has resigned as secretary but continues as treasurer. The executive board, therefore, has appointed A. D. McLarty as full-time secretary in view of the growing activities of the league. His office is at Urbana, Ill.

Personal Notes

BARRY DIBBLE, project manager, U. S. Reclamation Service, in charge of the Minidoka Project and the American Falls, Idaho, development, has been transferred to the Denver office of the U. S. Reclamation Service to take charge of electrical and mechanical work, succeeding J. M. GAYLORD, electrical engineer, who has resigned.

FRANK A. BANKS, construction engineer, Minidoka Project, U. S. Reclamation Service, has been placed in full charge of the American Falls, Idaho, development hitherto handled by Barry Dibble; and DANA TEMPLIN, engineer on the Minidoka Project, has been made acting project manager.

ARTHUR T. LUCE, superintendent of the water plant, Des Moines, Iowa, has resigned to accept the management of the municipal water plant at Marshalltown, Iowa, Mr. Hazelwood, Mr. Luce's former assistant, is acting superintendent of the Des Moines plant.

M. F. DE WITT, who has been assistant city engineer of Tucson, Ariz., for the past three years, has resigned to become construction engineer and superintendent for Kelsey and Robinson who have a $250,000 contract with the Mexican government for paving and a sewer and water system for Hermosillo, capital of the state of Sonora, Mexico.

FRANK H. KINSEY, formerly structural engineer in the construction department of the Bethlehem Steel Co., at Bethlehem, Pa., and chief engineer of the Edwin Burhorn Co., New York City, has opened an office as consulting structural engineer at 122 Bigelow Street, Newark, N. J.

CHARLES P. TOLMAN, after sixteen years as chief engineer and chairman of the manufacturing committee of the National Lead Co., has resigned and has opened an office at 111 Broadway, New York City, for consulting practice in manufacturing methods, handling materials and products, and dust and fume control.

WALTER G. KIRKPATRICK, of Atlanta, Ga., has accepted the professorship in municipal engineering at the University of Mississippi, succeeding Prof. Donald E. McLeod, who goes into enginering practice in North Carolina.

DAVID R. COOPER has resigned from the Fargo Engineering Co., Jackson, Mich., and has opened an office in the Dillaye Bldg., Syracuse, N. Y., for practice in hydraulic engineering, especially in the design of hydro-electric power plants.

PERCY A. CUPPER, state engineer of Oregon from 1918 to 1923 and attorney-at-law and consulting engineer, and ROBERT J. SIMPSON, assistant state engineer for the same period, announce the opening of a law and engineering office in the Oregon Bldg., Salem, Ore., and will specialize in water rights and cases involving operation and management of irrigation and drainage districts, water power, municipal works, and in general consulting engineering.

GEORGE LE BOUTILLIER, vice-president of the Long Island Railroad Co., has been elected president of the company to succeed the late Ralph Peters. Mr. Le Boutillier was born in 1876, graduated from the University of Cincinnati and in 1895 entered the service of the Pennsylvania R.R. in its engineering department. He remained in the engineering department, first as an assistant division engineer and then as a division engineer, until 1914, when he was transferred to the operating department as a superintendent. In 1920 he was promoted to be general superintendent at Harrisburg, Pa., and early this year he was elected vice-president of the Long Island R.R. to relieve Mr. Peters of the active management of the property.

IRA T. HOOK announces the opening of an office at 494 Norton St., New Haven, Conn., for industrial engineering service relative to materials and equipment, specifications, investigations, lay-outs, valuations and estimates. Mr. Hook is a gradute of the University of Michigan, was formerly on the engineering staff of the General Motors Corp., and recently was assistant professor of strength of materials in Yale University.

W. H. ROGERS, JR., Greenville, N. C., has been appointed county engineer of Pitt County, North Carolina, succeeding J. B. Harding who died Oct. 3.

JAMES F. MUIR, formerly supervising mechanical engineer with Toltz, King & Day, Inc., of St. Paul, Minn., and prior to that superintendent of mechanical equipment for the Minnesota & Ontario Paper Co. at International Falls, Minn., is now engineer in the mechanical division in the Boston office of Stone & Webster, Inc.

R. D. CORRIVEAU, engineer, who has been with the Canadian Deparment of Public Works since 1898, has been appointed assistant chief engineer of the department, succeeding Kenneth M. Cameron, chief engineer.

A. J. MCCUNE, state engineer for Colorado from 1899 until 1903, and from 1917 until now, has resigned and retired from active work. His successor has not been named.

Obituary

VICTOR H. REINEKING, consulting hydraulic engineer, Portland, Ore., died Oct. 16 in Milwaukee, at the age of 38. Mr. Reineking graduated from the University of Wisconsin in 1908. He was resident engineer on the Kilbourn, Wis., project, the High Falls and Johnson Falls dams on the Peshtigo River and a municipal lighting plant at Decatur, Ill. In 1913 he entered private practice in Portland and in conjunction with L. F. Harza reported on the Celilo Falls project on the Columbia River for the State of Oregon. Other hydraulic and hydro-electric work was reconstruction of the Elwha River dam and power plant at Port Angeles, Wash., and the Ochoco hydraulic fill dam. For several years he was assistant engineer to Baar & Cunningham, consulting engineers, Portland.

W. H. O. MURRAY, railway contractor of Montreal, was accidentally killed at Fabre, Que., recently. Mr. Murray was engaged upon an extension for the Canadian Pacific Ry. in the Temiskaming District. He served overseas four years with the Canadian Railway Construction Corps as major.

HOLMES BLAIR, president of the engineering firm of Blair & Drane, Charlotte, N. C., died Oct. 25 at the Charlotte sanitarium after a long illness; he was 63 years old. Mr. Blair's early years were spent in railroad construction in Illinois, Montana, the Dakotas and Colorado.

J. B. HARDING, for the last four years county engineer of Pitt county, North Carolina, died suddenly Oct. 13, 1923, from a stroke of apoplexy at the loading plant of his paving project. He formerly served seven years as locating and reconnaissance engineer for the National Railway Lines of Mexico, and was also chief engineer for the Atlantic Coast Realty Co. of Petersburg, Va.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Interviews with Industrial Executives—I

Rock Drill Users Profit by Manufacturers' Policy of Field Service

Obligation of Maker Held To Continue After Sale of Machine—Corps of Skilled Advisers Visits Jobs To Improve Operation and Care of Equipment.

WHAT is the manufacturer's responsibility to the purchaser of his equipment? Do his obligations end with the delivery of the product in good condition to the prospective user? Does the operation of the machine on the job concern him, or is the user the man upon whose shoulders the entire onus of operation and maintenance should rest? If not, what division of responsibility or what plan of co-operative service is possible and how can it be carried out in actual practice?

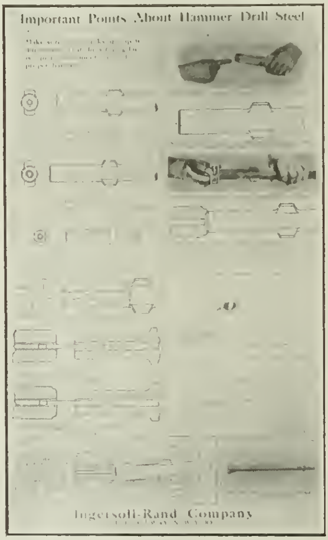
These are some of the questions to which equipment manufacturers have devoted a good deal of thought. No reputable maker would think of shipping to a customer a machine which was improperly designed, faulty in the character of its materials, or clearly unsuited to the work which it would be called upon to perform. Of course, scattered sales could occasionally be made by resorting to such practices, but the manufacturer seeking to establish or maintain his business on a stable, continuing, and expanding basis realizes that one of his biggest assets is the satisfied customer. In other words, the machine must not merely be right when it arrives on the job, but it must stay right, performing, day in and day out, its allotted task.

For Efficient Performance

The principle just enunciated is, in effect, the backbone of a policy of field service which the Ingersoll-Rand Co., manufacturer of rock drills and pneumatic machinery, has put into effect for the benefit of users of its equipment. It is realized that the successful and efficient performance of any piece of construction equipment must, in the last analysis, depend upon how it is treated by the man who runs it. In the case of rock drills, for example, the operator must be taught something of the structural limitations of his machine and be made to understand that he cannot ignore certain rules and then expect the tool to do its best.

Recognizing great possibilities, both for the maker and the user of equipment, in an educational service which would insure proper operation and maintenance on the job, the company has built up a corps of mine and tunnel equipment specialists who devote their entire time to visiting one job after another, inspecting machines and methods as actually employed on the ground, and, where faults are discovered, suggesting corrective measures. The following notes on the organization and operation of this field service force are based on an interview by *Engineering News-Record's* representative with J. H. Jowett, vice-president, and other officials of the Ingersoll-Rand Co. The organization's creed was expressed tersely by Mr. Jowett in these words: "The interest of this company has not ceased with the selling of its apparatus —it is equally concerned with its subsequent performance."

The company has headquarters in New York City and branch offices in 65 other cities, covering not only the United States, Mexico and Canada but Europe, Australia, Africa, South America, Asia, and the East. To the more



WALL CHART OF APPROVED PRACTICE

important branch offices one or more field service men are assigned. Their duty is to follow carefully what the tools are doing in the hands of their purchasers, and as a check on their activities some of the company's executive officers and technical experts make periodic surveys involving extended tours which enable local situations to be studied at first hand.

For the field service force only men with special qualifications are chosen. Obviously, they must have a background of practical experience in tunnels, mines, quarries and rock work generally. They must also possess a thorough knowledge of the design, construction, and the use of the equipment which it is their duty to inspect, and, finally, they must be temperamentally equipped for the work, which calls for tact and the ability to win the confidence of the men on the job with whom they deal. They must not be averse to travel, as their duties require them to be constantly on the move from one job to another. Their sense of observation must be developed to a high degree so that both the large and small mistakes in operating methods or equipment use may be noted and corrected. A type of man must be selected for this service who can talk to chief engineers, superintendents, or bosses of tunnel shifts in their own language, calling for an experience in which theoretical and practical knowledge of methods and tools are blended.

Recently Mr. Jowett and other members of the Ingersoll-Rand organization made an extended trip through the Western states to survey the work of the field service force. They found on every hand evidence of the educational campaign which their field representatives were conducting for improving the service of drills and other machinery. The following notes cover some of the suggestions which the manufacturer, through his field service men, is offering to equipment users:

Practical Suggestions on Drill Use

Regular Inspection—For the efficient operation of the rock drill the principle of the "stitch in time" is vital. Drill users are urged by the manufacturer to carry their machines back from the heading to some convenient point underground at the end of every shift, so that the tools can be examined, overhauled, cleaned, and oiled for service on the next shift. By following this practice minor repairs and adjustments can be made and the drill kept in service for long periods without having any serious accident occur. The expense involved, the manufacturer points out, is trifling compared with that entailed when drills must be taken all the way up to the surface and there turned over to the repair shops. In other words, frequent inspection underground offsets a rather common tendency on the part of the drrill-runner to carry on with a defective or limping tool until the machine is put out of commission because of a really serious breakdown.

Lubrication—One of the most important operating points stressed by the field service men is frequent and proper lubrication of rock drills. While the construction of the modern rock drill is extremely rugged, the service it is called upon to perform involves a great amount of wear and tear on the moving parts of the machine. Sometimes a service man encounters the spectacle of an operator endeavoring to loosen up a stuck drill with a flow of profanity and a sledge hammer. These are the men to whom the message of frequent lubrication must be carried. The remedy will often be found in the formula: "Feed the machine a little grease at a time, but often. When in trouble, lubricate!" Experience has shown that in most of the cases when steel is stuck the filling of the back and front oil pockets and opening up the throttle will free the steel.

It has been found by experiments covering a long term of years that "liquid grease" is especially suited to

the needs of rock drills. The company has made a careful study of lubricants and furnishes to purchasers of its equipment a list of approved greases and oils, which is printed on tags attached to the lubricating pockets of each machine when shipped from the factory. These printed instructions are followed up in the field by the company's service men.

The Scrap Box—One of the first points of inspection by the service men arriving on a new job is the scrap box. Here valuable information is usually secured. In the manufacture of rock drills standardization is carried to great lengths and component parts are all made interchangeable. Sound drill parts are sometimes scrapped when they still have much working life left in them. This is, of course, due to a lack of knowledge on the part of the repair man. The service men emphasize the importance of much care in the repair of machines and show the repair man how to determine when parts are worn out. Frequently 20 per cent saving in tool upkeep cost has been made in this way. Mr. Jowett emphasized the company's appreciation of the helpful and constructive suggestions made from time to time by drill fitters, i.e., the men in charge of rock drill repairs, who from their every-day contact with repair problems often suggest simple modifications in design or construction which help to reduce the cost of maintainance.

Repair Part Stocks—In addition to their advice regarding the salvage and re-use of discarded parts, the service men aid drill users in determining the proper size and character of their repair part stocks. Owners of drills sometimes make the mistake of either understocking or overstocking with repair parts. The carrying of large quantities of reserve equipment involves considerable overhead expense, insurance, and the cost of maintaining storage facilities. Recognizing these conditions, the Ingersoll-Rand Co. has devised a system by which it carries a proper supply of repair parts at its main plant and outlying branches. Such stocks are kept up in accordance with an intimate knowledge of the changing needs of each customer. Under the plan the customer can be supplied at short notice and he need not carry a large supply on his own shelves. Production is regulated to prevent an oversupply of parts which may be superseded by new models.

Drill Steel—Perhaps one of the most important duties of the company's field service men consists in impressing on the user the importance, first, of selecting drill steels of the proper quality and then outlining, for the benefit of the blacksmith on the job, the best methods or equipment for sharpening and tempering bits and forming shanks. By reason of its long experience in rock drilling, the company is in a position to suggest the most effective procedure, so far as equipment goes, in tunneling and mining operations, so that by following the hints of the field service men there is no reason for wasting time on cut-and-try methods. Often a suggestion regarding the type of bit best adapted to the particular rock encountered has resulted in greatly increased drilling progress.

The work in the heading must be closely co-ordinated with that in the blacksmith shop. For example, in forging bits and shanks on hammer drill steel care must be taken not to overheat the steel, as it may become decarbonized and thus spoiled. Too high a forging heat results in excessive breakage of bits, shanks, and steels. Where possible an oil furnace is recommended for heating steel prior to sharpening, while the use of a drill-sharpening machine, operated by compressed air, speeds up the work and produces bits of uniform quality and size.

The company's representatives always impress upon drill sharpeners the desirability of allowing the steels, after they are forged on the bit end and on the shank end, to cool off before reheating for tempering purposes. With the company's Swedish drill steel forging heats should not be less than 1,850 nor more than 1,950 deg. F. If after tempering, the bits are too hard the edges may break or chip off and if too soft they flatten out. For medium hard rock, field service men suggest heating steel to about 1,450 deg. F. (cherry red) for the tempering process. In some cases where it has been found impossible to harden the bits properly, the trouble has been due to the presence of alkali in the water for quenching the bit. In such cases the suggestion is made that rain water be used in a tank provided with a water jacket for cooling. Where very hard bits are required, the tempering may be done in a brine solution. All hammer drill shanks should be tempered in oil at a dipping temperature when quenched of 1,450 deg. F. (cherry red).

Shanks—The company's inspectors lay great stress on the necessity for correct drill steels as a means of obtaining the maximum work from the drill and prolonging its life. It is not enough for the bits to be properly sharpened. One of the big sources of trouble lies in steels with improperly formed shanks. Defective shanks have been found to be the most common cause of piston breakage. Among the principal causes of trouble are shanks with ends not squared off true or with diameters too small to insure a snug fit in the rotation sleeve or chuck. In either case the piston strikes on the edge of the shank end, instead of distributing the full force of the blow over the entire area of the shank. The same effect is produced by a worn front chuck bushing, which allows the steel to swing out of line with the direction of piston stroke. Any of these conditions, of course, concentrates the full force of the blow on a comparatively small area of the piston, resulting in excessive strain often followed by breakage. The field service men, during their visits, always make it a point to inspect drill steel shanks and to instruct blacksmiths in their proper formation and treatment. Stress is laid on having the shank dimensions correct, and in squaring off the ends the blacksmith is urged not to depend on his eye but to test the trueness of the surface with a T-square. Each shop is provided with wall charts outlining recommended practice as shown by sketches and explanatory text. As an aid in securing good results, the field service men supply the drill sharpeners with gages which show whether the shank is the right length and whether the hole (where hollow steel is used) is centered and of the correct size. Gages also are supplied to determine when a rotation sleeve or chuck is worn to the point where it should not be used further.

"THE WORK IN THE HEADING MUST BE CLOSELY CO-ORDINATED WITH THAT IN THE BLACKSMITH SHOP"

Holes for Water Tube—An additional important point in the formation of drill steel shanks for water-feed drills is to make sure that the hole in the steel is large enough to receive the water tube. If the shank is too soft the end will upset and cut off the water tube, and trouble also will be caused in getting the steel out of the chuck. The instructions of the field service men, therefore, include gaging the hole in the shank so that a steel may never be sent underground with the hole in the steel improperly formed. This is an important point, as the basic principle of the modern rock drill is the expulsion of the rock cuttings by a flow of water carried under pressure through the hollow drill steel. To insure proper and uniform punching of hollow drill steel a mechanical punch is manufactured

either for attachment to a drill steel sharpener or as an independent unit.

Conclusion

The foregoing notes indicate some of the points covered by the field service men during their visits of inspection. This is one manufacturer's conception of service to the users of his product. Back of the plan lies a realization that, in the end, the interests of both maker and user of equipment are identical—getting the most work done at the least cost.

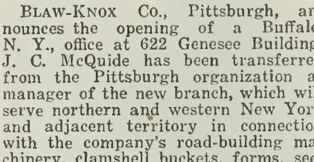
Business Notes

BLAW-KNOX Co., Pittsburgh, announces the opening of a Buffalo, N. Y., office at 622 Genesee Building. J. C. McQuide has been transferred from the Pittsburgh organization as manager of the new branch, which will serve northern and western New York and adjacent territory in connection with the company's road-building machinery, clamshell buckets, forms, sectional steel buildings and structural steel.

Equipment and Materials

Elevating Platform Truck

Announcement is made by the Crescent Truck Co., Lebanon, Pa., of a new elevating-platform truck operated by an electric storage battery and having a pay load capacity of 4,000 lb. The truck is designed for use in factory aisles, at docks, and on warehouse floors, where the load to be moved is



placed on skids under which the truck platform is projected and raised 4½ in., lifting the skid clear of the floor. The overall dimensions of the truck are: Length, 108 in., width, 39 in., and height, 43 in. The wheel base is 58 in. and the load platform dimensions 54 x 26 in. In its lowered position the platform top is 11¾ in. above floor level.

The machine has a two-wheel drive, a four-wheel gear and speeds of 6 miles per hour light and 4½ to 5 miles per hour loaded. Separate motors are provided for propelling the truck and raising the platform.

Publications from the Construction Industry

Portable Hoists — SULLIVAN MACHINERY Co., Chicago, has published two new bulletins on its single-drum and double-drum portable hoists for scraper loading.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Canadian Building Permits Decline During September

Total Value At End Of Third Quarter 8 Per Cent Below Corresponding Period In 1922

The value of building permits issued in Canada during the first nine months of this year showed a decline of eight per cent as compared with the corresponding period of 1922, and an increase of 21 per cent over the first nine months of 1921. The total for 1923 was $105,625,554; for 1922, $115,113,336, and for 1921, $86,970,449.

The value of the permits issued in September showed a slight decline as compared with August and there was also a small decrease as compared with September of last year. According to reports from 56 cities the estimated cost of building work during September was $10,485,613, while in August it stood at $11,541,593, and in September, 1922 at $11,424,119. There was, therefore, a reduction of $1,055,980 or 9.1 per cent in the former and of $938,506 or 8.2 per cent in the latter comparison.

Forty-seven cities furnished detailed statements showing that they had issued nearly 1,200 permits for dwellings at a proposed cost of approximately $5,000,000. Some 2,900 permits were issued for other buildings at an estimated valuation of over $4,800,000. The construction of several buildings is frequently authorized by a single permit; the number of buildings to be erected, therefore, would be larger than appears from the number of permits issued.

Four Provinces Gain

Nova Scotia, New Brunswick, Quebec and Alberta showed increases in the value of permits issued as compared with August, 1923. The largest actual gain of $882,752 or 35.3 per cent was recorded in Quebec, while Nova Scotia with a gain of $75,630 or 275.8 per cent, registered the most pronounced proportional increase. Of the declines reported in the remaining provinces, those of $1,437,093 or 55.1 per cent in British Columbia and of $720,943 or 13.3 per cent in Ontario were most noteworthy.

In comparison with the returns for September, 1922, Quebec, Alberta and British Columbia registered increases in prospective building. Quebec, with a gain of $444,507 or 15.1 per cent, showed the greatest increase. The heaviest loss of $801,581 or 14.6 per cent, occurred in Ontario, but that in Manitoba of $324,115 or 38.2 per cent was also pronounced.

Thirteen important cities showed gains in September building permits.

In preparation — "The Business Situation as Shown by Industrial Expansion," and "Water-Works Installation in 1922 and 1923."

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 239 to 252, are the following:

Hotel, Tacoma, Wash., Citizens Hotel Corp., $1,500,000.

High School, Hartford, Conn., $1,200,000.

Pulp mill and wharf, Cap Rouge, Que., St. Regis Paper Co., Ltd., $4,000,000.

Dam, Lake Cushman, Wash., Comrs. Light & Water, Tacoma, $1,250,000.

Channel, Pueblo, Colo., Pueblo Conservancy Dist., $4,000,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News pp. 239 to 252, are the following:

Apartment, New York, N. Y., Sherman Elwood Building Corp., $1,110,000.

Bridge sub-structure, San Francisco, Calif., to Healy-Tibbitts Constr. Co., $1,192,484.

Lock, Point Marion, Pa., U. S. Engineers Office, $750,000.

School, Brooklyn, N. Y., to G. F. Driscoll, $995,995.

British Metals Prices Advanced

The recent tendency in British wholesale prices is upward, particularly in textiles, food products and non-ferrous metals, according to reports received by the U. S. Bureau of Foreign and Domestic Commerce. The advance in metals, particularly, is taken as an indication of improved industrial demand, since continental competition has been held partially responsible for increased unemployment in the United Kingdom.

That British metals prices have paralleled American quotations, in several instances, is shown by the accompanying table.

Electrolytic copper was exactly the same price in Manchester, England, on Sept. 28, as in New York warehouses. Spelter, on the same date, was a small fraction of a cent higher in Swansea, England, than in New York. Brass tubing, however, was ¾c. per lb. higher in New York than in Manchester.

Pig iron, fabricated steel and lead were somewhat higher in the American warehouses, compared with the English quotations. Copper tubing, however, was over 1c. per lb. higher in Manchester than in New York, on the same date.

COMPARATIVE METALS PRICES, SEPT. 28, 1923

	U. S. A.		England	
Copper, electrolytic, per lb.	New York	$0.14	Manchester,	$0.14
Lead, per lb.	New York,	0.075	Manchester,	0.0548
Spelter, per lb.	New York,	0.06875	Swansea,	0.06875
Pig iron, basic, per gross ton.	Pittsburgh,	26.90	Lincolnshire,	21.15
Steel structurals, channels and angles, per lb.	New York,	0.0364	N. E. Coast,	0.1087
Steel bars, per lb.	New York,	0.0354	Manchester,	0.0203
Steel tank plates, per lb.	New York,	0.0364	Midlands,	0.0203
Steel hoops, per lb.	New York,	0.0519	Sheffield,	0.02538
Copper tubing, per lb. (base)	New York,	0.245	Manchester,	0.25585
Brass tubing, per lb. (base)	New York,	0.23	Manchester,	0 22743

Value Of October Contracts 17 Per Cent Heavier Than For Same Month Last Year

Falling Off of 7 Per Cent Compared With September—Water-Works, Industrial and U. S. Government Construction Gained

Contracts awarded on large engineering construction projects during October totaled $161,276,000, a gain of nearly 17 per cent, compared with $137,877,000 for the corresponding period in 1922. The October total, however, represents a decrease of about 7 per cent, compared with $173,072,000 for September.

Minimum costs observed in *Engineering News-Record* on each class of construction are as follows: Water-Works, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings, $150,000.

Of the $161,276,000 a total of $3,530,000 represented Canadian awards which fell off heavily from the September level.

All classes of construction fell off during October with the exception of water-works, industrial building and Federal Government projects. Water-works awards gained 26 per cent in total money value during the month, while Federal Government construction increased nearly 16 per cent. Industrial lettings, totaling $48,985,000, were over three times greater than those for the preceding month.

Among the large projects awarded during October were the following: A power station at Kearny, N. J., $20,000,000; addition to plate glass factory at Ottawa, Ill., $5,000,000; silk plant at Jacksonville, Tenn., $4,000,000; 25 mi. conduit, Portland, Ore., $2,571,404; hotel at Chicago, Ill., $2,250,000; hospital at Nashville, Tenn., $2,000,000.

The actual physical volume of construction represented by October contracts is exactly the same as that of October, 1922; 17 per cent heavier than for the corresponding period in 1921 and 74 per cent above the volume of October, 1920, lettings.

Business Briefs

Call money easy but firmer at 4½@5 per cent.

Time money remains dull with all loans at 5@5¼.

Record freight movement occurred on Oct. 17, when railroads moved more cars, both loaded and empty, than ever before on any one day in history of American railroads.

Planning to avoid a building crisis, the American Construction Council is urging that, where possible, all repairs and alterations be done this winter so as to avoid delays when the construction takes on a new impetus in the spring.

Engineering News-Record Construction Cost Index Number

November, 1923 .... 220.90
October, 1923 .... 220.30
November, 1922 .... 188.60
Peak, June, 1920 .... 273.80
1913 .... 100.00

Engineering News-Record's Construction Cost Index Number increased 0.6 points since last month, owing to slight advance in lumber. Prices of other basic building materials remained unchanged during the month. The average rate for common labor is still 54c. Thus, general construction cost is 17 per cent higher than one year ago and 19 per cent under the peak; it is 121 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly
October, 1923 (*4 issues of E. N.-R.*) 127
September, 1923 (*4 issues of E. N.-R.*) 137
October, 1922 (*4 issues of E. N.-R.*) 127
1913 100

Yearly
1922 (entire year) 130
1921 (entire year) 88
1920 (entire year) 91
1913 100

Engineering News-Record's Construction Volume Index Number is 127 for the month of October, and 130 for the whole of 1922, as against 100 for 1913. This means that the actual volume of construction in 1922 (not the mere money-value of the contracts let that year) is 30 per cent above the volume of construction for 1913. Our monthly volume number, 127 for October, 1923, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING OCTOBER, 1923

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total United States	Canada	Total
Waterworks	$187,000	$125,000	$15,000	$184,000	$409,000	$2,592,000	$3,512,000	$124,000	$3,636,000
Sewers		2,114,000	300,000	1,345,000	615,000	408,000	4,782,000	314,000	5,096,000
Bridges	27,000	587,000	50,000	306,000	538,000	285,000	1,793,000	632,000	2,425,000
Excavations, drainage and irrigation	....	....	205,000	31,000	405,000	208,000	849,000	25,000	874,000
Streets and roads	994,000	5,101,000	4,911,000	5,097,000	6,672,000	3,817,000	26,592,000	1,552,000	28,144,000
Industrial works	905,000	22,670,000	1,476,000	19,250,000	1,088,000	3,546,000	48,935,000	50,000	48,985,000
Buildings	2,335,000	21,421,000	7,611,000	10,076,000	4,964,000	13,031,000	59,438,000	550,000	59,988,000
Federal Government	216,000	978,000	3,722,000	534,000	40,000	388,000	5,878,000	....	5,878,000
Unclassified	294,000	2,005,000	145,000	1,750,000	1,193,000	580,000	5,967,000	283,000	6,250,000
October, 1923	$4,958,000	$55,001,000	$18,435,000	$38,573,000	$15,924,000	$24,855,000	$157,746,000	$3,530,000	$161,276,000
September, 1923	6,585,000	40,893,000	20,757,000	39,116,000	32,055,000	27,534,000	166,940,000	6,132,000	173,072,000
August, 1923	4,308,000	30,933,000	11,974,000	34,425,000	24,962,000	21,555,000	128,157,000	13,442,000	141,599,000
Total 3 months	$15,851,000	$126,827,000	$51,166,000	$112,114,000	$72,941,000	$73,944,000	$452,843,000	$23,104,000	$475,947,000

Labor Rates and Conditions Throughout the Country

Record car loadings and an active retail trade throughout the country, offer somewhat of a contrast to the recent falling off in production of textiles and metals. Although the Japanese demand has stimulated the building materials market, industrial activity, generally, is uncertain and there has been some curtailment in employment.

The principal wage controversies now awaiting adjustment are among foundry, clothing and railroad workers and derrickmen. A slight rise in living costs, due to higher food and clothing prices, tends to further complicate the wage situation. Rents of wage earners' houses are higher at present, than at any time during the last nine years, and are still rising, according to a nation-wide survey conducted by the National Industrial Conference Board.

The average rate paid common laborers (pick and shovel men) in construction operations, remains at 54c., the same as for the last four months; the June rate being 53c. per hour, according to *Engineering News-Record* figures. Local conditions are as follows:

Baltimore—Scarcity of structural iron workers. Conditions among common laborers nearing normal.

Boston—Labor plentiful in all trades.

Detroit—Conditions normal. Labor supply a little more plentiful.

Minneapolis—Wages slightly lower in brick and tile plants.

CURRENT BUILDING TRADES WAGE RATES PER HOUR

(Higher rates indicated by +, decreases by —)

Cities	Brick-layers	Car-penters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1 12½	$0 90	$0 70	$0.50	.....	$0.75	$0 30@ 35
Baltimore	1 50	+1.00@1 12½	.90@1 12½	.87½	$0.65	.80@1.00	.30@ 50
Birmingham	1 00	1 00	.50@1.00	.30@.40	.....	1.25	.30@.40
Boston	1.25	1.00@1 05	1.25@1.35	.82½	1.05	1.12½	+.60@.75
Cincinnati	1.25	1 05	1.05	.82½	1 05	1.05	+.50
Chicago	1.25	1 15	1.00@1.25	.88¾	1.10	1.25	.82½
Cleveland	1.40	1 25	1.25	.87½	1 00	1.10	.87½
Dallas	1.50	1.00	1 00	.40	87½	1.00	.30@.50
Denver	1.37½@1 50	1.12½	1.12½@1.18¾	.75@.81¼	1.00	1.15⅝	.35@.55
Detroit	1 12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1 37½	1.00	1.00@1.25	.87½	1.00	1.07½	.35@.60
Los Angeles	1 25	87½@1.00	.87½@1.00	.62½	.....	1.00	.50
Minneapolis	1 12½	.87½	.87½	.71½	.....	.87½	.50@.55
Montreal	—90	.65	.50	.35	.50	.65	—.30
New Orleans	1.25	.90	1.00	.65	.80	1.00	.35@.40
New York	1 50	1.25	1.25@1.50	1.00	1.00	1.25	.50@.75
Philadelphia	1 50	1.12½	1.02¼	.70@1.00	1.00	1.10@1.12½	.45@.50
Pittsburgh	1 40	1.20	1 12½	1.00	1 12½	1.25	.70
St. Louis	+1.75	1.50	1.25@1.37½	1 25	1 25	1.25@1.50	.45@100
San Francisco	1.25	1 00	1.00	81¼	1 00	1.12½	.50@.55
Seattle	1.25	1 00	1 00@1 12½	.93¾	1.00@1.12½	1.12½	.56¼@.62½

Montreal—Slight scarcity of structural iron workers; plenty of other crafts.

New Orleans—Plenty of labor, skilled and unskilled. Carpenters and plasterers now on strike, demanding increase in wage scale. Contractors, however, have refused to grant demands.

New York—The only wage controversy developing during the last month was a strike of marble carvers, cutters and setters. The marble workers have demanded $11 per day as against $10, which they agreed to accept on May 1.

Philadelphia—Supply of labor equal to demand.

St. Louis—Carpenters wage rate, $1.75 per hour, effective Nov. 1, against $1.50 one month ago. Building and Common Laborers' District Council planning to demand increase of 20c. per hour for 3,000 members, effective March 1. All classes of common laborers affected except plumbers' helpers, who received increase Oct. 1.

San Francisco—New building projects dropped off somewhat; building trades mechanics, however, all busy completing old contracts.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Market slow in Birmingham district despite low price of $23 per gross ton for No. 2 foundry iron. Several thousand tons of foreign iron received during week. Average price about $1 below last month and $5 per ton under year ago.

Railway Supplies—Standard rails, $43 per ton at Birmingham and Pittsburgh mills; light rails higher in St. Louis. Ties higher in Chicago. Railroad steel requirements heavy, particularly in plates.

Pipe—Demand active in wrought pipe; no change in discounts. Cast-iron pipe slightly lower in Chicago and San Francisco. Sewer pipe advanced somewhat in Boston.

Road and Paving Materials—Few changes in road oil and asphalt prices since last month. Mexican asphalt up 50c. per ton in Boston and down about the same amount in Detroit. Road oils lower in St. Louis. Gains in Texas and Wyoming crude oil output offset decline in California. Paving stone higher in Chicago, Boston and Philadelphia; wood blocks up in Boston and Chicago.

Sand, Gravel and Crushed Stone—Sand advanced 5c. per cu.yd. in Dallas and Cincinnati. Crushed stone, however, dropped 5c. in Boston and gravel 15c. per cu.yd. in Cincinnati during month. Changes due to local labor and transportation conditions.

Lime—Hydrated finishing, advanced 25c. in Birmingham, 50c. in Boston, $2 in Atlanta and $3.50 per ton in Dallas; Detroit reports decline of $1 per ton. Hydrated common, up 25c. in Birmingham, $1 in Boston and $1.50 per ton in Atlanta; down $1 in Detroit. Lump finishing, higher in Boston, Birmingham and Atlanta. Common lump, advanced 10c. in Atlanta, 15c. in Birmingham and Boston and 25c. per bbl. in Dallas; dropped 50c. in Montreal and $1 per ton in Detroit.

Cement — Mill prices firm and unchanged. Very little fluctuation at f.o.b. points. Birmingham reports rise of 10c. and Boston, 12c. per bbl., against declines of 20c. in Dallas and 40c. per bbl. in Atlanta, during month.

Structural Steel—October steel demand showed improvement over preceding month. Steel pipe, sheets, tin plate and nails most active items in present market. Plates and shapes still at $2.50 base; bars, $2.40 per 100 lb., with few quotations under that figure. Railroad and ship plates form bulk of steel plate demand; structural material quiet.

Brick and Hollow Tile—Common brick, wholesale, at dock, New York, $19@$20, against $20, one month ago and $14@$15.50 per M. one year ago. Drop of 50c.@$1 in Birmingham, $1 in Minneapolis and $2 per M. in Dallas. Boston quotes rise of $2 per M. Imported brick not penetrating further than eastern seaboard. Hollow tile slightly lower in Minneapolis, Cleveland and Dallas, owing to lighter demand and lower fuel prices.

Lumber—Shipments gain, despite slight falling off in production and new business. West Coast Lumbermens' Association report sales of 27,246,902 ft. b.m. for export during week of Oct. 25. Pine timbers advanced $1 in New York, $2.50 in Dallas and from $2 to $4 per M. ft. in Boston; Chicago reports decline of $1, Birmingham $2, Detroit and Philadelphia $2.50 per M. ft., in month. Douglas fir rose 50c. in Seattle and $2 per M. ft. in Detroit; dropped $3 in Philadelphia and $6 in Denver since Oct. 4. Hemlock up $2 in Boston and $8 in Montreal; down $3 in Philadelphia. Spruce advanced $2 per M. ft. in Boston.

Explosives—Slight decline in 60 per cent gelatin dynamite in Dallas; no other changes.

Scrap—No. 1 machinery cast and heavy melting steel down $1 in New York. Stove plate dropped 50c. in St. Louis. Slight advance, however, in railroad malleable cast in latter city.

Linseed Oil—Raw oil, 98c., against 95c. per gal. (5 bbl. lots) f.o.b. New York, one month ago. Advance of 4c. per gal. reported in San Francisco, during week. No changes in nineteen other cities.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Nov. 1	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	*$26.05*	$31.55
Northern Basic	*25.00*	33.27
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	*25.00*	34.27
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	*29.00*	36.27
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	23.00	27.50
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	*24.25*	33.64
Virginia No. 2 (silicon 2.25 @ 2.75)	*28.17*	37.17
Basic	*25.00*	29.50
Gray Forge	25.00	32.00
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	*25.50*	31.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	*28.00*	33.50
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	26.77	33.50
Basic	26.77	30.00
Bessemer	27.77	32.50

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$15.00	$11.50	16@16.50
Stove plate	12.00	12.00	*16.00*
No. 1 machinery cast	*16.00*	16.50	19.50@20
Machine shop turnings	8.00	4.00	12.50@13.50
Cast borings	9.00	5.50	14.00
Railroad malleable cast	15.00	12.50	**21 00**
Re-rolling rails	13.00	13.00	21.50@22
Re-laying rails	......	30.00	28.00@31
Heavy melting steel	*11.00*	16.00	.....

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb is charged extra:

	Pittsburgh		Birmingham	Chicago	St. Louis
	Nov. 1	One Year Ago			
Standard bessemer rails	$43.00	$43.00	.	$43 00	$43.00
Standard openhearth rails	43.00	43 00	*$43 00*	43 00	43.00
Light rails, 8 to 10 lb	43@45	45@47	2 00*	43.00	43@45
Light rails, 12 to 14 lb	43@45	45@47	2.00*	43.00	43@45
Light rails, 25 to 45 lb	43@45	45@47	2.00*	43.00	43@45
Rerolled Rails	*37@39*	28@32	.....	......	....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	**$1.70**	**$1.90**
Chicago, Hardwood and Red Oak	**1 35@1.45**	**1.50@1 70**
Chicago....Empty Cell Creosoting (add'l)	**.50**	**.60**
San Francisco...... Green Douglas Fir	.84	1 14
San Francisco, Empty Cell Creosoted Douglas Fir	1.70	2.25
St. Louis, White Oak	1 30	1.60
St. Louis (creosoted) (zinc treated)	1.70	2.05
St. Louis, Red Oak, plain	1.20	1.50
St. Louis, Sap pine-cypress	1.05	1.35

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh		Chicago	St. Louis	San Francisco	Birmingham
	Nov. 1	One Year Ago				
Standard spikes, 9/16-in. and larger	$3.15	$2.75@3.00	$3.00	$4.00	$5.00	$3.72
Track bolts	4@4.25	3.85@4.50	4.00	5.05	6.20	*4.57*
Standard section angle bars	2.75	2.75	2.75	4.00	4.00	**3.20**

PIPE

WROUGHT PIPE—The following mill discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	48%	50%	49%
2½ to 6 in. lap welded	44%	47%	46%
	Galvanized		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	34%	37%	36%
2½ to 6 in. lap welded	30%	34%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 15%. Cast iron, standard sizes, 17½% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York		Chicago	St. Louis	San Francisco
		Nov. 1	One Year Ago			
4 in.	$53.00	$68.60	$60.30	*60 20@64.20*	$61.60	*$65.00*
6 in. and over	49.00	63.60	55.30	*57.20@60 20*	57.60	*61.00*

Gas pipe and Class "A," $5 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York		St. Louis	Chicago	San Francisco	Dallas
	Nov. 1	One Year Ago				
3	$45.00	$45.00	$50 00	$62.50	......	$73.00
4	55.00	55.00	50.00	75.00	$76.50	83.00
5	80.00	80.00	85.00	100.00	97.75	108.00
6	105.00	105.00	85.00	175.00	127.50	133.00
8	170.00	170.00	195.00	187.50	212.50	199.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	....	$0 105	......	.....	$0.15	$0.12	......
4	..	105	$0.11	$0.1175	.15	.15	$0.15
5	...	.1575	.1375	....	.23	.18	.18
6	$0.24	.1575	.165	.1645	.23	.21	.21
8	.38	.245	.26	.26	.35	.30	.325
10	.57	.3675	.338	.364	.53	.42	.476
12	.72	.4725	.442	.468	.68	.54	.612
15	1.13†	.63	.65	.78†	.90	.90	.884
18	1.65†	.875	.85	1.092†	1.25	1.32	1.153
20	1.98†	1.05	1.125	.....	1.50	......	.....
22	2.64†	1.40	1.375	1.456†	2 00	......	1.564
24	2.97†	1 575	1.625	1 872†	2.25	2.16	2.04
27	4.81†	2 795	....	2.95†	4.69†	3.00	3.34
30	5.33†	3.096	....	3.65†	5.94†	3.60	4.06
33	6.93†	4.14	....	4.45†	6.88†	......	4.99
36	7.91†	4.715	....	4.80†	7.50†	......	5.42

	3	5	8	12	24	36
Boston	**$0 131**	**$0.202**	**$0.320**	**$0 612**	**$2 05†**	**$6.15†**
Minneapolis	....	......	.40	72	2.55	5.66†
Denver	.135*	.18*	.27	.47	1.70	.....
Seattle	.13	......	.36	.72†	2.60†	.....
Los Angeles	.13	.165	.275	.475	1.65	.....
New Orleans	.145*	.168*	.28	.476	1.182	.....
Cincinnati	.12	.18	.28	.54	1.80	4.10†
Atlanta	.105*	.16*	.27	.455	1.75	.....
Montreal, *delivered*	.68‡	.45†	.70	1.35	4.50†	.....
Detroit	.117	.1755	.273	.5265	2.34†	6.15†
Baltimore	.117	.175	.273	.5265	1.755	3.9975
Kansas City, Mo	....	..	..	.....	..	....
Philadelphia	.12	.18	.28	54	1 80	5.2275

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. **minimum** f.o.b. place named:

	Nov. 1	One Year Ago
New York, 45% asphalt......(at terminal)	$0.053	$0.06
New York, 65% asphalt......(at terminal)	052	.06
New York, binder............(at terminal)	06	.0675
New York, flux..............(at terminal)	06	.065
New York, liquid asphalt....(at terminal)	.048	.07
St. Louis, 50@60% asphalt	*.055*	.045
St. Louis, 40@50% asphalt	*.053*	..
Chicago, 40–50% asphalt	.0525	.0525
Chicago, 60–70% asphalt	.055	.055
Dallas, 45% asphalt	.0495	.10
Dallas, 55% asphalt	.0455	.13
Dallas, binder	.061	.15
San Francisco, binder, per ton	9.50*	13.00*

* F.o.b. Oelum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Texas*..)	$23 00*	$15.00†
Boston (*Mexican*)	**22 00**	**18 00**
Chicago (*Stanolind*)	22 25	16.00
San Francisco, *f.o.b. refinery*, Oleum, Cal	17.00	11.00
Dallas (*Texas*)	27 10	21.10
Seattle, "*D*" *grade, California, f.o.b. Richmond*	24 75	20.50
Denver (*California*)	24 00	....
Minneapolis *f.o.b. Twin Cities (Stanolind)*	25 45	19 10
St. Louis (*Mexican*)	29 50	24 50
Baltimore (*Standard Oil*)	18.00	14.00
Montreal (*Imperial*)	28 00	21.00
Atlanta (*Mexican*)	26.00	23 50
Detroit (*Mexican*)	*22 00*	*18.00*
Cincinnati (*Kentucky Rock*)	17.50	13.50
Maurer, N. J. (*Bermudez*)	28.00	26.00
Maurer, N. J. (*Mexican*)	21.50	18.50
Philadelphia (*Mexican*)	*19.00*	**16.00**
Kansas City (*Texas*)	....	....
Los Angeles "*D*" *grade, California, f.o.b. El Segundo Refinery*	17.00	11.00

*F.o.b. Bayonne, N. J.
†F.o.b. Marcus Hook, Pa.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade 1)	5-in. granite, 30 blocks per sq.yd.	$138.00 per M.
Chicago	About 4x8x4 dressed	**3 60** per sq.yd.
	About 4x8x4 common	**3 20** per sq.yd.
San Francisco	Basalt block 4x7x8	70.00 per M.
Boston	5-in. granite 28 blocks per sq.yd.	**130 00** per M.
Atlanta	Granite	2.66 per sq.yd.
Detroit	5-in. G anite	106 00 per M.
Baltimore	Granite	2.85 per sq.yd.
Montreal	Granite	104.75 per M.
New Orleans	Granite, 4"x8 x 4	3.25 per sq.yd.
Cincinnati	Granite	138.00 per M.
St. Louis	4x8x4 dressed	*3.05* per sq.yd.
	4x8x4 common	*2.90* per sq.yd.
Kansas City	Granite	.. per sq.yd.
Philadelphia	Granite	3.75@**4 50** per sq yd
Minneapolis	Sandstone	2.74 per sq.yd.

FLAGGING—

New York	Bronx, 4 ft wide	$0.22 per sq.ft.
	Manhattan, 4 ft. wide	.22 per sq.ft.
	Queens, 5 ft. wide	.24 per sq.ft.
	6x24-in. cross-walk	1.10 per lin.ft.
Chicago	18 in. wide....No market	.... per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 80c.; 5 x 20 in., Queens, 85c. *St. Louis*: Class "A" straight, delivered, 5 x 16 in., $1.45 per lin.ft. *Chicago*: 5 x 18 in., **$3 35** per lin.ft. delivered.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2.58
New York (*delivered*)	3½	16	2.79
Boston	3½	18	**2.70**
Chicago	4	16	**3.50**
Chicago	3½	16	**3.50**
St. Louis	3½	16	2 55
St. Louis	4	16	2.90
Seattle	4	16	Off market
Minneapolis	3½	16	2.70
Atlanta	3½	16	1.90
New Orleans	3	16	2.50
New Orleans	3½	16	2.81
New Orleans	4	16	3.15
Dallas	4	18	3.90
Baltimore	3½	16	None used
Montreal	4	16	4 50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	3½	16	2.38
Kansas City	4	16	....
Philadelphia	4	16	None used

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In.		Gravel ¾ In.		Sand	
	Nov. 1	One Year Ago	Nov. 1	One Year Ago	Nov. 1	One Year Ago
New York	$1 75	$2.00	$1.75	$2.00	$1.25	$1.00
Denver	1.90	1.75	1.90	1.75	1.00	0.75*
Chicago	2.00	2.25	2.00	2.25	2.00	2.25
St. Louis	2 30	1.40†	2 35	1.45†	2 10	1.20†
Seattle	1.25	1.00	1.25	1.00	1.25	1.00
Dallas	2 38	2.25	2.38	2.25	**2 00**	2.25
Minneapolis	1.85*	1.75	1.85*	1.75	1.25	1.00
Cincinnati	*1.35**	1.40	*1.35*†	1.40	**1 35***	1.15
San Francisco	2 15	2.25	2.15	2.25	1.50	1.50
Boston	1 40	....	1.40	..	1.10	....
New Orleans	2 85	2.85	2.85	2.85	1.25	1.35
Los Angeles	2 50	.....	2 50	...	1.75	...
Atlanta	1.85†	2.00†	1.85†	2.00†	1.24†	1.35†
Detroit	1.62	2@2.25	1.62	2@2.25	2 02½	2.00
Baltimore	1.40	1.40	1.60	1.60	0 70†	0.70*†
Montreal	1.25†	1.25†	1 50†	1.50†	1 25†	1.25†
Birmingham (Crushed slag used instead of gravel)					1.30†	1.20†
Philadelphia	2 00†	1.70	2 00†	1.75	1 50†	1.65
Kansas City	..	2.00		2.00	.	0 66*†

New York—Grits, $1.75 per cu. yd.; ready mixed, $2.00
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit.
† Per ton

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In.		¾ In.	
	Nov. 1	One Year Ago	Nov. 1	One Year Ago
New York	$1 65	$1.65	$1 75	$1.75
Chicago	2.00	2.25	2.00	2.25
St. Louis	1.75	2.10	1.90	2.20
Dallas	2.83	1.65	2.83	1.65
San Francisco	2.15	2.25	2.15	2.25
Boston	*1.66*	....	*1.66*	....
Minneapolis	1.85	2.00	2.00	2.25
Kansas City	.	2.00	....	2.00
Denver	3.50	3.50	3.50	3.50
Seattle	3 00	3.00	3.00	3.00
Atlanta	2.00*	2 10*	2.00*	2 10*
Cincinnati	1.65	1.55*	1.65	1.55*
Los Angeles *delivered*	2.75	.....	3.00	.....
Detroit	1.75	1.90@2.00	1.75	1.90@2.00*
Baltimore	2.50	1.70*	2.55	1.60*
Montreal	1.80*	1.50*	1.90*	1.90*
Philadelphia	2.00*	1.75*	2.00*	1.60*
Pittsburgh	2.85	2.85	2.85	2.85
Cleveland	3.25*	3.00*	3.25*	3.00*

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.40	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa	0.85	0.90	2.50	
Birmingham, Ala	1.05	1.15	2.05	0.80
Buffalo, N. Y., and Erie, Pa	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.45	1.45	1.45	1.25
Eastern Pa. and Northern N. J	1.20	1.20	2.50	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25
Longdale and Glen Wilton, Va	1.25	1.25	2.50	1.00
Toledo, Ohio	1.50	1.50	1.50	1.50

LIME—Warehouse prices:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
New York	$18 20	$13.10	$3.75*	$3.00@3.25*
Chicago	20.00	20.00	1.50†	1.50†
St. Louis	23 20	20 00	1.87½†	1.87½†
Boston	**23.00**	**17 00**	**4.50***	**2.75***
Dallas	**23 50**	.....	....	**2.00†**
Cincinnati	16.80	14.30	....	
San Francisco	22.00	....	....	2 10†
Minneapolis	25.50	21.00 (white)	1.70†	1.50†
Denver	24.00	.....	....	2.70†
Detroit	*20.00*	*19.00*	...	*19 00*‡
Seattle, *paper sacks*	24.00	.....	2.80†	...
Los Angeles	.....	18.50	....	2.00†
Baltimore	24.25	17.85	2.55	.
Montreal	21 00	21.00		*9.50*‡
Atlanta	**25 00**	**16.00**	**2.45†**	**1.60†**
New Orleans	.....	...	2.40†	1 85†
Philadelphia	23.00	16.00	.	1.24†
Kansas City	.. ..	.....	.	...
Birmingham	**14 50**	**13 75**	**2 00†**	**1.80†**

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.80, Sheboygan $1.70. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Nov. 1	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	..	1.75
Cincinnati (Utica)	1.72	1.72
Boston (Rosendale)	2 80	....
St. Louis (Carney)	2.35	1.75
Birmingham (Magnolia) pozzolan cement	2.10	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Nov. 1	One Month Ago	One Year Ago
New York, del. by truck	$2.70@2.80	$2.70@2.80	$2.60
New York, alongside dock to dealers	2.30	2.30	2 30
Jersey City	2.48	2.48	2 73
Boston	**2 90**	2.78	....
Chicago	2.20	2.20	2.20
Pittsburgh	2.24	2.24	2.24
Cleveland	2.46	2.46	2.46
Detroit	2 48	2.48	2.47
Indianapolis	2 41	2 41	2.41
Toledo	2 48	2 48	2 48
Milwaukee	2.37	2.37	2.37
Duluth	2 25	2 25	2.14
Peoria	2.41	2 41	2.39
Cedar Rapids	2.48	2 48	2.45
Davenport	2 43	2 43	2.43
St. Louis	2.45	2 45	2 35
San Francisco	2.61	2 63	2.71
New Orleans	2.90	2.90	3.30
Minneapolis	2.50	2.50	2 39
Denver	2.84	2.84	2.85
Seattle	2 90	2.90	2.90
Dallas	*2.05*	2.25	2.25
Atlanta	*2.60*	3.00	2.54
Cincinnati	2.54	2.54	2.51
Los Angeles	3.16	3.16	..
Baltimore	2 65	2.65	2 90
Birmingham	**2.80**	2.70	2 40
Kansas City	....	2.45	2 85
Montreal	2.25	2.25	2 88
Philadelphia	2.96	2 96	2.51
St. Paul	2.50	2.50	2 39

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind	$1.95	Hudson, N. Y	$2.20
Universal, Pa	2 00	Leeds, Ala	2.20
Steelton, Minn	2.06	Hannibal, Mo	2.10
Fordwick, Va	**2 20**	Lehigh Valley District	2.10
Mitchell, Ind	2 10	Wyandotte, Mich	2.30
Iola, Kan	2.10	Alpena, Mich	2.10
Mason City, Ia	2.10	Richard City, Tenn	2.20
La Salle, Ill	2.10	Kingsport, Tenn	2.20

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago Mill	Warehouse: New York	St. Louis	Dallas	San Francisco
032	22	$0 95	$1 02	$1 24	$1.04	$1 12	$1 21
049	28	1 20	1.30	1 58	1.32	1 38	1 52
068	35	1 47	1 59	1 94	1.62	1 67	1 87
093	45	1 89	2 04	2 50	2.08	2 00	2 42
126	57	2 34	2.53	3.09	2.59	2 55	2 99
153	68	2 79	3.02	3.60	3.08	3.15	.....
180	78	3.20	3 47	5 22	3.64	3 47	.....
245	103	4 22	4.57	4 60	4.66	4 58	.....
287	119	4 88	5 28	6 44	5.39	5.26	6 00
336	138	5 66	6.13	7 39	6.25	6 11	.....
395	160	6 56	7 10	8 67	7.25	7.12	.....
			PAVING				
036P	17	$0 72	$0 78	$0.95	$0.79	$0.76	.....
053P	24	1.02	1 10	1.35	1.12	1 07	.....
072P	31	1.29	1 40	1 71	1.42	1 39	.....
097P	40	1.66	1 80	2 20	1.83	1 90	.....
049R	24		1.10	....	1.12	1 07	.....
067R	31		1.40	....	1.42	1.39	.....
089R	40		1.80	....	1.83	1 90	.....

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27Dia.	2.3	$22 00	$21 25	$20 72	$20 00	$25.50
26 "	2.5	22 00	22 50	22 39	19.11	27 58
25 "	3.0	22 00	25 25	24 93	.....	30 71
24 "	3 4	24 00	27 25	27 10	24 09	33 16
22 "	4 33	27 00	31 75	32 27	.....	35 10

*Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
3/4 and larger..	$2 40	**$2.70**	$3 54	$3.20	$3.35	*$3.38*	$3 65
5/8	2 45	**2 80**	3 59	3 25	3.50	*3 43*	3 75
1/2	2 50	**2 90**	3 64	3 30	3 55	*3 48*	3 85
3/8	2 65	**2 95**	3 69	3.45	3 75	*3.63*	4 05
1/4	2 90	**3 00**	4 04	3 70	4.35	*3.78*	4 65

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

Inches	Chicago	St. Louis	Dallas	Inches	Chicago	St. Louis	Dallas
3/4 and larger	$2 30	$3.05	*$3 08*	3/8........	**$2 70**	$3.30	*$3 33*
5/8 in........	**2 40**	3.10	*3 13*	1/4........	**3.30**	3.50	*3 48*
1/2..........	**2 50**	3 15	*3 18*	....	.....	.....	....

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Nov. 1	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)...	*$22.40@23.65*	$23.65	$16.90@18.55	$46.50	$54 00
New York (at dock)...	*19@20*	20.00	14@15.50	......	......
Chicago..........	11 00	11.00	11 00	34 00	42 00
St. Louis, salmon......	16@18	16@18	14 00	38@40	40@42.50
Denver, salmon.......	12.00	12 00	12.00	......	......
Dallas...........	*11.00*	13 10	10 90	33.00	......
San Francisco.........	15.00	15 00	15.00	......	......
Los Angeles (del.).....	15 50	15 50	.....	(not used)	
Boston (del.)........	**23 00**	21.00	......	48.25	56 00
Minneapolis (del.).....	*16@18*	17@19	18@19	......	......
Kansas City..........	.....	14 50	14 00	......	......
Seattle..............	15.00	15 00	14 00	55.00	......
Cincinnati...........	18@19	17@20	17.00	*42.00*	*45.00*
Montreal	16.50	16 50	16 00	100.00‡	68 00
Detroit (del.).........	18.25	18.25	16.50@17.50	38 50	41.50
Baltimore (del.).......	21.00	21.00	20 00	40.00	45.00
Atlanta	11 00	11 00	12 00	40.00	45.00
New Orleans..........	18 75	18 75	15.75	......	......
Birmingham.......	*12.50@14.00*	13@15	12.50	......	......
Philadelphia	22 00	22 00	20@28	38.00	46.00
Pittsburgh (del.)......	16.00	16.00	16.00	......	......
Cleveland	16.00	16.00	16.00	......	......

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡Imported.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Nov. 1 on Trucks*	One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12...	$0 1179	$0 1230	$0 0724	$0.135	$0 089	$0 108	......
6x12x12...	.1769	.1844	.0996	......	.122	.156	......
8x12x12...	.2211	.2305	.1358	.23	.162	.244	$0.1968
10x12x12...	......	....	.1695	......	.186	......	.2442
12x12x12...	......	....	.1937	......	.232	......	.3175

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston..................	$0 13	$0.24	......
Minneapolis (f.o.b. cars).......	*.07*	*.12*	*$0.20*
Minneapolis (delivered).........	*.075*	*.130*	*.210*
Cincinnati..................	.0815	.153	....
Kansas City................	...	...	....
Denver....................	.065	.123	188
Seattle (delivered)	.11	.25	.36
Los Angeles factory...........	.1042	.188	....
New Orleans................	.12	.23	....
Detroit (delivered)............	.1145	.2147	.27
Montreal..................	.115	.225	30
Baltimore..................	.125	.27	......
Atlanta...................	.102	.175	......
Dallas....................	*.110*	.20	.285
Birmingham.................	.11	.18	......
Pittsburgh (delivered).........	.068	.128	.179
Cleveland.................	*.08*	*.16½*	......

San Francisco and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh Mill	Birmingham Mill	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.....	$2 50	**$3 00**	$3 64	$4 20	$3.45	$3.40	$3.60
Channels, 3 to 15 in..	2 50	**3 00**	3 64	4 20	3 45	3.40	3.60
Angles, 3 to 16 in., ¼ in. thick...........	2 50	**3 00**	3 64	4 20	3.45	3.40	3.60
Tees, 3 in. and larger..	2 50	**3 00**	3.64	4 20	3.45	3.40	3.60
Plates, ¼ in. thick and heavier.........	2 50	**3 00**	3.64	4.30	3 45	3.40	3.60

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York Nov. 1	One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
¾ in. and larger	$2.75@3.00	$4 40	$3.85	$3.75	$4.15	$5.00	$4 90
		CONE HEAD BOILER					
¾ in. and larger	$3.10@3.35	$4.50	$3 95	$3 85	$4.35	**$5 20**	$5.00
⅝ and 11/16........	3.25@3.50	4.66	4 11	4 00	4 70@4.95	**5 35**	5.15
½ and 9/16........	3.50@3.75	4.90	4 35	4 25	4 95@5.10	**5 60**	5.40

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire.......	$3.00	$3.80	$4 25	**$4 55**	$3.34	$4 95
Cut...........	....	4.45	5.80	5.75	3.64	5 00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco: Galv.	Black	Seattle Black
½.........	$9.85	$7.65	$8.00
⅝.........	7.80	6.30	7.75
¾.........	7.75	6.15	7.70

Pittsburgh base in lots of 200 kegs or more, $3.50

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs *$2.31* per roll in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.75 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., **$5.80** per square.

ROOFING MATERIALS—Prices f.o.b. New York, in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton..............	$67 50
Tar pitch (in 400-lb. bbl.), per 100 lb......................	1 62½
Asphalt roofing (in barrels), per ton, f.o.b. plant*..............	38.75
Asphalt felt (light), per ton, f.o.b. plant*....................	75.00
Asphalt felt (heavy), per ton, f.o.b. plant*....................	75.00

* Delivered in Metropolitan Dist., $3.00 additional.

WINDOW GLASS—Double strength, box list, united inches, 34, "AA" grade, at discount of 84@*85* per cent from standard lists, f.o.b. New York; "A" grade less 86@*87* per cent and "B" grade, *88@89* per cent.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10...............	$3.00	$4.45	*$4.00*	$5.25	$4.59
No. 12...............	3.10	4.50	*4.05*	5.30	4.64
No. 14...............	3.20	4.55	*4 10*	5.35	4 69
No. 16...............	3.40	4.65	*4.20*	**5.45**	4.79
Black					
*Nos. 18 and 20.......	3 70	5.00	*4 70*	5 60	4 95
*Nos. 22 and 24.......	3 75	5 05	*4 70*	5 65	5.00
*No. 26............	3 80	5.10	*4 75*	5 70	5 05
*No. 28............	3.85	5.20	*4.85*	**5 80**	5 15
Galvanized					
No. 10..............	4 00	5.35	**5 85**	5.50	5.15
No. 12..............	4 10	5.45	**5 95**	5 60	5.25
No. 14..............	4 10	5.45	**5 95**	5 75	5.25
Nos. 17 to 21.......	4 40	5.75	**6.25**	5 90	5.55
Nos. 22 and 24........	4 55	5.90	**6 40**	6.05	5.70
*Nos. 25 and 26.......	4 70	6.05	**6 55**	6 20	5.85
*No. 28...........	5.00	6.35	**6 85**	6 50	6.15

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Nov. 1	One Year Ago	Chicago: Oct. 6	One Year Ago
Raw in barrels (5 bbl. lots).....	$0.98	$0.93	$1.14	$0.94

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry Nov. 1	Dry 1 Yr. Ago	In Oil Nov. 1	In Oil 1 Yr. Ago
Red	14.00	12 75	15 50	14 25
White	14.00	12 75	14 00	12 75

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft	25 to 32 Ft.
3x3 and 4	$40.00	$41.00	$42.00	$45.00
3x6 and 8	40.00	41.00	42.00	45.00
4x4-6 and 8	40.00	41.00	42.00	45.00
3x10 and 12	40 00	41.00	42.00	45.00
3x14	42 00	42.00	44.00	46.00
4x10 and 12	40.00	41.00	42.00	45.00
4x14	42.00	42.00	44.00	46.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$42.00	$44.00	$46.00
6x14	47.00	49.00	51.00
8x10	42.00	44.00	46.00
8x14	47.00	49.00	51.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York* 20 Ft. and Under	New York* 22-24 Ft.	Chicago 20 Ft. and Under	Chicago 22-24 Ft.
3x4 to 8x8	**$49 00**	**$50 00**	*$44.50*	*$46.50*
3x10 to 10x10	**53 00**	**54.00**	*50.50*	*52.50*
3x12 to 12x12	**57.00**	**58.00**	*57.50*	*59.50*
3x14 to 14x14	**64 00**	**67.00**	*63.50*	*65.50*
3x16 to 16x16	**69.00**	**70 00**	*71.50*	*73.50*
3x18 to 18x18	**83 00**	**84 00**	*81.50*	*83.50*
4x20 to 20x20	**93.00**	**94.00**	.....	.....

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under.

Other Cities

	8x8-In. x 20 Ft. and Under P.	Fir	Hemlock	Spruce	12x12-In. 20 Ft. and Under P.	Fir
Boston	**$67.00**	......	**$62.00**	**$62.00**	$85.00	.
Seattle	.....	**$29.50**	...	...	...	**$29.50**
New Orleans	28.00	....	....	....	31.00	.
Baltimore	33.50	53.00	53.00	60.00	38.00	53.00
Cincinnati	40.00	75.00	75.00	90.00	44.00	80.00
Montreal	50.00	......	......	......	.....	*65.00*
Los Angeles	.....	50.00	......	......	....	51.00
Denver	.....	43.25	......	......	....	*48.00*
Minneapolis	42.00	43.75	41.50	......	44.00	45.75
Atlanta	35.00	......	......	......	39.00	..
Dallas	**50.00**	...	......	......	**54.75**	.
Kansas City		......	......	......		....
Birmingham	30@35	......	......	.....	40@45	......
Philadelphia	*62.00*	*59.00*	*59.00*	77.00	*73.00*	*70.00*
Detroit	*43.75*	*49.75*	......	......	*56.75*	**52.25**
St. Louis	44.00	......	......	......	56.00	......

	1-In. Rough, 10 In. x 16 Ft. and Under P.	Fir	Hemlock	2-In. T. and Gr. 10 In. x 16 Ft. P.	Fir
Boston	**$55.00**	....	**$52.00**	**$62.00**	..
Seattle	......	**$25.00**	.		**$29.00**
New Orleans	72.00	....	.	31.00	...
Baltimore	60.00	44.00	44.00	34.00	50.00
Cincinnati	76.00	81.00	76.00	35.00	90.00
Montreal	56.00	50.00	**45.00**	45.00	45.00
Los Angeles	......	45.00	....	.	....
Denver	....	34.25	34.25	..	34.25
Minneapolis	42.00	39.75	39.50	38.25	36.25
Atlanta	19.50	......	.....	29.00	......
Dallas	**50.00**	......	.....	**53.33**	......
Kansas City	.....	......	.....	.....	.....
Birmingham	*24@28*	....	....	*32@36*	......
Philadelphia	*33@34*	63.00	46.00	*51.00*	65.00
Detroit	*49.00*	**38.00**	.....	*41.50*	*39.50*
St. Louis	40.00	......	......	29.00	......

Birmingham—Quotes carload lots, f.o.b. sidings; $4.00 additional per M.ft. to contractors.
Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.
Denver—Quotes dealers price to contractors on large projects.
St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M.ft. additional.
Seattle—Price to contractors, delivered.
Dallas—Wholesale to contractors, $10 per M.ft. additional.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23½
12 in.—2 ft. from butt	6 in.	60 to 69 ft	.21½	.25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36½
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	.35	.41

MISCELLANEOUS

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Nov 1	One Month Ago	One Year Ago
$2 65	$2.65	$2.50

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	20%
Patent flattened strand, special steel wire rope	20%
Patent flattened strand, iron rope	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington Discount: 5 points less than discount for Eastern territory.
Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.
Arizona: Discount 10 points less than discount for Eastern territory.
Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.
North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ½-in., 8 ft., ⅝-in., 6; ¾-in., 4½; 1-in., 3⅓; 1¼-in., 2 ft. 10 in.; 1½-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	*$0.15@0.17*	New Orleans	*$0.17½*
New York	.18	Los Angeles	.20
Chicago	.18	Seattle	.18
Minneapolis	*.18*	St. Louis	.19½
San Francisco	.16	Montreal	.22
Atlanta	*.18½*	Detroit	.20
Denver	*15½@17½*	Baltimore	.18
Cincinnati	*.19*	Kansas City	.
Dallas	.21	Birmingham	.20½
Philadelphia	*.17*		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Boston	.24	.26
Kansas City	.....	.....
Seattle	.165	.19
Chicago	.22	.25
Minneapolis	.1917	.2123
St. Louis	.2225	.2475
Denver	.2025	.2275
Dallas	.225	*.302*
Los Angeles	.1975	.2225
Atlanta	.23	.2575
Baltimore	.22	.23
Cincinnati	.225	.25
Montreal	.195	.235
Birmingham, *delivered*	.16	.17
New Orleans	.195	.22
San Francisco	.1625	.1925
Philadelphia	.215	.24

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f. o. b. New York:

Sulphate of aluminum, in bags, per 100 lb.	$1.40@1.50
Sulphate of copper, in bbl., per 100 lb.	*4.90*@5.00
Soda ash, 58%, in bags, per 100 lb.	1.33@1.51
Chlorine, liquid, cylinders, 100 lb., per lb.	*.08½*@.09
Hypochlorite of lime (bleaching powder) in drums, per 100 lb.	2.00@2.10

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.29
Birmingham	.58	Kansas City	.735
Boston	.365	New Orleans	.67
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.34
Cincinnati	.29	Philadelphia	.32†
Cleveland	.215	St. Louis	.43
Denver	1.27*	St. Paul	.60

* Minimum carload, 40,000 lb.
† Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.

A Consolidation of Engineering News and Engineering Record | McGraw-Hill Company, Inc.—James H. McGraw, *President*

Engineering News-Record

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, *Editor*
Frank C. Wight, *Managing Editor*

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Beginning Again

PREDICTION as to the effectiveness of the move toward co-operation initiated last week by the committee of the four national engineering societies is dangerous. It may mean the start of real effective co-ordination of engineering society effort in this country; it may be only a repetition of one of its several well intentioned predecessors which varied from the almost unanimously acknowledged failure, Engineering Council, to the debatable and debated Federated American Engineering Societies. The new co-operative effort has this in its favor—that it represents real co-operation and not assumption of composite authority. The deliberations of the joint conference will not commit the engineering profession to any expression of opinion or to any combined effort but they will serve for rapid interchange of society opinion and, in those cases where opinion in the four major branches is unanimous, they will promote the simultaneous action of those four branches. Society independence and professional integration may thus both be served. Whether this will be successful or not depends partly upon the care with which the joint conference does its early work but more particularly upon the attitude of the societies themselves toward the recommendations of the conference.

Water-Supply Co-operation in Jersey

TWO weeks ago we noted that low rainfall and runoff in the thickly settled portion of Northern New Jersey, with consequent water shortage in a large section, had stimulated adjacent municipalities to join with Newark in the Wanaque development being carried out for it by the North Jersey District Water Supply Commission. This movement has grown so rapidly since our earlier note that already the applications call for such a total as to convince both the commission and the interested municipalities that the Ramapo should be developed alongside the Wanaque. This feeling is accompanied by a growing belief that there should be joint public ownership and a co-ordinated development of all the sources of public water supply in North Jersey, both for economy's sake and to ensure an equitable division of the water without the inter-municipal and the private corporation conflicts that have prevailed for many years past. Some such plan was strongly urged by Allen Hazen in his masterly report of two years ago. Mr. Hazen suggested the creation of a new commission for this purpose. Since then, a court decision ruling that Bayonne could not proceed with its proposed Ramapo development without obtaining the consent of the North Jersey District Water Supply Commission as well as of the State Conservation and Development Commission, has indicated that a new agency is not required in law. All these things point to a promising beginning of the solution of the serious water problem confronting northeastern New Jersey. There is water aplenty for all this territory. Its wisest development may require supplementary legislation but the greater need has been such an awakening of public sentiment as would result in municipal co-operation to meet the common needs of scores of rapidly growing communities. That seems to have come.

Earthquake Effects

TAKEN together, the picture of Japanese building damage printed in this issue and the account of W. S. Sample, published last week, contain some of the most valuable information upon earthquake resistance and effects ever obtained. Previous earthquake visitations of modern cities have been far exceeded in violence by the recent one in Japan, and for the present it seems fair to assume that the Tokyo effects represent the maximum of earthquake action, for engineering purposes. It is a great satisfaction to know that the modern buildings fully withstood the shaking, so far as their framework is concerned. That the more rigid shell was cracked and broken in many places is not surprising, since forced distortion of any structure acts most severely on the least flexible elements. The earthquake study committee which has been formed by the American Society of Civil Engineers may succeed in discovering what is responsible for this cracking and how it may be avoided in future buildings, though at all events it is better to have a building cracked than shaken down into ruins. The subject is of primary interest of course to regions known to be visited by seismic disturbances; yet it is quite possible that such study will have equally useful bearing on methods of construction applicable to other regions. Strength and efficiency of construction are always closely related.

Capitalizing Traffic Congestion Cost

STRUCTURAL improvements to relieve traffic congestion are obvious necessities in most of our large cities. But such improvements cost money and the authorities are reluctant to enter into large capital expenditures when temporary alleviation can be had by the various expedients of signaling and manual control. Not infrequently, however, a proper analysis of cost will show that the capitalized cost of the expedient is greater than that of the major operation required to cure. Such an analysis is made for railway grade crossing improvement. When the capitalized cost of crossing flagmen begins to approach the first cost of a permanent crossover it is time to consider the construction of such a crossover. Take a similar situation in our cities. Traffic policemen are being demanded at more and more crossings. One such policeman a day costs the city the interest on $50,000. At the famous Fifth Ave. and 42nd St. crossing in New York City six to eight policemen are constantly on duty for at least two shifts. The city could afford to spend $800,000 for a structure here that would permit traffic crossing without control. These permissible first costs,

it should be noted, capitalize only the policeman charge; they take no account of the scattered savings, difficult to compute but no less existent, which would result from easy and rapid travel through our streets. Nor do they try to measure the immeasurable saving of life and limb that would result from a clear crossing.

A Bad Beginning

SITTINGS of Secretary Work's "fact finding commission" have begun, under that body's new name of Committee of Special Advisors on Reclamation. While we have had no illusions concerning the sincerity of purpose which led the secretary to appoint this body, in view of his disingenuous procedure in the ousting of Arthur P. Davis and his avowed purpose to smash the efficient administration of the Reclamation Service, we yet have felt hopeful that the committee would at least approximate to constructive and sound conclusions. This hope is seriously shaken by the method adopted by the committee. Opening its work by holding hearings, a lifeless method at best, it is doing the amazing thing of holding these hearings in secret. The very purpose of the committee's existence is to throw the light of publicity on the obscure and intricate subject of reclamation—and yet the committee itself shuns the light and does its work behind closed doors! Is it the committee's desire to command the public's confidence? The committee cannot gain or hold confidence by indulging in star-chamber procedure, certainly not in a subject that has become as embittered by personalities and political chicanery as the handling of reclamation by Secretary Work. It needs to change its method without delay, and work openly under the public eye. It also needs to protect its own good name by preventing the issuance of untruthful press reports of its secret hearings, such as have found their way into newspaper columns during the past week or two.

More Disorganization

EVEN while the Reclamation Service scandal is yet fully before the public, news comes that activities are under way in Washington which threaten a similar "reform" of other branches of the Interior Department. Investigations by secret agents—"inspectors" working by detective methods—are in progress, and by the example of what we learn of the activities of political "inspectors" in the Reclamation Service it is to be feared that disorganization and disruption of these other bureaus are only a question of time. To engineers the threat of serious injury to the efficiency of our national administration through the demoralization of such bodies as the geodetic and geological surveys will be apparent. But the matter is of public concern quite apart from its bearing on engineering interests. The new manager of a large industrial corporation who would seek to apply dark-lantern methods of the kind now current in the Interior Department would have a short and catastrophic career.

Contract Bond Reform

ALL attempts to set up standards of responsibility for contractors in road work will be largely futile as long as unrestricted bonding prevails. Given increasingly higher rates commercial bonding companies can extend the limits of risk almost indefinitely. Contract surety premiums have increased enormously in a decade. In pavement work there has been upwards of 1,000 per cent increase in 25 years. Surety companies claim that their increased rates are justified by the losses. In rebuttal contractors and highway engineers contend that the losses complained of are due to unwise risks which are constantly being taken in the strife for business and that the high commissions paid agents tempt them to accept hazardous business and even to conceal the full hazards from their home offices. Whereabouts justice lies in the controversy need not be inquired at the moment. The facts are that almost any contractor can get a surety bond and that a rate of $1\frac{1}{2}$ per cent on the contract price is an absurd charge for the public to pay for safety against the real risks of highway work. Some way of changing the situation needs to be found. It is proposed in the conclusions of the joint committee of the Associated General Contractors and the Association of State Highway Officials, ratified by both associations in convention last year, that negotiable securities be substituted for surety bonds and that 35 per cent of the contract price is sufficient security for any highway work not extremely hazardous. Until laws are changed this practice is not generally possible and in no event can the highway official refuse a bond, if it is offered, or the contract, if the bonded bidder has named the lowest price. The argument returns then to the need of reform in bonding practice if standards of responsibility for contractors are to be set up with any hope that they can be successfully applied in canvassing bidders.

Business Engineering

MORE or less jocularly we have called attention to a number of curious engineers who seem to swarm the country—"hot dog engineers" and "matrimonial engineers" and "business engineers." Some of those specialists were readily recognized but we must confess we were not able to discover what the "business engineer" was until the other day we ran across a circular from a reputable firm of engineers engaged in industrial work which contained the following paragraphs:

> Three terms—"plan," "structural design" and "income"—are the key terms of business engineering.
>
> The "plan" for any investment building must be foundationed on something deeper than architectural considerations; it must rest on the fundamental service or production needs and the growth possibilities of the business. The "structural design" must not only be good architecturally and engineeringly, but it must also have a correct relation to production or service requirements, to load factors, and to the cost of construction and maintenance. But no matter how good a building or a plant may be architecturally, how well planned it may be from a construction standpoint, or how well suited to its service or production requirements, unless it has the right relation to the *possible income from the investment*, it is not good business engineering.
>
> That, then, marks the difference between construction work and business engineering: one is building; the other is building *in relation to potential income and growth*. One is a matter of blue prints, building materials and labor; the other embraces all of these things, and in addition the building in of sound investment values.

This contains excellent advice. We have only one quarrel with it. It sets up a distinction between engineering and "business engineering" which does not really exist and implies to the lay mind, to whom the circular is addressed, that engineering *per se* has no concern with economics but is merely the skillful putting together of materials into usable machines or structures. This, as all engineers know, is false. Engineering is essentially economics—it is doing for one dollar what any fool can do for two, not only in the spending of the first cost dollar but also in the continued spending of the operating and the maintaining dollar. This is elementary engineering science and engineers who pretend that by practicing it they are doing something ahead of the run of their fellows are not fair to their own profession.

Vibration in Hydraulic Turbines

IN VIEW of the progress in recent years in the design and construction of hydraulic turbines, with their sensitive automatic control devices and the nicety of balance that is now attained, it is a decided shock to hear of a large unit being actually installed with something so far wrong in its design as to prevent successful operation. Elsewhere in this issue reference is made to a 40,000-hp. water wheel which, on being put in service, vibrated so seriously that the power company shut it down and finally corrected the trouble, or at least reduced it to safe limits, by the comparatively rough method of decreasing the runner diameter 5 in. by cutting metal off the runner around its entire circumference with an oxy-acetylene torch.

A paper before the American Institute of Electrical Engineers, in discussing the case, points out that the vibration problem, which has come with large reaction units under high heads, has not been thoroughly understood, and states: "In cases where vibration occurred a cut-and-try system of remedying it was usually resorted to and as little publicity as possible given to the procedure." This is all too true. If aversion to publicity is allowed to prevent placing discoveries on record, progress toward a solution of difficulties is hindered. In this instance particularly it is of great importance that the profession have the benefit of what has been learned. The facts brought out in finding a solution for the trouble in this case have thrown new light on the necessity for avoiding certain relations or combinations in designing reaction runners and guide vanes. Also there was developed a method of measuring and studying vibration in large units on a comparative basis that will be of great value in making similar studies elsewhere.

The vibration of reaction wheels has not been sufficiently well understood. In some plants where it has occurred there has been resort to struts and mass concrete to brace and weight the unit to absorb the vibration. As individual units have been made larger and put under higher heads the problem has grown more serious and the time has now come when it must be reckoned with in design. Although some manufacturers have doubtless had a sufficient knowledge of the proper proportions and relations of certain parts of the unit to keep within safe limits, nevertheless the causes of vibration have not yet been analyzed to such an extent that they can be expressed by exact formulas. Much more study on the subject is necessary. Fortunately, and as a result of the incident already referred to, there has been developed what seems to be an excellent means of making accurate studies of turbine vibrations. This deserves the careful attention of other company engineers wherever large reaction wheels are used. The power company is the logical agent for conducting studies that deal with operating conditions; the power company has the men and the equipment at the plant and no one else has so much at stake.

The development of the large-size, high-head reaction wheel made it imperative that vibration be controlled. Nothing is to be gained by glossing over previous difficulties or attempting to evade the issue. As the result of the case described in this issue it is safe to say the power company concerned will go thoroughly into the question of possible vibration in planning for future units. There is therefore an object lesson in this incident—now that the importance of keeping vibration down to a minimum is understood and since it is believed that this can be accomplished by proper design, there will henceforth be no excuse for failing to take vibration into account.

The "Modern" Highway System

EXAMINATION of the annual report of the Wayne County, Michigan, road commissioners always gives one an interesting hour, if for nothing more than to show the forward steps of an organization that for the past seventeen years has been proceeding on a consistent program of highway development. When we think of highways, our thought is chiefly of the road surfacing. Looked at from this point of view, the most spectacular part of the paving work of Wayne County is drawing to a close. Its concrete highway system, laid out to cover 25 per cent of the county's mileage, will, after the prosecution of a persistent program since 1906, be brought to a conclusion by the 1924 work. Of course, grading and improvement of the secondary road system will still go on for some years.

But does that mean that the Wayne County highway system is "complete"?

The recent report of the road commissioners answers that question, for the greater part of the report is not taken up with paving, but rather with bridge building, grade separation, and with such roadside developments as tree planting, tree trimming, the improvement of road intersections, the sodding of embankments, the disposition of the wires of the public utility companies, the placing of highway signs, and the improvement of the large natural parks which are co-ordinated with the highway system. In other words, though every square yard of hard surface paving planned for the county should be completed and though the surfacing of the secondary roads should be done, there is still work, much work, ahead of the road commissioners. Edward N. Hines, chairman of the commission, asked recently when its job would be done, gave this reply:

"It will not be done until every mile of road in the county is improved; until every bridge is made safe and adequate in width; until pedestrian paths are provided on the trunk lines; until all grades are separated; until the system is lighted; until all the ditches are closed; until public comfort stations are provided to take care of the traveling public in a sanitary way; until all of our roads are planted; until we have numerous public parks and playgrounds; until all poles are off the highways and all wires are underground."

He added, significantly, "A big contract, but we have made a start on all of these projects, all of which are a necessary part of our ideal of what constitutes a modern highway transportation system."

All counties and states are not ready to accept this broad definition of what constitutes a modern highway transportation system. As a people we have not dared to visualize the full meaning of complete road service. Indeed, there is too much to be done to get the elements of a system of improved roads to have warranted most of us in reaching ahead much further than is necessary to secure graded and drained roadbed and adequately paved surfaces. Meanwhile we need prophets and leaders in the great enterprise of road building and we have them in the Wayne County Highway Commissioners and their far-seeing chairman.

Reconstruction of Sixteenth Street Viaduct in Denver

Combination Steel and Reinforced-Concrete Structure Designed So As to Utilize Existing Portions and Salvage Old Steel

By Elsie Eaves
Civil Engineer, Secretary to Herbert S. Crocker, Consulting Engineer, Denver, Colo.

SEVEN participants, five railroads, the street railway and the City and County of Denver, are paying jointly for the reconstruction, widening and straightening of the 34-year-old Sixteenth St. Viaduct in Denver, crossing the Platte River and numerous railroad tracks and carrying a heavy burden of street railway and vehicular traffic. Both design and construction features, particularly the sequence of carrying out the work, have been controlled by the number of organizations interested, their financial ability (two being in the hands of a receiver) and also by their operating requirements. Column bent spacing was fixed by existing track alignment and the desire to re-use certain steel girders. Concrete girders were designed so as to utilize the old steel for reinforcing after thorough cleaning. Additional steel reinforcing columns and trusses were jacked up under a new heavy concrete deck to insure their taking proportionate load.

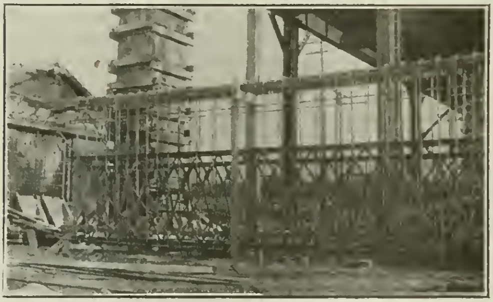


FIG. 1—CROSS-GIRDER REINFORCEMENT ASSEMBLED ON GROUND
Old hand-railing used as reinforcing is in position at the bottom of the assembled steel.

In 1889 the Denver City Cable Railway Co. constructed a 3,000-ft. steel viaduct, 34 ft. wide, on masonry footings across the Platte River and the railway tracks. In 1910 two bad grades at the north end were removed by extending the approach one block. In 1916, when the Denver Union Station was remodeled, the portion of the viaduct over the terminal tracks was rebuilt with four new through girder spans. This viaduct has been closed to vehicular traffic for some years but has been retained for street railway service. In 1921, however, its reconstruction became necessary to provide adequate connection with north Denver.

The Denver practice of financing structures of this kind is to apportion the cost by agreement among the utilities served. The railroads proposed to reinforce the old bridge and build a fireproof deck. At the same time the City and County of Denver presented an alternative plan for rebuilding in concrete, utilizing some 75 per cent of the steel of the old structure. As the railroad estimate did not provide new foundations, and as records were not available to determine the condition of the substructure of the old bridge, it was decided to adopt the city plan. The amount each participant should contribute was based upon the proportion of its frontage on the viaduct right-of-way and upon its traffic served. Since the Denver Tramway Co. and the Denver & Salt Lake R. R. were in the hands of receivers it was impossible for them to contribute their share of cash, but the city agreed to handle the Denver & Salt Lake R. R. share and permitted the Tramway Co. to provide equipment, yard facilities and labor in lieu of money.

The design was separated into five broad divisions: (1) new pedestal foundations, U-wall abutments and concrete river piers; (2) removal of the two deck-truss river spans and the substitution of two skew, four-rib, spandrel-column, concrete arch spans; (3) dismantling and remodeling of the steel in the original structure built in 1889 and the design of a concrete structure enveloping the re-used steel; (4) widening the old part to a 44-ft. roadway to correspond with the remainder of the new structure, strengthening, elevating to grade and remodeling without dismantling of the steel portion at the north end which was built in 1910 and (5) the

FIG. 2—TRAVELERS REMOVING OLD STEEL AND REPLACING NEW
Traveler 1 at right moving backward on old structure removes steel behind it. No. 2 at left is ready to erect steel stringers on concrete bents constructed by the Tramway Co.

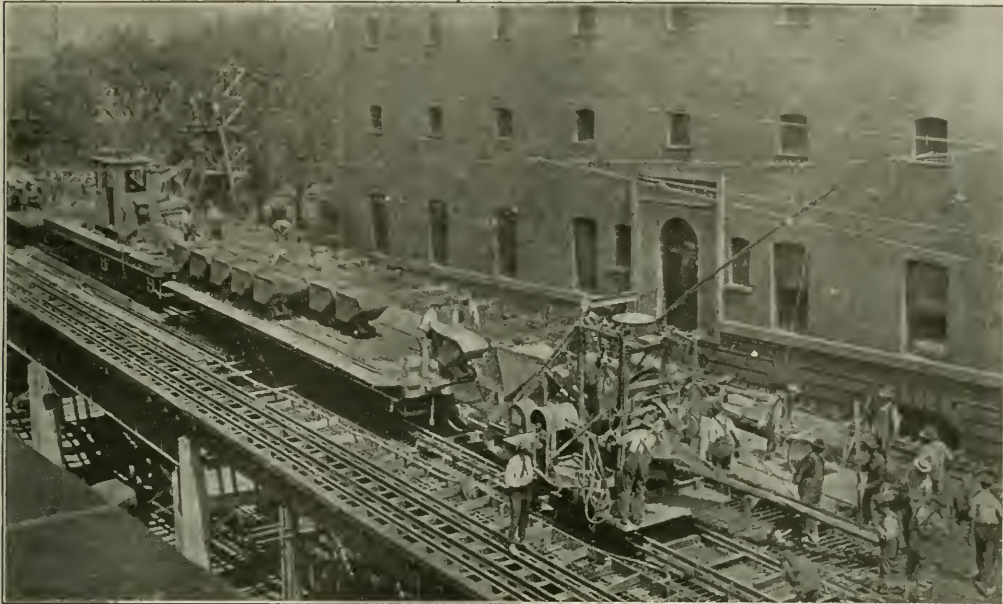


FIG. 3—TRAMWAY MIXER TRAIN ON TOP OF VIADUCT

Electrically-operated 10-ft. mixer attended by flat car equipped with batch cars in position to load mixer. Motor car used for switching is next in the train. In the background is the tower of the city's mixing plant. The mixer train is on the construction track and at the left is the operating track for outbound traffic, both supported by the steel girders on concrete bents of the center portion of the viaduct. As soon as the outside portion on the right is finished the tracks will be interchanged and the outside portion on the left will be built.

widening, strengthening and remodeling without dismantling of the "Terminal Section."

As the first and second groups were of new construction they presented no unusual difficulties. In the third group the old steel girders and transverse floor beams were used as stringers under the street railway tracks in the new design, so that the span lengths were fixed by the steel lengths available. This portion of the viaduct crossed railroad yards where the track alignment was fixed and clearances were secured without yard changes. The construction in this group was entirely of concrete, except for the steel stringers under the tracks, a continuous girder design being used, with sections of from three to five spans between expansion joints of the split-bent type.

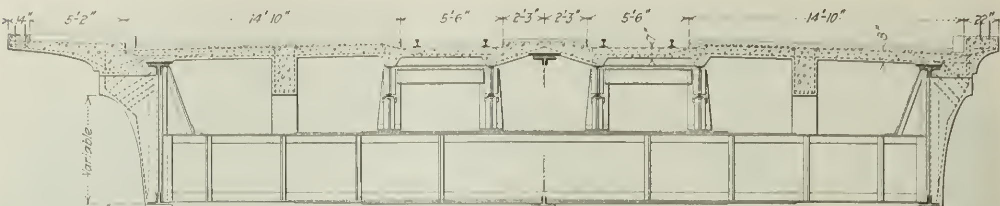
To enable the Denver Tramway Co. to operate cars over the viaduct before the entire structure was completed, the plan contemplated the construction first of the center portion carrying the track. The old hand-railing was used as reinforcement in the concrete cross-girders and old 48-lb. rails in the columns. While the weight was more than required, and the handling costs were greater, the low first cost made the use of this second-hand material attractive.

Jack Steel to Bear Load—In the fourth and fifth groups the new concrete decking and the heavier wheel loads made necessary steel columns and trusses to reinforce the existing structure. The problem of insuring that these new members carry their proportionate share of the load led to the plan of placing the center columns with a driving fit, pouring the superstructure, then jacking up the trusses under the load. By means of deflections, the amount each truss should be jacked up was found to vary from $\frac{1}{8}$ to $\frac{3}{8}$ in., depending upon its length. The entire steel structure in the fourth group was jacked up from 0 to 10 in. to bring it to the new grade.

Construction and Progress—On Nov. 14, 1922, the Denver Wrecking Co. began removing the timber decking, closely followed by the Denver Tramway Co. removing the flooring between its tracks. The foundation contractor also began excavation. As the city planned to dismantle, remodel and re-erect the steel on force account under the engineer's direction, a city steel gang followed the floor wreckers, burning off rivets, backing them out and bolting the steel ready for removal. In view of the low salvage value of the 105-ft. deck trusses on the two river spans, their floor beams were removed, anchors loosened and struts and lateral bracing cut, so that by throwing a line over the top chord of the far truss and using a stiff-leg derrick to pull the span over sideways, the steel was dropped into the river bed, where it was cut into carload lengths and snaked out to be sold as scrap.

A network of water pipes, gas pipes and telegraph cables as well as many old, unused and broken lines was encountered by the foundation contractor. In many cases the design of special footings was necessary, and for several blocks the south pedestal footings and U-wall abutment footings had to be carried down 16 ft. to avoid a 4-ft. sewer. At the river several hundred feet of 24-in. water main had to be moved out of the way of the new foundations by the water department's forces.

Street Railway "Works Out" Its Share—The Denver Tramway Co. "worked out" its share of the cost of building and setting the forms, placing the reinforcing steel and mixing and placing the concrete for the center



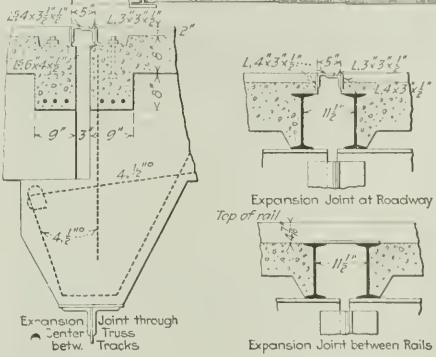


FIG. 5—FLOOR AND EXPANSION JOINTS AT "TERMINAL SECTION"

Concrete supplements structural steel in existing structure.

bents which were to support the steel girders under the street railway tracks. It was in this section that the second-hand rail and the old hand-railing were used for reinforcement. The old steel was cleaned of rust and adhering concrete by pneumatic tools and generous applications of caustic soda solution.

Work was begun at the river and pushed toward the south end. The foundation contractor concreted the pedestals, closely followed by the Tramway Co. gang putting up reinforcing steel, setting forms and pouring column bases, moving along the ground a small electrically-driven mixer as the work progressed. A construction track on the old steel structure yet standing served for the concrete train and other special equipment. The bents were poured from above by means of this train. Both sides of the split bents were poured at the same time, this operation being made possible by use of a metal-covered diaphragm fitted with straps which was pulled out from the top as steel was erected.

Waiting only for the Tramway Co. to get well started on the concreting, traveler 1, on the river end of the steel work, picked up the old steel and loaded it on trucks for removal to a yard where it was cleaned with caustic soda solution and wire brushes and then remodeled. Traveler 1 waited until the first four remodeled girders were returned to the first span, where it erected them before removing more steel and progressing toward the south end. Traveler 2 was then erected on the first span. In operation, traveler 1, running on the old steel structure, dismantled the bridge behind it. Motor trucks carried the old steel to the reframing yard and returned with the fabricated material which traveler 2, running on the newly placed steel, erected on the new concrete bents.

Removal of the light steel members was done by a small crane car operating over the tramway tracks on the viaduct. In the reframing yard, the heavy steel members were handled by a 5-ton steel guy derrick. Aggregate bins, equipped with bucket conveyors, located at this yard, served as loading bins for the tramway mixer train. All the center bents and a large proportion of the outside girder concrete were poured by this train which consisted of an electrically-operated 10-ft. mixer, mounted on trucks. Three flat cars, each equipped with sixteen 2-sack batch cars running on industrial tracks, plied between the mixer and the material bins. As each car carried enough batches to feed the mixer for 45 min., sufficient time was allowed for the empties to return to the yard for reloading.

Arches Over The River—The original plans provided that the two center ribs of each arch span should be constructed first, in order to carry the street railway, but as the contract was not awarded in time to carry out this program a temporary trestle was erected to serve the purpose. Temporary piling supported both the trestle and the arch centering. The four center ribs were concreted first on piers constructed by the foundation contractor. When, fifteen days after pouring, the wedges were struck, it was found that those under the center of the span were loose. The slight deformation of the falsework causing this condition may have been due to the method of placing concrete first at the skewbacks and pouring symmetrically about the vertical axis of the arch until the final concrete was placed at the crown. Levels taken before and after striking the wedges showed that the removal of the centers had little effect on the arch.

Instead of building haunches on the ribs to serve as seats for the spandrel columns, steel rods projected from the ribs to tie on the spandrel column reinforcement, and the surface of the rib was roughened to provide a good bond with the column concrete. This method gave a joint of excellent appearance. Spandrel columns and decking were poured after the centering of the arches had been struck.

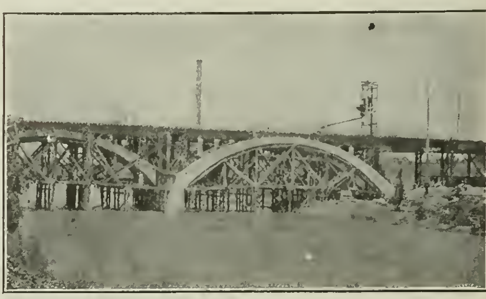


FIG. 4—TWO ARCHES SPAN THE PLATTE RIVER

The center ribs of both spans and the downstream rib of the north arch have been built. The spandrel columns on the center ribs of the north (right) span and the decking have been poured and stripped of forms while the columns and decking of the center of the south span are being poured.

The contractor's plant consisted of one mixer and one tower, the concrete being carted to alternate ends of the arch to secure the balanced pouring.

Widening—After contracts for the foundations and for the arch spans were let, there remained the building of the two outside portions of the main structure and the placing of the concrete decking on the north end section and the "Terminal" section. As the Denver Tramway Co. wished to place the concrete in the remainder of the viaduct, the city contracted for sand and gravel, made complete form drawings and contracted with a local milling company for the construction of forms ready to be set up. Cement was bought by the city for the entire job to insure proper proportioning.

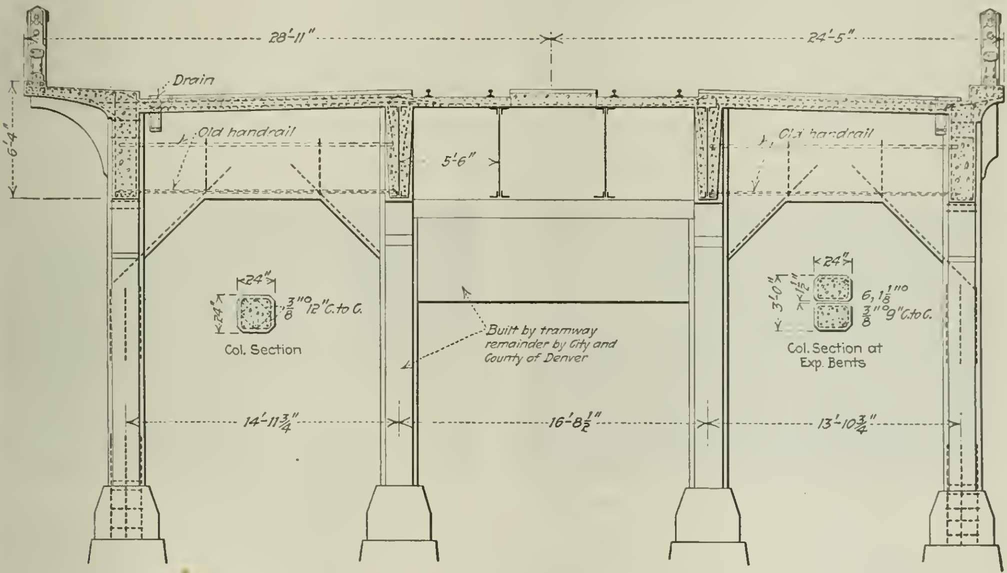


FIG. 6—TYPICAL SECTION OF ALL-CONCRETE REPLACEMENT

A tramway flat car was converted into a light derrick car, with which column reinforcing cages and column forms (assembled on the ground) were lifted into place and reinforcing steel and forms were handled. The girder sections between expansion joints, amounting to as much as 264 cu.yd., had to be poured continuously. To expedite the work, the tramway concrete train was supplemented by a tower, the train on the bridge competing with the mixer and tower on the ground to see which could place concrete the more economically. The split-bent expansion joints in this section were not so easily constructed as in the center portion; each half was formed and poured separately.

The engineer for the city on this work, which it is hoped will be completed early in 1924, is Herbert S. Crocker. Heading his designing staff is Ira O. Thorley who worked out the details of the plan of remodeling and who proposed and designed the continuous girders and split-bent joints. John S. Means is resident engineer in charge of the field work. Frank B. Varnum, who built the foundations, and the C. S. Lambie Co., which subcontracted the arch spans to Rodgers & Pickard, were the only contractors.

Compressive Tests of Hollow-Tile Walls

As a RESULT of some tests of hollow-tile walls, 6, 8 and 12 in. thick, 4 ft. long by 12 ft. high, tested for compression, the United States Bureau of Standards presents the following conclusions: (1) Walls built of high strength tile were set with great care by an experienced mason. They were undoubtedly much stronger than walls built under ordinary commercial conditions. (2) Great differences in strength of tile do not appear to have appreciable effects on the strength of the wall. (3) Stress failure of the thin walls was about the same as for the thick walls, showing there was no appreciable column action. (4) No relation was found between the ultimate strength and the load at first crack. (5) Stress at failure, computed on the net sectional area, was remarkably constant with tile on end, being independent of the size of the tile. (6) Walls having the cells of the tile vertical had on the average more than twice the strength of those having the cells horizontal. (7) Walls loaded with an eccentricity of 2 in. over one-half the width of the wall had about one-half the strength of similar walls axially loaded. Apparently this ratio is independent of the thickness of the walls. (8) Excessively loaded walls failed by crushing of the tile under the bearing plate. (9) Due to the wide differences in the modulus of elasticity of the tile, strain-gage readings were of little use. In general the deformation across a joint was much greater than the adjacent tile, in many cases being twice as great. (10) No relation could be found between the modulus of elasticity for the wall and that for the tile.

The above information is contained in the United States Bureau of Standards Technologic Paper No. 338, this report having been prepared by H. L. Whittemore of the Division of Metals and Bernard D. Hathcock.

An Experiment in Earth Road Construction

Highway Extension Work by Purdue University Teaches Back-District Farmers Good Road Methods

By Ben H. Petty
Assistant Professor of Highway Engineering, Purdue University, Lafayette, Ind.

A UNIQUE experiment in highway extension work was made by Purdue University during the past summer in the southern part of Indiana. In the winter of 1921-22 the Agricultural Extension Department conducted a very complete survey of agricultural conditions in six counties of this end of the state. Some astonishing conditions were revealed. One was that very little can be done to improve the backward farming situation until an adequate system of roads is constructed to provide the farmers an all-year outlet to their produce market.

An improved road is a curiosity in many parts of this district. The writer has traversed so-called roads which ran for long distances in the beds of streams. In many places outcrops of ledge rock make a series of steps on hills that are practically unsurmountable for automobiles. During a rain the earth roads are converted into mud holes which practically eliminate traffic until they are dried out. In winter there is apparently no bottom to the roads, it being impossible to traverse some of them even on horseback.

There are some improved roads of stone or gravel leading out of the larger towns for various distances, most of them extending only a few miles. More roads are being improved each year but it will be many years before this improvement can be extended adequately to serve the entire district. Due in large measure to the fact that road conditions are so poor, this district has not been developed to its possibilities. Therefore the property valuation is low and very little revenue is produced through taxes for road development. Hundreds of acres appear on the tax duplicate as $10 per acre and some as low as $3. This of course is in the more inaccessible sections; some parts are well developed and contain very valuable farm land.

The present conditions simply mean that the farmer who is not fortunate enough to be located along one of the few improved roads is isolated for several weeks or months of the year. The survey showed that some roads were impassable as many as six to eight months.

In endeavoring to relieve this situation an agreement was worked out between the Highway Engineering and Agricultural Extension Departments of Purdue University and the State Highway Commission whereby an engineer could be sent into this district to spend the summer in directing the construction of demonstration sections of earth roads. The arrangements were perfected in June, 1922, by W. Q. Fitch of the Agricultual Extension Department and the writer in co-operation with the local county agricultural agents in the six counties. These plans provided for the construction of short standard sections of earth road in each county by the aid of volunteer labor on the part of the interested farmers. The short sections were to serve as models to guide the farmers in extending the improvement.

During June two trips were made into the district and in company with the local county agricultural agents inspections were made of various proposed sites for demonstration work. Suitable stretches of road, varying from ½ mile to 2½ miles in length, were selected in each county where definite assurance of co-operation could be secured from the local farmers. The kind and quantity of necessary equipment available locally was ascertained and a tentative date for commencing work was set conforming as nearly as possible to the desires of the interested farmers who were to do the work.

STARTING IMPROVEMENT ON EVANSTON-TROY ROAD

EVANSTON-TROY ROAD AFTER IMPROVEMENT

Under the leadership of the county agents, road booster meetings were held in these various localities, organizations were perfected and definite plans of procedure were worked out. Men living in the vicinity of the sections selected for improvement were interviewed by committees and their pledges secured to donate a certain number of days' work with teams or as single hands.

As an indication of the interest aroused, the case of the Rome-Derby Road in Perry County may be cited. To straighten and improve a half-mile stretch of earth road with a gravel surface, those interested pledged a total of $1,300 to be paid either in cash or in work on the basis of $1.50 per day for single hands and $3 per day for teams. A large amount was pledged in Derby seven miles away. On only one other section were cash donations solicited, that being the Zoar road in Dubois County. About $400 was secured mostly from Huntingburg merchants four or five miles away from the half-mile section being improved.

Professor R. B. Wiley, acting head of the school of Civil Engineering, arranged with J. D. Williams, director of the State Highway Department, for co-operation in the way of needed equipment in those districts where local equipment was insufficient or

lacking altogether. This co-operation aided materially in the successful prosecution of the work. The county highway superintendents and, in most cases, the township trustees co-operated splendidly.

The roads selected for improvement were all township roads in very bad condition. Practically all of the roads in this district are too narrow. The demonstration sections of earth road were built to a width of 20 ft. between shoulders, conforming with the standard county road width. On some of the roads there were no culverts at all and storm water had an unrestricted sweep across the roadway. Where culverts existed they were invariably too short, averaging about 12 ft. in length, thereby limiting traffic to a single track. On the improved sections the culverts were lengthened to the full width of the roadway.

In Indiana the township roads are under the supervision of the township trustees. The funds available for road work in the poorer townships are very limited, in many cases averaging as low as $20 per mile per year. This accounts for the neglect of the roads in many localities.

The accompanying table gives the results of the summer's work. The total cost is based on the assumption that the volunteer labor was paid for at prevailing rates. The cost of engineering supervision is not included. The writer spent from one week to ten days in each county directing the work.

COST OF EXPERIMENTAL ROAD IMPROVEMENT, SOUTHERN INDIANA

County	Road	Length in Miles	Days of Labor: Hand	Days of Labor: Team	Material Purchased	Days for Tractive Power	Total Cost
Crawford	Grantsburg-West Fork	⅛	25@ $2 00	6@ $4.00	*Dynamite $6.00	....	$80.00
	Riceville-Wicliffe	⅓	49@ $2.00	15@ $4.00	*Dynamite $5 00	4@ $15.00[1]	223.00
DuBois	Huntingburg-Zoar	½	107@ $2 50	103@ $4 00	Miscl. $164 00	......	847.50
	Jasper-Ireland	1	72@ $2.50	53@ $4 00	Oil on road $1,045.00	....	1,437 00
Spencer	Evanston-Troy	½	77@ $2.00	78@ $4 00	* Miscl. $10.00	1@ $15.00[1]	491 00
	Dale-Stendale	2	*30@ $2.00	*10@ $4.00	Miscl.[4] $65.00	41@ $50 00[2]	215 00
Warrick	Elberfeld-Millersburg	1	6@ $2.00	12@ $4.00	*Culverts $50.00	3@ $20.00[3]	170 00
Perry	Rome-Derby	½	174@ $1.50	119@ $3.00	Dynamite $17.75	....	647.00
Pike	Petersburg-Oatsville	1	*10@ $2.50	*10@ $4 00	....	4@ $33.00[2]	197.00

* Estimated. [1] Traction Engine. [2] Tractor [3] Truck. [4] 40 gal. gasoline @ 25c. = $10.00, 1,000 ft. bridge lumber $30 00, 100 lb. dynamite $25.00.

Conclusion—The summer's work as a whole was highly successful. The improvements received considerable publicity in the local papers and the position of Purdue University and the State Highway Commission was greatly strengthened in this district. The farmers have been shown what can be accomplished in standard earth road improvement with meager equipment and at very low actual cost. Undoubtedly these demonstration roads will stimulate similar improvements in these counties. The farmers have been taught to help themselves in the matter of road improvement and this is exactly what they will have to do to get better roads until such a time as revenue from taxation provides sufficient funds to finance such improvements.

To Investigate Arch Dams

ENGINEERING FOUNDATION'S committee on arch dam investigation has recently submitted a progress report. Two meetings were held in San Francisco, in the early part of the year, and a tentative program was formulated. The committee was fortunate enough to secure for the proposed investigation of arch and multiple-arch dams the active co-operation of the following parties who own or control dams: United States Reclamation Service; State of California; City of San Francisco; Pacific Gas and Electric Co., San Francisco; and Southern California Edison Co., Los Angeles. Furthermore the officials of the University of California, Stanford University, and Massachusetts Institute of Technology have offered the use of their testing laboratories and have assured the committee of other co-operation.

A search was first made for types of instruments which would be suitable for the proposed investigation. Some of the instruments required were readily obtainable in the open market, and others were ordered from manufacturers according to specially prepared drawings and specifications. The owners of dams co-operating actively with your committee agreed to furnish all the necessary instruments and to bear all the expenses incidental to a complete investigation of their dams in accordance with the program.

Dams Selected—In view of the considerable expenses involved in making continuous and accurate measurements on suitable structures, most of which are located far up in the mountains, it was decided to start on a somewhat limited scale and to include during the first season of field observations only structures for which the conditions for making measurements appeared to be particularly favorable. Consequently, the following dams were selected for the first part of the investigation: Hubbart Dam, Mont. (under construction); Clear Creek Dam, Yakima Project (both dams built by the U. S. Reclamation Service); Dam No. 6 of Southern California Edison Co.; Lake Spaulding Dam, Pacific Gas and Electric Co.; Lake Eleanor Multiple-Arch Dam, San Francisco; and the Lake Hodges Multiple Arch Dam, California.

The tests on each dam were placed in the immediate charge of a sub-committee of engineers who are particularly familiar with that dam. In order to co-ordinate the work on all dams local members of the main committee are acting as chairmen of the sub-committees.

Preliminary steps were taken for having laboratory tests made on models. Furthermore, several power companies have expressed willingness to consider financing the construction of a specially designed test dam, which could be tested repeatedly and finally loaded to destruction.

Professor C. Derleth, Jr., of the University of California, is chairman of the committee, and Fred A. Noetzli, Los Angeles, is secretary. Other members are H. Hawgood, D. C. Henny, W. F. McClure, M. M. O'Shaughnessy, H. Hobart Porter, F. E. Weymouth, Silas H. Woodard, Paul Bailey, R. P. McIntosh, and Wynn Meredith. The committee will be glad to receive information about interesting arch and multiple-arch dams and suggestions that will be helpful in its investigations. Several engineers in America and Europe have co-operated in this way.

Federal Land Reclamation: A National Problem

3. Agriculture on Irrigated Lands.

By CARL S. SCOFIELD
Agriculturist, U. S. Department of Agriculture

The Third of a Series of Articles on the History and Performance of the Great Government Adventure in Irrigation of the Arid Land of the West.

IN UNDERTAKING the utilization of the arid lands of the western United States through irrigation, conditions and problems have been encountered that are new to our race. Our agricultural people have been since the beginning of civilization accustomed to farming under rainfall. The engineers who have planned and built our irrigation works have had to meet and solve many new problems not only in connection with the construction work but more particularly in the continued profitable use of the water in agriculture. Irrigation farming may be older than any other kind of highly developed agriculture but the people of northern Europe who have contributed so largely to our population and occupied our agricultural lands have had no practical experience with irrigation. The engineers who constructed and operated the extensive irrigation works of antiquity in Western Asia and Northern Africa have left no written accounts of their work, and the problems and difficulties of the men who farmed those irrigated lands have not been recorded. There are evidences that irrigation was used both in North America and in South America long before the arrival of Columbus. In Peru and along the Gila and the Santa Cruz in Arizona, the discoverers found irrigation in use to a limited extent and it is now known that there were much more extensive irrigated areas that had long since been abandoned, as for example in the Salt River Valley of Arizona.

With us the development of irrigation farming has been for purposes of homemaking rather than to contribute directly to the volume of our agricultural products. In the valleys of Utah and in the foothills of California where irrigation was first undertaken about the middle of the last century, it was used to support pioneer communities. Later, extensions were made chiefly to provide support for families or communities largely engaged in other enterprises such as mining, stock raising, dry farming, or lumbering. It is only in recent years and to a limited extent that our irrigated lands have begun to produce commodities beyond the requirements of the immediate neighborhood and these commodities are chiefly specialties such a citrus and deciduous fruits, certain off-season truck crops, dairy products and long-staple cotton. The chief purpose that these lands have served is to support other industries and to make possible the effective utilization of adjacent dry lands.

The western half of the United States which includes practically all of our irrigated land is the great livestock breeding ground for the country. On its broad prairies and in the mountain parks and valleys our sheep and cattle are born and reared. Each year the wool goes East to market and the lambs and steers move into the corn belt to be fattened. The breeding herds and flocks stay on the ranges. But this western country is subject to great vicissitudes of climate, to prolonged droughts and to winter storms. These take enormous toll from the breeding stock on the open range. A series of hard years such as recur almost every decade might sweep these ranges clean if it were not for those scattered valleys in which irrigation has made it possible to produce the feed and provide the shelter to carry the breeding stock through.

On the western Great Plains, on the high benches of the Great Basin, and in the broad valleys of the Snake River and the Columbia lie millions of acres of fertile land. This is the region to which we look for our great supplies of wheat. It was in this region that we produced the "food that won the war." But the rainfall that makes this production possible is extremely irregular. The only regular thing about it is that good seasons are followed by bad seasons. If the land is to be utilized in the good seasons there must be farmers on hand or nearby with work-stock and equipment to put in and harvest the crops. Or to put it another way, the stability of dry farming in the West depends upon the maintenance throughout the dry lands of irrigated sections to which the farmers may retreat and find support for themselves and their stock during the drier years. It is in these irrigated areas, small and scattered though they are, that we have some measure of insurance against the losses that would otherwise be disastrous to our national supply of meat and bread.

Development of Irrigation Projects

The first irrigation projects were small undertakings designed and constructed by individuals or by local co-operation, as by the pioneers of Utah. The investment of capital was small and soon liquidated. Later it became necessary to cope with larger engineering problems, to adjudicate and validate water rights and to undertake work that required large capital investments. This step involved the recognition that the irrigation works together with the lands they served with water should become security for the capital invested in construction. To be good security the lands must be productive, must be able to support a prosperous agriculture. For the larger projects which required expensive works for the storage, diversion and distribution of water, the money investment came to be a most important consideration. To repay this investment from the earnings of the land requires a long period of liquidation during which the agriculture must continue to be prosperous.

This situation has made it essential that in projecting a large irrigation enterprise the promoter or the engineer must take into account not only what it will cost to construct the works but also the character of the land to be served with the water, the quality of the water with respect to its dissolved salts, the character of the farmers who are to use the land and the water, and finally, those complex relationships of agriculture and economics which have to do with crop production and marketing.

The development of a successful irrigation project involves at least three different classes of problems, viz., legal, engineering, and agricultural. The last named group may be made to include not only the possibilities and limitations of crop production but also those matters that have to do with the settlement of the land, the type of farming, and crop utilization. The present paper deals with these agricultural problems.

The Land and the Water

It is an outstanding characteristic of our arid lands susceptible of irrigation that within a restricted area they are more variable in character and in potential productivity than the lands of humid regions.

This fact is due to the nature of their origin and formation. For the most part these irrigable lands have been made along river channels or delta cones. The soil deposited by flood waters may vary from gravel to clay within a few feet either laterally or vertically. Even where the surface topography is uniform the surface soil may vary in texture and depth between wide limits. It is generally true that the area of irrigable land in any project exceeds the available supply of water so that there is opportunity to select only the better lands for irrigation. There is often a strong temptation to the engineer who locates the distribution system to select compact and accessible units of land even though these may include soil areas of doubtful value as has been done for example on the Huntley, Shoshone, and Yuma Projects. The initial construction cost per acre of land served may be less if the water is distributed to the most accessible land, but when it comes to repaying these construction costs it becomes evident that productivity and not accessibility is the safer criterion for selecting land irrigation. The irrigation engineers of North Africa have found after years of bitter experience that their real problem is first to locate areas of good land in the desert and then conduct the water often long distances to reach that land.

Surface Topography—In selecting land for irrigation, a number of factors must be kept in mind. The surface topography must be such that the cost of leveling for irrigation is not prohibitive. Labor or money invested in preparing land for irrigation is just as definitely a capital investment as though it were invested in works for the storage or distribution of water. It sometimes costs as much as $100 per acre to level land for irrigation though such cases are exceptional. But there are large units of land put under ditch where the cost of leveling is as much as $35 to $40 per acre. Land with a good surface topography may be leveled for $5 to $10 per acre. The cost of leveling the land may be actually greater than the cost of the water yet too often it is not taken into account in advance as one of the factors to be considered in selecting land for irrigation.

Texture and Depth of Soil—The texture and depth of the soil is no less important than the surface topography. If a soil is to be continuously productive under irrigation its texture must be such that part of the water applied may percolate downward past the root zone to carry away any excess of dissolved salts that would otherwise accumulate by the evaporation of the water from the soil or transpiration from growing plants. On the other hand, the chief function of the soil is to serve as a reservoir in which water may be stored for use by plants from one irrigation to the next. To do this effectively the soil must be not only permeable to water so as to absorb water readily when irrigated but it should be deep enough and fine enough to hold several inches of available water within the root zone. Coarse sandy soils or a thin layer of good soil over a sand of gravel subsoil cannot hold a sufficient quantity of available water to provide the growing crop with a uniform supply.

Movement of Water at Roots—The third important factor of irrigated land has to do with the movement of water below the root zone. If the productivity of irrigated land is to be maintained there must be some percolation through the root zone in every part of the irrigated area. Unless such percolation occurs the dissolved salt brought into the soil by the irrigation water must in time accumulate in toxic quantities. In the ordinary course of irrigation, part of the water applied, and often too large a part, percolates through the root zone in the more permeable spots. Such excessive percolation is of no advantage but often quite the reverse. The aim of efficient irrigation is to distribute the water to the land in such a way and in such quantities that there may be some percolation through the root zone everywhere. In this way the excess of dissolved salts may be removed and an undue waste of water avoided. In any event conditions below the root zone must be such that the percolating water may be removed as drainage. Where such conditions do not exist naturally it must be possible to establish them artificially if the land is to continue productive.

The three essential features of irrigated land may be summarized as follows: The surface topography must be such as not to involve excessive cost for leveling; the texture of the soil must be such that it is permeable to water and sufficiently deep and retentive to hold several inches of available water within the root zone; and the subsoil conditions must be such as to permit the escape of water that percolates through the root zone.

Characteristics of Water—With respect to the character of the water, the essential requirements may also be stated simply. All irrigation water carries some dissolved material. The quantity may be small, as low as 100 parts per million, or it may be large, as high as 5,000 parts per million. In dealing with these proportions it may be kept in mind that an acre-foot of water weighs about 2.7 million pounds. The water that is applied to the land in irrigation is used or lost in three ways. It is evaporated from the soil, it is absorbed and transpired by plants, or it percolates through the root zone into the country drainage.

That part of it that is lost by direct evaporation leaves all of its dissolved salts in the soil, the part that is absorbed by plants leaves nearly all of its dissolved salts behind. It is only the water that percolates below the root zone that carries salt away. In this fact lies the significance of insuring that some water shall percolate downward through every part of the soil.

Owing to the fact that a large part of the water applied as irrigation is evaporated into the air either directly from the soil or from the leaves of plants, the soil solution is invariably more concentrated than the irrigation water. It is not uncommon to find that the soil solution in irrigated land contains as much as 5,000 parts or even 10,000 parts per million of dissolved material. This is a very different situation than exists in soils that are watered by rain or melted snow and

watered sufficiently to be leached frequently if not continuously. In such soils the solution contains from 100 to 1,000 parts per million of dissolved salts. When plant roots absorb water from the soil they do not take in the solution as it exists in the same way that a horse drinks water from a trough. They take the water from the solution and only such of the dissolved constituents as are needed for purposes of growth. As the soil solution becomes more concentrated it becomes increasingly difficult for the plant to absorb from it the water it needs. For most crop plants the limit of concentration of the soil solution is about 1.5 per cent or 15,000 parts per million. Crop plants differ somewhat in their limits of tolerance and they differ also as to the quantity of water they require. The average water requirement is probably not far from 400 pounds of water for each pound of dry matter produced.

The salts that are dissolved in the irrigation water or that exist in the soil solution have to be considered not only in relation to the crop plants but also in relation to the soil. The soil cannot be regarded merely as finely divided inert material in which the solution is held. It is an exceedingly complex system, some parts of which react chemically with the solution. As a result of these reactions certain constituents of the solution may combine with the soil and other constituents that were combined with the soil may pass into the solution. Such reactions are more pronounced when the solution is more concentrated. The results of these reactions between the solution and the soil may be manifested by pronounced changes in the physical condition of the soil as well as by changes in the chemical composition of the soil solution.

Permeability of Soil—The factor of physical condition that is most important in irrigated soils has to do with permeability to water. Permeability is directly influenced by certain of the reactions that take place between the soil and the soil solution. When a soil has been in contact with a concentrated solution in which the salts of calcium or magnesium predominate, the physical condition and permeability continue to be good if the concentration of the solution is reduced as by leaching with pure water. On the other hand, if the soil has been in contact with a concentrated solution in which the salts of sodium and potassium predominate the soil becomes puddled and its permeability is greatly reduced when the soil is leached with pure water. It has long been known that some irrigated lands become puddled or hard and impermeable to water. This condition has been thought to be due to action of the dreaded "black alkali," sodium carbonate. Recent investigations have shown that the soil may become puddled or impermeable from the action of sodium in the form of any salt. Even sodium nitrate has been shown to have the same effect as sodium carbonate. These facts make it important to take into account the character as well as the quantity of salts in irrigation water. Where the proportion of earthy bases in solution is less than the alkali bases, a condition that is almost certain to cause trouble, it is possible to change the balance of salts by treating the land or the water with gypsum.

There is ample evidence in our older irrigated areas of the significance of these differences in the quality of the water. There are extensive areas where through inadequate drainage the soil has become water-logged and salty and where complete and satisfactory reclamation has followed drainage. The Rio Grande and North Platte projects afford striking examples of such restoration. There are other areas as in the valley of the Great Salt Lake in Utah where the land that was once productive became water-logged after a few years of irrigation and has remained impermeable to water and consequently unproductive even though elaborate drainage systems have been installed.

It is generally assumed that the occurrence of alkali troubles in irrigated land is due solely to the excessive use of water or the lack of adequate drainage. As a matter of fact an irrigated soil may become water-logged and unfit for crop production without becoming salty, though instances of this condition are uncommon. But it is not uncommon to find instances as in Southern California where the soil becomes salty or impermeable and unproductive without becoming water-logged or showing need of drainage. The development of such conditions is likely to be associated with the sparing use of water containing less calcium than sodium in solution.

Water-Logging—Many of the first irrigation projects, especially those established 20 to 30 years ago, were put in without any thought of the need of drainage. Some of these early projects soon developed troubles from underground water. These troubles were generally ascribed to the excessive and reckless use of water by the farmers and drainage relief was first considered merely as an expensive alternative to the more economical and efficient use of water in irrigation. Our irrigation engineers have been slow in appreciating the fact that the salts brought into the soil by irrigation water must be carried downward by percolation and outward by drainage or the productivity of the land would inevitably be ruined. It is not so much that underground water causes a rise of alkali as that it prevents the leaching action of irrigation water that is necessary to keep the soil productive.

From this it may be inferred that the character of the water used in irrigation may be a matter of the greatest importance in determining the time that the land may continue to be productive. This is a matter of concern not only to the farmer on the land but also to the agency that provides money on long term credits either for the construction of the project or as loans for the development and equipment of the farms. Irrigation works are designed and built to last for many years. It is clearly the expectation that the agriculture that these works make possible shall be as enduring as the works themselves. Yet it has been the sad experience in many localities that after a few years of irrigation the land becomes unproductive and must be abandoned.

The factors of the character of the soil and quality of water that determine sustained productivity under irrigation are almost infinitely complex. Some progress has been made in recent years in understanding them but the work is only started. Twenty years ago there was very little agricultural information available to engineers concerning the potential productivity of irrigated land or the effect on the soil of the salts dissolved in irrigation water. Facts bearing on these subjects are being accumulated by agricultural investigators working for the federal government and the Western states. The importance of these investigations is coming to be appreciated not only by engineers but also by

financial men and economists who have to consider the advisability of financing the rehabilitation of existing projects or the construction of new ones.

Crops and Cropping Systems

Farmers on irrigated lands have a wide range of crops from which to select. Almost every crop known on the continental United States is grown to some extent under irrigation. About half our irrigated acreage is now devoted to forage crops of which alfalfa is by far the most important. One-fourth of the land is used for cereals. Something less than 10 per cent is devoted to fruit crops and the remainder is used for such crops as sugar beets, cotton and truck crops.

There appears to be rather more of a tendency toward crop specialization among farmers on irrigated land than elsewhere. This is particularly true with the growers of citrus and deciduous fruits, certain truck crops, and sugar beets. There are certain definite advantages to be obtained from specializing in one or in a limited number of crops and there are certain disadvantages also in this system of farming. The chief advantages are that the farmer who specializes on one or a very few crops needs less equipment than the one who grows many different crops. It is also possible for him to become expert in his work. He may learn how to get good yields and to control the insect pests and plant diseases of one crop while he could scarcely hope to do so for a large number of crops. The outstanding disadvantages are that a one-crop system of farming does not provide continuous productive employment throughout the year and, with some crops at least, better yields may be obtained from a system of rotation of crops.

It is seldom possible to determine in advance of experimentation what crops or what system of cropping is best adapted to a newly irrigated region. It may take several years for a group of farmers on a new project to find themselves and to learn the difficulties and the possibilities of a new region. Their first crops will naturally be alfalfa and grain. Then as they become acquainted with local conditions and accumulate knowledge through experience, they will work into specialties or adopt a system of diversified crops grown in rotation.

This has been the course of events on several of the older projects as for example the Salt River, Yuma, and Imperial Valley projects in the Southwest. It became apparent more than fifteen years ago that alfalfa and grain crops could not be expected to bring returns on these projects that would justify the cost of production and pay the long haul to distant markets. Furthermore there was need of a crop requiring summer cultivation in order to control the weeds that became serious in fields devoted continuously to alfalfa and grain. To meet this need experiments were made under the auspices of the federal Department of Agriculture with long-staple cotton. This crop yields a product that is relatively high priced and can bear the cost of transportation. Its use in rotation with grain and alfalfa affords an opportunity to clear the fields of weeds and the seed, of which it yields 2 to 3 pounds for each pound of lint, is a valuable by-product both as a source of oil and as a feed for live-stock.

The production of cotton is now well established on all the important irrigated lands in the Southwest from the Pecos Valley to the San Joaquin. Its successful establishment has involved the solution of a number of agricultural problems as well as the organization of the farmers for controlling supplies of planting seed, selling the crop, and financing its production. The returns from the crop have gone far toward making these projects prosperous and the incidental benefits, such as improved yields of other crops and community organization, have been well worth while.

Successful irrigation farming must involve relatively high returns from the land. The labor costs of production which include the distribution of water to the crops are higher than in ordinary farming. The fixed charges assessed for repaying the cost of constructing the irrigation works and for operating and maintaining them must be added to the ordinary fixed costs such as taxes and interest on investment. It is only by more intensive use of the land or by obtaining much larger yields that these added costs can be met if the products of irrigation farming are to compete in the same markets with the products of ordinary farming.

The working out of a system of farming best suited to an irrigation project is a problem which deserves co-operation between the engineering management, the bankers, and the farmers. Its successful solution is a matter of such great importance to the whole community that it merits the attention of the best intelligence the community possesses. It involves matters of crop production, of financing and of marketing. A compact, circumscribed community such as an irrigation project constitutes a definite social and economic unit like a large family. It may be in part self-sustaining but it requires many commodities it cannot or does not produce. In order to obtain these it must produce certain commodities for outside sale. What shall these be? How much of what is needed locally can be produced locally? Of the products that may be grown for outside disposal, which are best suited to the limitations of transportation? Such questions as these need to be clearly formulated and seriously considered, not only by the farmers themselves but by the whole community. In formulating these questions and in assembling the data needed for their consideration the engineer may render a very important service to the community. Such an undertaking calls for the clear and well-ordered thinking that characterizes the engineering type of mind.

Irrigation Farmers

It has been remarked above that there is a great diversity in the soil of an irrigated region. Such diversity is no less marked among the farmers. In any consideration of the factors that make for the success or failure of an irrigation project the character of the farmer must be taken into account. It is no less important than the character of the soil or of the water. When a new irrigation project is opened for settlement, people of all sorts and conditions flock in to take up the land. Some of them come with the expectation of making homes on the land and of making a living by farming. Many others have no thought of homemaking or of farming. Their aim is to get possession of land which may be sold later at a profit. In both classes one finds many individuals who know little or nothing of farming as well as those who lack the physical or mental qualities that are necessary to cope successfully with the new and often trying conditions of pioneer life.

There have been many serious misconceptions cur-

rent regarding pioneer conditions on newly irrigated lands. In many respects those conditions are less severe than those encountered by the pioneers who cleared and broke the prairies of the upper Mississippi valley. There is this difference, however, it takes more capital and more agricultural skill to develop and bring into production an irrigated farm than was required to make a self-supporting home on the humid prairies. The contrasts are more apparent, too, between the settled and orderly life of the older regions and the uncertainties of the new because of better communication. Modern pioneers to the new lands of the West are no less capable and no less courageous than their ancestors who settled Ohio and Kansas. Those early pioneers endured great hardships and made many mistakes. Many of them failed. With the lapse of time these mistakes and failures are largely forgotten and only the successes are in evidence or remembered. In the settlement and development of new irrigated areas there must be inevitably much hardship and many failures.

As the incoming settlers take up the land the initial conditions of diversity are emphasized. It is part of the equipment of a good farmer to be able to select good land and to appreciate its relative value. The natural result is that when the new region is finally settled, one finds the good farmers on the good land and the poor farmers on the poor land. While the situation is not peculiar to irrigated land, its consequences are made more conspicuous there because of the greater importance of community relationships and responsibilities. In an irrigated district each farmer is expected to contribute his share toward liquidating the cost of the project works and to the annual cost of operating and maintaining them. If he fails to do this, the burden falls heavier on his neighbors. If a few individuals in a community fail to meet their community obligations it is only natural that others, though possibly better able to do so, should mark time and wait to see whether the penalties for non-payment are really to be enforced.

The management of an irrigation project is essentially an engineering job. But the engineer whose lot is cast in such work finds his path beset with problems for the solution of which there are no formulas in his engineering handbook.

Sustained Productivity

There have been a number of instances both in this country and in the Old World where the productivity of irrigated land has been comparatively short-lived. In some of these the causes have been obvious, on others obscure. There appears to be no valid basis for the view sometimes advanced that irrigation farming cannot be continued indefinitely on the same land. Nor is there much foundation for the belief that irrigated lands are made increasingly productive by the salts carried in irrigation waters. Among the factors that influence crop yields, the so-called plant-food elements in the soil are probably not of the first importance. On irrigated lands as elsewhere, such factors as weeds, insect pests, and plant diseases are likely to be more potent in reducing crop yields than the lack of fertility as that phrase is commonly understood.

Irrigated lands may be made unproductive through the accumulation of salts in the soil or by the rise of underground water. These hazards are characteristic of irrigation and merit serious attention. The other factors mentioned above, that contribute to reduced production, operate on irrigated land as elsewhere. It is probable that the chief justification for a rotation of crops is that the practice affords an opportunity to keep down weeds and reduce the ravages of insect pests and plant diseases. It is well known that certain leguminous crops such as alfalfa and clover leave the soil richer in combined nitrogen which may benefit succeeding crops. And nearly every soil responds in productivity when its supply of organic matter is increased as by the application of manure or by plowing under crop residues. It is sound agricultural doctrine to recommend crop rotation, the use of farm manure, and of green manure crops whenever possible. But none of these nor all of them together can be warranted to maintain or increase the productivity of irrigated land.

Where the quality of the water or the methods of irrigation are such that soluble salts accumulate in the root zone of the soil, an ultimate decrease in productivity is inevitable. The symptoms or apparent causes of such decrease may be very different with different crops. With some crops the symptoms are similar to those of drought or shortage of water. With others there may be shown an increased susceptibility to disease. Certain of the non-parasitic maladies or "physiological diseases" of orchard fruits appear to be associated with conditions of malnutrition which may be due to abnormal concentrations of the soil solution. There is very little that is definitely known concerning these causes of reduced productivity. It seems highly probable, however, that other causes than the exhaustion of the supply of plant food must be found if this problem as it exists on irrigated land is to be correctly understood.

The causes that contribute to rapidly decreasing productivity on irrigated land are now under investigation by a number of state and federal agencies. It is clear that those causes must be understood and remedies devised or the future of irrigation in this country is in danger. The investigations now most actively pressed have to do with the alkali problem and with those non-parasitic diseases that are so serious in sections devoted to orchard fruits. The progress so far made in these investigations is encouraging and there seems to be good reason for hoping that the agriculture of an irrigation project may be as permanent as the dam.

Live-Stock Industries

The focus of popular interest in irrigation farming centers on crop production, yet the welfare of the people engaged in such farming is largely determined by their success in using or disposing of their crop products. Though much of our irrigated land is well suited to, and is used for, the production of forage and grain crops, many of the projects are located far from large markets so that their products must bear heavy transportation charges. When such bulky products as hay and grain must be shipped long distances to market, the cost of transportation becomes a large part of the market price. Wherever it is possible to do so, these bulky products should be fed to live-stock on the farm or at least within the community where they are produced. It may cost $10 per ton to ship hay or grain to market and $20 per ton to ship butter or meat animals, yet it takes at least 30 pounds of hay or 5 pounds

of grain to make a pound of butter or a pound of meat.

There are, in addition, two other valid reasons for feeding the bulky crop products on the farm. The first is that it provides remunerative employment at seasons when the labor requirements of crop production are low. The second is that farm manure is unquestionably helpful in maintaining crop yields.

A large number of irrigated areas are located in the midst of extensive areas of range land or between the range lands and live-stock markets. Such advantages of location should be utilized as fully as possible. The products of the irrigated lands such as hay, grain and beet tops are now used extensively for wintering range stock or for partly finishing cattle and sheep for slaughter. There are certain hazards and disadvantages to the use of crops in this way due to fluctuation of demands and of prices from season to season. In consequence the profits may be large one season and the losses may be heavy another season.

Returns are much more certain and in the long run, may be fully as good, where the forage and grain crops are fed to dairy cows and hogs. Dairying and hog production fit together well because the hogs make good use of skim milk and buttermilk which are by-products of dairying. Climatic conditions on many of the projects are well suited to these industries. Irrigated pastures of mixed grasses and clover for dairy cows and alfalfa pastures for hogs provide cheap, excellent summer forage. These conditions give our irrigated land advantages which may more than offset the handicap of distance from market and enable them to compete successfully with the dairy sections of the East and Middle West. In fact the center of the dairy industry is moving westward and on several of the northern and intermountain projects dairying is proving to be the way to economic salvation.

On some of the projects, dairying is made difficult or impossible because of the lack of suitable supplies of water for domestic and stock use. Where there is no underground water available or where it is very salty, it is not easy to carry on dairying. This is a fact which merits the attention of irrigation engineers, for the difficulty, where it exists, is one which they should find a way of overcoming.

Economics of Irrigation Farming

In a time like the present when agriculture is in a state of depression it is particularly difficult to formulate conclusions concerning conditions on the isolated and widely scattered irrigated areas. On many of them the pinch of deflation has been most distressing, on others it has been much less acute. On the whole, it appears that where the system of agriculture was fairly well balanced and particularly where dairying and associated live-stock industries were well established, there has been little downright hardship. There has been a pause in the expansion of operations and of credit that characterized the war period. Land prices have declined sharply, production less sharply.

There are two different points of view from which irrigation farming has to be considered. One is from the standpoint of the individual who is or may become engaged in it and the other is from the standpoint of the country as a whole. Farming under irrigation may be compared with dry farming which is often carried on nearby under similar climatic conditions or it may be compared with the more intensive farming that is possible under conditions of ample rainfall. When compared with adjacent dry farming, the chief differences are that the cost of production is higher per acre under irrigation, and consequently the returns must be higher than for dry farming if the enterprise is to be profitable. An assured supply of irrigation water reduces the hazard of drought but it does not protect against such troubles as hail and frost and the ravages of insect pests and plant diseases. The fixed and labor costs of farming with irrigation are so much greater than with dry farming that irrigated lands cannot be expected to compete successfully with dry lands in grain production.

The slightly larger yields obtained by irrigation do not justify the increased cost of water and labor. Each acre of irrigated land must be made to yield two or three times as much in crop value as dry land to make it pay. Comparisons between irrigated land and other equally expensive land in distant parts of the country are not satisfactory. There is a tendency to rate irrigated lands at prices rather above those of lands of equal productive capacity in humid regions, notwithstanding the fact that the labor cost of crop production is substantially higher under irrigation. The implication is that the agricultural value of an assured water supply is probably overestimated. If there is to be any material extension of irrigation in the West such extension should be determined largely by the needs of western markets for the products of irrigated land. It is not to be expected that these isolated lands located so far from eastern consuming centers can compete with eastern farms in such crops as potatoes and hay. In any event there is need for the greatest care in selecting the land to be irrigated. The future will undoubtedly see less irrigation of land of doubtful productivity.

Home-Making Value—From a national standpoint our irrigated lands have a value far greater than that of the contribution they make directly to our supply of agricultural products. These lands provide farm homes for possibly 100,000 families. They make it possible to utilize enormous areas of arid and semi-arid land for pasture and for grain production which could not otherwise be used.

These considerations cannot be overlooked in taking stock of the present situation or in dealing with the policy of future extensions. It seems altogether probable that the construction costs of the projects that remain to be built will be higher than for existing projects. While it is doubtful if present agricultural conditions justify the rapid and large-scale extension of the irrigated areas in the West it is true that the local requirements of other industries and developments appear to justify a steady forward movement in irrigation construction. There are many projects, large and small, yet to be built. Conditions change from year to year in this new country. Factors that determine the feasibility of a project are influenced by these changes. Meanwhile there is every reason for maintaining and protecting the welfare of the projects already built and of solving those problems which stand in the way of their continuing prosperity.

[*Further articles in the series will deal with past experiences and problems of reclamation and with future development. In next week's article Dr. F. H. Newell will summarize the twenty years of achievement in reclamation. The following week George F. Kreutzer will discuss land settlement problems.*—EDITOR.]

Locomotive Shop Served by 180-Ton Crane: M.-K.-T. R.R.

Transverse Track Layout—Main Building Houses All Shop Facilities—Enlargement and Future Transfer Table

IN A LARGE steel-frame locomotive repair shop recently erected at the Bellmead terminal of the Missouri-Kansas-Texas R.R. at Waco, Texas, the engines will enter and leave the building on yard tracks and all interior handling of the engines will be done by an overhead crane of 150 tons capacity. This arrangement avoids the expense of a transfer table, but the plans provide for such a table when the shop is enlarged to double its present capacity of twenty engines per month. The present and future shop layout is shown in Fig. 2, and directly behind the main building is the engine terminal.

The transverse type of arrangement of shop tracks and pits was adopted after consideration of such factors as man travel, handling of materials and engine parts, concentration of work of similar character, supervision of the shop and the adaptation of the present construction to a compact plan for future development. As shown in Figs. 2 and 3, the main part of the shop has two longitudinal bays, an 80-ft. erecting bay and a 71-ft. machine bay. Two overhead traveling cranes serve the erecting bay, the upper one being a 75-ft., 180-ton crane to handle locomotives and the lower one a 15-ton crane to handle material. There are fifteen repair pits, 50 ft. long and spaced 25 ft. c. to c. The pit tracks are extended 8 ft. into the machine bay, so that in front of the engines there is space for wheels within reach of the 15-ton crane of this bay which carries the wheels to and from the machines or the storage platform.

Two track connections are provided. One of the pit tracks at the south end is connected to a yard track and at the north end a through track extends across the shop. Engines entering in this way will be picked up by the 180-ton crane and placed at the assigned repair

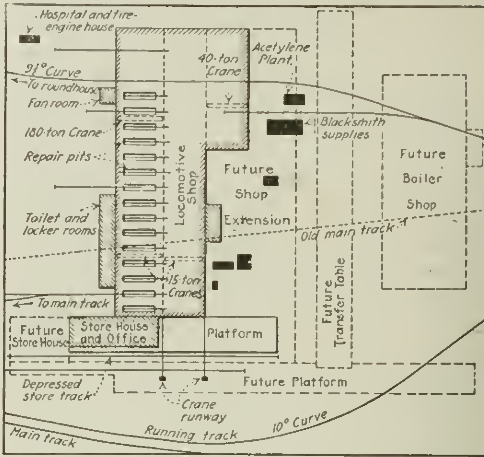


FIG. 2—NEW SHOP LAYOUT AND FUTURE EXTENSIONS

pit. In the same way, completed engines will be picked up and placed on one or other of the tracks for removal from the shop.

In the enlargement of the plant for its ultimate capacity of handling heavy repairs to forty engines per month, the shop will be widened instead of lengthened, each transverse track then having two pits. Thus there will be two 80-ft. erecting bays with two 71-ft. machine bays between them, each 80-ft. bay having a 180-ton crane for handling the engines. At the same time a transfer table will be provided in front of the new part of the shop and will serve both the repair shop and the future boiler shop, which will be 352x142 ft., located as indicated in Fig. 2.

Economical operation of the shop as now built and provision for future development with a minimum expense for interior rearrangement of tracks and pits were main factors in the design of the building. An outstanding feature of the work as now built is the concentration of all the principal shop facilities under one roof. The main building, which comprises the erecting and machine bays, is 477x156 ft., with a blacksmith and tank shop in an extension 202x71 ft., served by a 40-ton crane. At the rear of the erecting bay is an addition containing the toilet, locker and wash rooms. The boiler shop occupies the four north bays of the main building, next to tank and blacksmith shops.

FIG. 1—LOCOMOTIVE SHOP AT WACO, TEXAS; MISSOURI-KANSAS-TEXAS R.R.
The long steel building contains erecting, machine, boiler, tank and blacksmith shops. Storehouse and office building at right. Locker rooms in low structure behind main building. Power house at left.

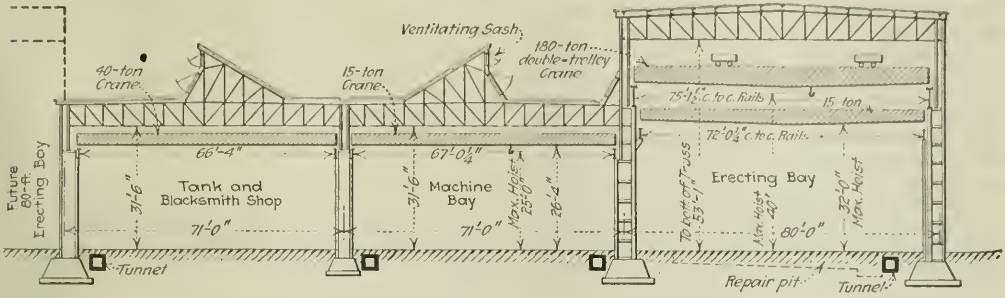


FIG. 3—CROSS-SECTION OF REPAIR SHOP

At the opposite end is a two-story extension 152x50 ft., with store rooms on the lower floor and the shop office and tool manufacturing room on the upper floor. A platform for the storage of castings and heavy articles adjacent to the storehouse is served by the 15-ton traveling crane of the machine bay. This crane passes through the end of the building and its runway extends over the storehouse platform and track, so that wheels and heavy castings can be handled directly between the car or platform and the shop machines. This layout of the several departments is planned with a view of providing the most convenient handling of material and reducing to a minimum the amount of man travel.

Steel-frame shop construction consists of columns spaced 25 ft. c. to c. longitudinally, connected by struts and girders and supporting the roof trusses and crane runways. In the lofty erecting bay the columns are offset near the top to form seats for the girders of the 180-ton crane; the 15-ton crane has its outer runway carried by flanged members forming offsets on the columns, while the inner runway is carried by brackets on the columns. The two lower bays have a modified pond truss or sawtooth roof arrangement with hinged sash on the glazed fronts. Hinged sash is provided also along the top of each side of the erecting bay. Steel sash with factory wire-glass composes almost the entire wall area, with ventilating sash in many of the panels. The ends, however, are partly of brick. Track entrances are fitted with swinging doors of steel frame and steel sash. The roof is of cement tile laid on the purlins and covered with composition roofing. Mastic surface on reinforced concrete is used for the shop floor. Electric current for power and lighting, purchased from the Waco plant of the Texas Power & Light Co., is distributed by cables and conduits laid in floor conduits. New machinery equipment will be used throughout, with individual motors for the tools and other machines. A circuit with self-registering apparatus provides for checking machine performance. For heating the main shop there is a fan system by which air taken from the outside is warmed by being passed over steam radiators and then blown through underground ducts to vertical pipe branches with discharge hoods about 8 ft. above the floor. Radiators for direct steam heating are used in the offices and store room. Steam and compressed air for the shop and engine terminal are supplied from a power house with two 328-hp. boilers, two air compressors of 2,000 and 500 cu.ft. capacity and duplicate fire pump equipment. Oil fuel is used, but the plans provide for future coal and ash handling facilities if these should be necessary. This building is of brick and steel, with an 8-ft. concrete smokestack 177 ft. high.

Minor works now being built as part of the shop plant include a supply building for the boiler and blacksmith shops, a paint shop, fire engine and hose house, first-aid room and a brick lavatory and locker room for the roundhouse employees. For safe and convenient communication between the plant and a city street a concrete subway 8x8 ft. and 355 ft. long has been built under the intervening freight yard. At the rear of the repair shop is the engine terminal, with 15-stall roundhouse, back shop, two ashpits and facilities for supplying the locomotives with water, sand and fuel oil.

Preparation of the site required about 140,000 cu.yd.

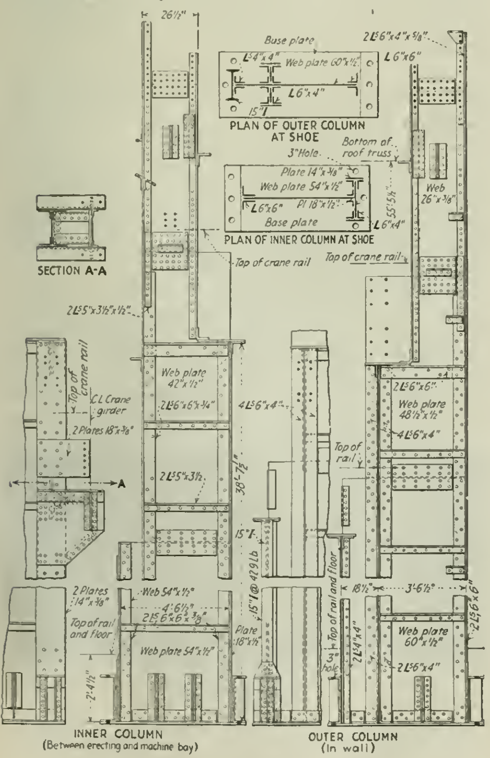


FIG. 4—COLUMNS AND CRANE RUNWAYS

of grading and about a mile of relocation of the main line, the old main track now forming the east approach to the shop and terminal plant. The general contractor for the building was H. D. McCoy, Cleburne, Texas; grading and concrete work, including foundations and shop pits, J. E. Hutt Contracting Co., Kansas City, Mo.; furnishing and erecting structural steel, Mt. Vernon Bridge Co., Mt. Vernon, Ohio; electric power installation, Beckett Electric Co., Dallas, Texas.

This Bellmead shop plant represents the last item in an extensive program of shop, yard and engine terminal improvements carried out on the Missouri-Kansas-Texas Lines during the receivership which ended early in 1923. All design and construction work are under the direction of F. Ringer, chief engineer, M.-K.-T. R.R.; assisted by J. M. Metcalf, principal assistant engineer; A. L. Sparks, architect; and M. C. M. Hatch, mechanical engineer. E. W. Metcalf is engineer in charge at Waco. The shop itself is estimated to cost $1,700,000.

A Study of Vibration in Francis Type Water Wheels

Serious Vibration in 40,000-hp. Unit Cured by Increasing Runner Clearance—Device Measures Pressure Variations

A PAPER on vibration in Francis turbines was presented at the Pacific Coast convention of the American Institute of Electrical Engineers held at Del Monte, Calif., early in October, and was frankly discussed by manufacturers and power company engineers with the result that facts of great importance in the field of water-wheel design were brought out. The paper, by Roy Wilkins of the Pacific Gas & Electric Co., was entitled "A Study of Irregularity of Reaction in Francis Turbines." The following is a resumé of chief points of the paper combined with notes on the discussion from the floor of the convention as reported by a member of *Engineering News-Record* staff. One point not mentioned in the paper or in the discussion, but which should be pointed out so that the reader may grasp the situation, is that the turbine in question has a capacity of 40,000 hp.

The power company found a newly installed Francis turbine which had excessive vibration and proceeded to develop means of studying and analyzing the causes. The vibrations were found to be caused by changes in hydraulic pressure and to have a period in the order of electrical frequencies commonly used; hence they could be recorded by standard oscillograph methods. A device was built for measuring these pressure variations which consisted of a $1\frac{1}{2}$-in. pipe union carrying a diaphragm of spring steel to the center of which was attached an arm extending to a pair of microphones of the variety used in wireless transmitting sets.

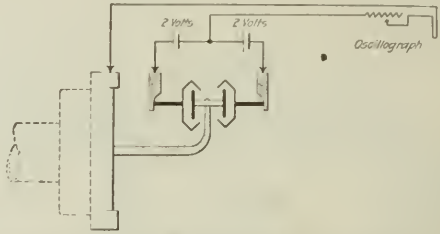


FIG. 1—DIAGRAM OF CONNECTIONS IN THE RECORDING DEVICE

The outer elements of these microphones and a wire grounded to the union, as shown in the diagram, formed an elementary bridge with microphones and batteries as members and the oscillograph element as detector. This device could be tapped into turbine casing or penstock at any convenient point, a $\frac{1}{2}$-in. connection, if not too long, being ample to actuate it. In most of the records made with the oscillograph the vibration of a 60-cycle wave was also recorded simultaneously on the sensitized surface for purposes of comparison.

The first tests were explorations of pressures on the runner vanes. These were made by the use of a Pitot tube traveling with the runner and passing to the center of the draft tube whence a packing gland made connections leading out to the device described above. By filling the rotating tube with air under pressure and then closing it at the instrument end, the air is trapped under the water pressure in the turbine and centrifugal action and leakage are minimized. In this way the whole face of the runner entrance was explored under actual operating conditions. Records were made of pressure variations occurring at various points in the revolution.

Having completed an exploration of the unit that vibrated excessively, the newly developed device was used to test other reaction turbines of the system, the idea being to compare the amount of vibration with features of design in several turbines under different conditions of load, head, etc., to determine, if possible, what features or conditions caused excessive vibration.

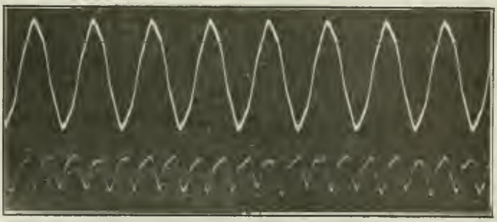


FIG. 3—RECORD OF RESONANT VIBRATION—THE OBJECTIONABLE SORT

This unit had 19 runner vanes and 20 guide vanes. The hum was apparent in both powerhouse and penstock. The generator of 5,000 kw., was 220-lb. pressure and 450 r.p.m. The upper curve is a 60 cycle wave recorded simultaneously for comparison.

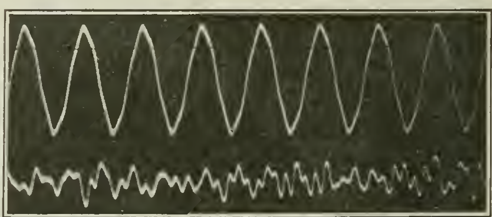


FIG. 4—RECORD OF IRREGULAR VIBRATION—THIS WAS NEITHER AUDIBLE NOR HARMFUL

This unit had exactly the same scroll case, speed, water pressure and capacity as the other unit, but had 17 runner vanes and 20 guide vanes. The pressure variation shown is as high as in the other case, but there was no harm or vibration.

The final conclusion was that vibration in the unit giving trouble would be decreased by increasing clearance between the guide vanes and the turbine runner. It was decided to do this by cutting down the runner with an oxyacetylene torch. The cuts were made on the 15-in. face of the runner vanes where the metal was 1⅜ in. thick, a 15x2½-in. piece of metal being taken off each vane, thus decreasing the runner diameter by 5 in.

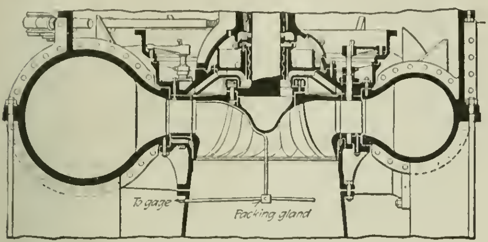


FIG. 2—LOCATION OF PITOT TUBE IN RUNNER

This change increased the thickness of the water ring around the runner and very materially decreased the vibration. How this change has affected the efficiency of the unit and whether a new runner, finished in the shop to the smaller diameter, is to be substituted later, was not announced but at least the information brought out establishes the fact that most of the vibration was eliminated by increasing the thickness of the water ring around the runner.

Tests made on this and on other units led to the conclusion that a sufficient thickness or width of the water ring around the runner is essential if harmful vibration is to be prevented. The power company interpreted their tests to indicate that if the water ring was thick enough the shape of the guide vanes was not important. This latter point differed from the conclusion of the water-wheel manufacturers as expressed at the convention, their tests and experience indicating better results with improved guide vane design.

FIG. 5—PIPE UNION CARRYING DIAPHRAGM AND MICROPHONES

Until recent years irregularity of reaction has been of little importance and has been treated as a more or less necessary evil. However, the danger of vibration increases with the head, and features of design satisfactory for low heads may give trouble under high heads. Uneven or irregular vibrations do not set up a condition of resonance and therefore are less audible and less injurious to the equipment than uniform pulsations which cause resonance and permit a maximum amplitude of vibration. For this reason certain limitations should be observed with regard to the relative number of guide vanes and runner vanes. If there are one, two, four or six more runner vanes than guide vanes, once every revolution, due to the vernier effect, a corresponding number of runner vanes simultaneously pass guide vanes, thus harmfully combining the effect of pressure changes due to the transit from the leading to the trailing side of runner vanes. On the other hand, with three, five or seven more runner vanes than guide vanes, the vernier effect occurs irregularly and although there is the same combining of pressure changes, these combinations recur at irregular intervals and cannot do the harm that results from resonant vibration.

The entrance angle and the amount of change in direction which the water is obliged to make between guide vanes and runner is another factor in the complex cause of vibration. There must not be; at any gate opening, necessity for a change of direction in the flow of water between guides and runner greater than can be accomplished without disrupting stream lines. Of course the permissible limits of this angular change decreases with decreased clearance and with increased head.

Reference was made in the discussion to vibration in large units under low head that had been muffled by heavy bracing; there was frequently repeated commendation of the device for recording turbine vibration described in the paper and a general agreement that much more study of the subject was needed particularly with the co-operation of power companies and water-wheel manufacturers.

A British Narrow-Gage Railway

A 12-mile line of 23½-in. gage has become a part of the system of the Great Western Ry., England, by the recent consolidation of British railways. This is the Vale of Rheidol line, in the mountainous part of Wales. With one continuous grade of 2 per cent for 6¾ miles, engines of relatively high power are required and the Great Western Ry. shops have recently built two 25-ton side-tank engines of the 2:6:2 type having a tractive effort of 10,510 lb. Double-truck open cars are used in summer, having the roof supported by light posts and carrying curtains to be let down in wet weather. Each car, 32 ft. long and 6 ft. wide, accommodates 48 passengers on cross-seats, an aisle or gangway being left along one side.

Through the Reclamation Country

By F. E. Schmitt
Associate Editor, *Engineering News-Record*

THIS is the sixth of the series of letters written by Mr. Schmitt during a journey recently made through the West in which he visited irrigation projects, studied developments, and interviewed builders, operators and settlers, in order to present to our readers the actualities of reclamation as revealed to an unprejudiced investigator.

The series of letters began in the issue of October 4.

Delhi, Calif.

HERE at Delhi is located the second and newer of California's state-aid irrigation settlements. Much can be learned here about the difficulty of getting under way on an irrigated farm. It puts emphasis on the fact that the settler's money problem at the time of first starting out is one of the most difficult elements of irrigation development. But this fact is apparent on any reclamation project; few or none of them are fully settled up, and starting up may be seen in all its phases, in addition to which its long-time effects are more or less evident. It seems that many of the troubles and bitternesses existing on the projects trace back to the initial money difficulties.

A banker in a project town told me, in getting down to brass tacks on reclamation troubles, "This irrigation farming isn't a poor man's game. The man who has only $1,000 shouldn't expect to come here and make a go of it." And Walter E. Packard, superintendent of the Delhi settlement, said something similar in speaking of how he assures himself not only that the intending settler is suited for farming but also that he has sufficient capital: "The financial problem of the settler is the most important one we have to deal with in developing our project."

Estimates made by various men on reclamation projects indicate that 30 to 35 per cent of the original settlers are still there, or that about twice as many as are now there have come and gone again. Since some few left because they could sell at a profit, this probably means that there have been two "crops" of settlers. Many of the first crop were squeezed out by the consequences of trying to start out without money.

Initial Money Needed—It costs more to start up farming under irrigation than elsewhere. But most settlers come to a reclamation project with very little money to spare. On a very optimistic guess based on a few statistics, it might be said that the average settler has $1,000 to $2,000 when he first sets foot on his land. He must spend some $4,000 to $6,000 before he is established and has a crop in prospect. Where is the money to come from?

Two bankers may be quoted. A Joint Stock Land Bank official, when the question was put whether it is easy for the reclamation farmer to get money for starting in, bluntly said no; that there is no security for a loan. The case is the same as that of a home builder who owns a lot and wants to build a house but has no money—the lot is no adequate security for the house loan. Building-loan systems have been worked out for the latter case, but no such system has been established for the reclamation farmer. I asked a Federal Land banker, "Can a method of financing the reclamation farmer's start be worked out?" He answered, "I see no way in which it could be done"; but he did express himself hopefully about the method adopted by California—a state loan backed by retention of title and further secured by state supervision of its expenditure, which is not very far from a building-loan system.

Figures on the farmer's initial money requirements differ widely but a little generalizing may help to explain. He comes on a raw, unleveled and unfenced piece of land with a ditch leading water to one corner of it. He must build distributing ditches, which may cost $10 to $15 per acre; he must level his fields to receive the water and border them to retain it, at a cost of $10 to $100 an acre; he must spend $2,000 to $2,500 on fencing the land, building a house and barn, and buying stock and tools—and this is a low estimate. Finally he must plow and seed the land (another $10 to $40 per acre) and then sit down and feed his family while waiting for returns. The case is just the same on a Carey Act or district project; reclamation problems are not a particle different from irrigation problems on other projects.

For Delhi, Mr. Packard figures as follows: $50 an acre for the distributing pipe; $20 for leveling (this is a minimum estimate, and under the bad loose-sand conditions at Delhi is likely to be exceeded often); $85 for buildings, water supply, etc.; a total of $155 per acre—all this after the settler has bought the land at $220 per acre! And the farmer makes his payments on all this money, *with interest*, and pays his water charges too. He pays or he gets out.

But to return to the reclamation project: Some money can be borrowed on the raw land, of course—at 10 per cent, a ruinous rate for fixed capital investment. The shrewd and hardy pioneer will do without usurious loans where possible, and manage by hook or crook to dig his way through the first year without much money to speak of. But this type of man is an exception, and it is hardly surprising under the circumstances if more men fail than pull through during the pioneer period. Yet many serious-minded people profess to regard the two to three crops of settlers as an indictment of reclamation, or of governmental awkwardness or something. Half a dozen farmers and irrigation managers have told me that they see no way of avoiding the three crops, and that the weeding-out process is inevitable.

California State-Aid Plan—On the California state settlements, the state finances the farmer's start, and it also requires that he must have money enough of his own to pay for 10 per cent of the cost of the land and 40 per cent of the improvements. The whole case is extremely interesting, but the point for the present is the result, as compared with reclamation results: At Delhi the settler has to invest very much more in the land than on any reclamation project, has to invest just as much in improvements, and has to repay in full, with 5 per cent interest running from the very first day; and practically 100 per cent of the farmers there manage to do this. The unfinanced reclamation farmer, with much less to pay and with the interest on the cost of the irrigation works generously thrown off, fails in 50 per cent of the cases, and even where he survives he claims (or his loud-voiced representa-

tives claim) that he cannot pay the modest construction cost installments, *which are less than interest on the cost.* The comparison is not to the credit of the reclamation farmer; but it shows, among other things, that initial financing is a very important matter.

There is something to be said on the other side of the case. I have seen a number of reclamation farmers who started out with nothing and made a pronounced success—on the North Platte, Grand Valley, Minidoka, Umatilla, and Newlands projects, and probably they can be found on all. One of these farmers said, "A man who gets right down in the dirt and roots can't fail to make a success of irrigation farming here"; and he was one who had had no farming experience, being a former railroad carpenter. Genuine pioneering, in other words, still has its place.

Inflated Ideas of Pioneering—The oldtimers who went out into the Western forests and prairies to hew out a home did not generally start out with money, I believe, or get any extensive bank loans, but made a start somehow (though doubtless a lot of them failed, too). Irrigation farming is said to be harder than making a start in the woods, but the Mormon immigrants that finally reached the Great Salt Lake desert and irrigated it did not make a start with money, but very successfully starved themselves through the first year. Allowing for all the difference between former and modern conditions and needs, one is bound to give much weight to the opinions of long-time observers of irrigation conditions who say that one of the weaknesses of irrigation development is in the quality of the settlers, their inflated expectations, lack of readiness to endure hardships, and lack of instinct to help themselves and to win out. A Washington engineer attributes many irrigation failures to amateur settlers who "thought they only needed to tickle the soil to become rich, and when they found that they had to work two or three years they gave up."

Nevertheless, the settler's finance problem strikes me as very serious. The lack of reasonable credit discourages and pinches many who could otherwise make a successful start, and it loads up others with heavy interest charges that force them to plan their whole system for making money rather than making a living. It also leads to the loan company or banker becoming more important than the government or the project manager.

There are failures even under the Delhi system. But the failures are detected quickly (Delhi is less than three years old) and are weeded out promptly without the obstacle of ill-guided Congressional or Departmental mawkishness. The state is in the position of primary creditor and asserts itself; if a man is closed out it is the state that closes him out, and it does so before the state's equity has become impaired. On well-managed private or district projects something of the same kind happens. On federal reclamation projects the government never takes action to protect its lien or its equity but the loan creditor is always the one who closes the farmer out. So, very naturally, the mortgage or bank loan is the important obligation to the farmer, while the government obligation is unimportant—so unimportant that it really isn't there at all. As a private project manager told me, "We close out the failures promptly. The government can do the same thing; and it would, if it were left alone by the Secretary."

Project Management—As a matter of fact, the ordinary reclamation project may be compared to a $5,000,000 to $15,000,000 corporation doing a yearly business of several million dollars. The project manager is the executive head of this enterprise, and if he is supposed to develop the property and make it efficient he ought to have just the same freedom of action as the president of a manufacturing or commercial enterprise of the same size. But under the Department's practices the project manager has very little executive authority and is not expected to lead; he is powerless to prevent his farming community from going to the bad or to lead it on to improved methods of work.

This point is important because hardly any of the reclamation projects that I have seen or about which I have heard are up to a productive efficiency that might reasonably be expected of them. Since irrigation costs money, the land should be brought to high productivity, as against the very mediocre productivity shown by the crop figures which I reported last week. Many of the projects raise alfalfa as one of their main crops, and they ship it as hay, a low-grade crop, when they might feed it on the farm and ship milk and butter. Dairying is very inadequately developed on most projects, so farmers, business men and agricultural experts say. John F. Richardson, the Newlands project manager, who has worked specially hard to bring up dairying, says, "Every farmer that has good cows, tends to them decently and understands them, is getting along and paying his bills." And he explained that the project office and the experiment station there are constantly preaching the doctrine of "cow dung, elbow grease and butter fat" as the way to success.

Selecting the Settler—One interesting thing in the Delhi system is its wide difference from that by which reclamation projects are started up. At Twin Falls I heard a lively eye-witness story from a man who former lived in Billings, of how the Huntley reclamation project was opened with a grand land lottery. High officials of the Land Office were there from Washington—how on earth they butted their way into a reclamation proceeding I can not imagine—a little girl in a pink sash drew tickets out of a barrel, and lucky land-gamblers who never intended to farm got the first pick of the most valuable pieces of land, which they sold the same day at a huge profit. That barbarous method has not survived; moreover, under the conditions of the past few years there has been an automatic selection of settlers, for those who came were largely men anxious to build up a farm. But it still is true in all federal and in most private irrigation developments that the new settler is simply dumped on the land and allowed to wrestle with the severe problem of financing and the difficulties of a strange soil and country without the slightest help.

There is no provision in the reclamation law for financing the settler. It has even been decided by legal talent that the Reclamation Fund can not be used for giving the settlers advice. The results obtained on the projects, so far as I have been able to see, are fully as good as can be expected under these circumstances. All through, the project managers are in the difficult and uncomfortable position of being expected to develop their projects into successful farming communities by sheer faith and hope. They have performed brilliantly, even if they are engineers.

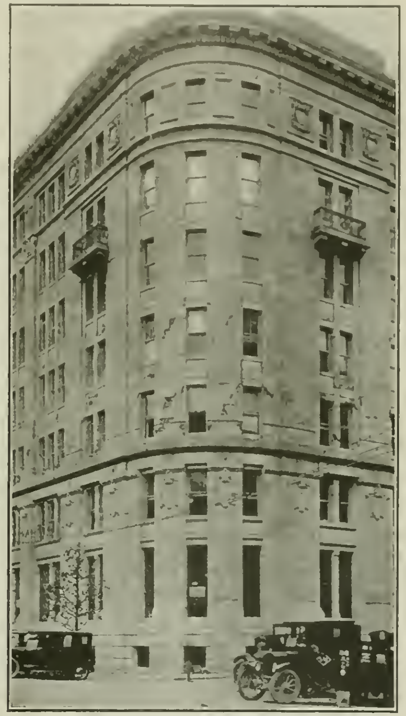
How Three American-Built Steel-Frame Structures in Japan's

Photographs Supplementing Report in Last Week's Issue by Wilbur S. Sample, Engineer

THE N. Y. K. BUILDING—No permanent distortion of the steel columns occurred but a large percentage of the masonry piers enclosing the exterior wall columns and the plastered partitions between the interior steel columns were shattered.

Capital Withstood the Violent Earthquake Shocks of Sept. 1

For the George A. Fuller Co. of the Orient, Which Built the Modern Structures in Tokyo



THE JAPAN OIL BUILDING—Steel frame proved adequate, the principal damage being identical with that in the N. Y. K. Building, noted on facing page.

THE MARUNOUCHI BUILDING—Another evidence of the stability of the modern structure. The main damage to masonry was below the fourth story. Reinforced-concrete floor slabs and interior walls stood up well

A Novel Type of Filter

By George W. Fuller
Consulting Engineer, New York and Philadelphia

Abstract of a paper read Oct. 16, 1923, at Conference on Pollution of Streams by Industrial Wastes, Held at Engineers' Club, Philadelphia.

STREAM-LINE filters were one of the most interesting exhibits at the Shipping, Engineering and Machinery Exhibition at Olympia, London, in September. They are the [patented] invention of Dr. H. S. Hele-Shaw, last year President of the British Institution of Mechanical Engineers.

The principle of this filter was discovered last winter while experimenting with lantern projections to indicate the behavior of films under pressure in connection with the Theory of Stream-Line Motion, established by Dr. Hele-Shaw. Announcement of the discovery was made before the Royal Society May 10, 1923.

In its simplest form this filter is made of a pack of specially prepared paper, impervious to water and oil and somewhat roughened to provide passageways, the pack being held within a container between two pressheads. One of the pressheads is movable and provided with a screw arrangement for suitably compressing the many hundreds of sheets which make up the paper pack. Through the entire pack from presshead to presshead are two alternate sets of circular holes, the larger being for the influent and the smaller for the effluent. At one presshead are channels through which, under such pressure as desired, the influent is led to each of the openings of larger diameter; and at the other presshead are channels connecting with the smaller holes in order to remove the effluent. The influent, even under heavy pressure, can pass from the larger tubular openings only through the laminae of the heavily compacted pieces of paper, with stream-line motion, into the smaller tubular openings which form an exit from the filter.

These filters are built of the horizontal or vertical type. The largest stream-line filter exhibited at Olympia consisted of a battery of 16 vertical filters, each pack containing 16,000 sheets, 256,000 sheets in all, with 32 influent openings making "the total number of filter units 8,192,000." Its rated capacity was 10,000 gal. per hour.

Cleaning—Stream-line filters require frequent cleaning, depending upon the quantity and quality of influent filtered since the preceding cleaning. This is done in one or both of two ways: Either (1) the deposit on the walls of the influent tubular openings is pushed through suitable ports in the presshead by means of light free-fitting pistons which are actuated by the pressure normally used in forcing the influent through the filter; or (2) the deposit is removed by forcing the effluent back through the effluent openings, through the laminae of the compressed paper pack, thence through the walls of the influent tubular openings and out through a suitable port. I saw several packs of paper dismantled after more or less use in filtering various substances and I was impressed by the complete absence of stain or other sign of service by the paper, other than at the edges of the influent openings.

Accomplishments of edge filtration, as distinguished from ordinary filtration through a body of granular material, depend upon the ability to regulate the attenuation of the films in which the liquid passes in stream-line motion. It is essential that the material used in this new filter have a rough surface so as to provide passageways, as satisfactory results do not appear to be obtainable with smooth surfaces. The special paper now used is not only impervious and relatively cheap, but its flexibility allows pressure to be applied to the packs in varying degree, thus providing a control for the size of the passageways. As a result of passing certain mixed liquids through the stream-line filter several times, and increasing the pressure on the paper pack between each filtration, it is understood that different substances are removed each time, thus accomplishing what for convenience has been designated as "fractional filtration." The paper in use is said to withstand ordinary acid solutions up to 10 per cent strength, but filtration is interfered with by alkalies approaching 1 per cent.

Some of the accomplishments of the new filter are as follows:

Removes the color or stain from moorland swampy water.

Produces a colorless effluent from a solution of erythrosin when diluted with 5,000,000 parts of water, and having a brilliant orange color with fluorescent green glint.

Produces from milk a clear effluent, nearly tasteless.

Extracts the oil from feed water.

Separates water and impurities from oil.

Extracts 30 per cent of the salt in sea water.

Decolorizes unrefined sugar.

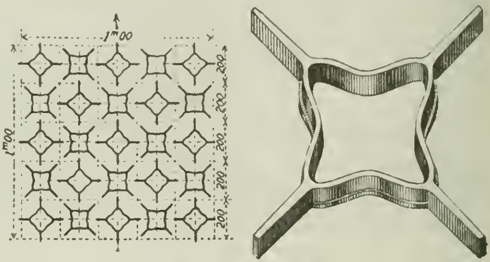
Separates cyanogen from gas house sludge.

Reduces dilute activated sludge to a 60 per cent water content.

It is too early, of course, to say much as to the economic worth of this filter in the industries or to outline the scope of its benefits to science. But the indications are that it will have a bright future along many lines of activity.

Armored Concrete Pavements in France

ISOLATED sections of concrete pavement strengthened against wear by embedded iron castings arranged symmetrically as illustrated, have been tried out successfully in a number of French cities. In constructing this pavement the base of lean concrete is leveled and smoothed with a coat of mortar on which the castings



CAST-IRON UNITS EMBEDDED IN CONCRETE PAVEMENT

are arranged by hand and then filled flush with a rich concrete. The castings, as illustrated, are about 2½ in. deep and weigh about 1¾ lb. each. Their shape is such as to provide quite even distribution of metal in the surface of the concrete. There are about 25 castings per square yard. It is stated that wherever it has been tried this pavement has stood up remarkably well under heavy traffic.

Boating on Hetch Hetchy Reservoir

The completion of the Hetch Hetchy dam in the Yosemite National Park by the City and County of San Francisco for water supply purposes raised the question as to who had control of the renting of boating and other recreational facilities on the reservoir, which will be about seven miles long and have an average width of one-half mile. According to a decision rendered by John H. Edwards, solicitor of the Interior Department, a director of the National Park Service under the supervision of the Secretary of the Interior "has exclusive power to grant any concession affecting the Hetch Hetchy reservoir or the lands appurtenant thereto which will not in any way materially injure the structures of the reservoir, interfere with, or hinder the city's use of it, or in any way pollute the waters thereof."

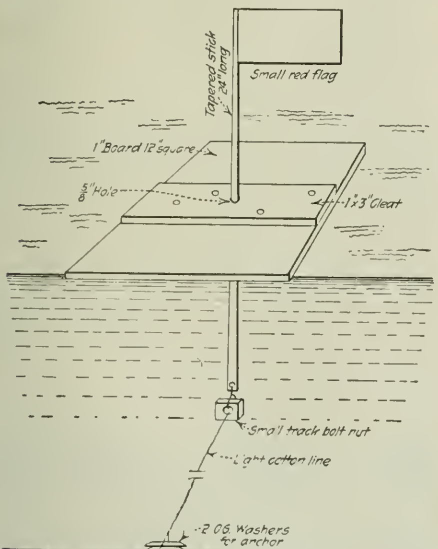
From Job and Office

Hints That Cut Cost and Time — For the Contractor and the Engineer

Simplifying the Taking of Soundings Under Adverse Conditions

By E. B. Fauntleroy
Engineering Department, Norfolk & Western Ry., Norfolk, Va.

Taking soundings over a wide area, congested with shipping, where the water is deep and usually fairly rough, is a problem the solving of which may require considerable ingenuity. These obstacles are all encountered at the coal piers of the Norfolk and Western Ry. in the outer harbor at Norfolk, Va. Here a light wind makes navigation in the ordinary skiff uncomfortable; large steamers, tugs and small boats



FLOATING TARGET FOR TAKING SOUNDINGS

are numerous, the tide is strong and water from 35 to 50 ft. deep.

Soundings are taken semi-annually. At right angles to the docks lines are run out at 50-ft. intervals and soundings taken on these lines at 10-ft. intervals up to 50 ft. out; thence every 25 ft. up to about 150 ft. out. The remaining area in front of and between docks, out to and across the channel, is divided into 100-ft. squares at the corners of which depths are measured. Along the docks a light graduated wire on a wooden reel for measuring distances out and a small rowboat serve admirably.

In the much used channel where there is more sea and where waves from passing steamers are bothersome, the problem is difficult. Here it is impossible to stretch a wire for any length of time, and a small boat must be quickly handled to prevent being run down; the tide is unusually strong and the water 40 to 50 ft. deep. To mark points on the range lines a small floating target as shown in the sketch was effectively used, was easily made and could be quickly set and moved. These targets were set from 200 to 600 ft. apart as required and distances measured with a light wire 200 ft. long, using two boats with detachable motors. With this equipment and using fixed points on shore, the intersections of the range lines could be accurately located and the work done with despatch.

Moving 7,500-Ton Office Building to Provide for Street Extension

Moving a seven-story office building of the Illinois Central R.R. at Chicago is one of the latest examples of the success with which large structures can be transferred from one site to another. The building is on the southeast corner of Michigan Ave. and Roosevelt Road (or 12th St.) and had to be moved 85 ft. south to permit of extending Roosevelt Road to the lake front. This structure, originally the Ashland Block, was torn down and rebuilt on its present site in 1890. It is about 130x80 ft. in plan, with its narrower side on Michigan Ave. and in the direction of travel. At the middle of the rear a court or recess reduces the width to 64 ft. The height is 100 ft. from street to top of parapet wall. Weighing 7,500 tons, it is said to be the heaviest building ever moved.

The building is of composite construction with exterior and interior brick walls, cast-iron columns, I-beam girders and wood joists. The outside walls and interior corridor walls are brick bearing walls, but in the two street fronts the walls do not extend below the ceiling of the first floor, being supported by cast-iron columns standing on stone piers whose tops were in the basement. Cast-iron interior columns in two sections of the building carry steel I-beam girders running lengthwise or east and west. Upon these I-beams are wood joists and wood flooring. Wood frame and composition covering constitute the roof. Originally the column spacing was about 17x20 ft., with the longer spacing north and south. A few years ago the east portion of the building was strengthened, on account of increased floor loading, by the addition of six intermediate cast-iron columns carrying I-beam girders and reducing the panel spacing to 17x10 ft.

Actual moving operations were limited to the period from 5 to 8 a.m. each week day, by order of the South Park Commissioners, so that traffic could be diverted from Michigan Ave. during the operations, such diversion being impracticable for the later heavy traffic on this congested thoroughfare. Moving was begun Sept. 24 and finished Oct. 3. Interior shoring was used only in the first-floor openings in bearing walls, to support the walls above these openings.

Although the distance moved was not great the work was made difficult by the small space available. Since the rear of the building in its new position is only 16 ft. from another structure there was no room for a straight

pull with the hauling cables and these cables had to be led out to capstans placed in an open lot at the east side of the new site. Deadmen composed of steel rails were driven into the ground within the 16-ft. space and to these were shackled steel sheaves giving the cables a right-angle turn. Similar sheaves were shackled to heavy timbers under the building and bearing against the underpinning on which the building was carried. The cables were led to and fro under the building in the usual manner and the free ends were carried across the rear of the building to four two-horse capstans on the east side.

Timber blocking was built up in the usual way on the concrete floor of the basement and wedged tightly

MOVING 7-STORY OFFICE BUILDING IN CHICAGO
View looking west along Roosevelt Road. The building is being moved south for the widening of this thoroughfare. The tall tower in the distance, beyond the elevated railroad, is one of the connecting towers for the long Roosevelt Road viaduct, crossing railway tracks.

against the building, which was supported by needle beams resting on lines of stringers along both sides of the walls and columns. Several of these stringers were timbers 20x20 in. in section and 90 ft. long. Steel plates under each stringer rested on steel rollers riding on four lines of steel rails carried by the blocking timbers. Ordinary building jacks or screw jacks were used to take the load when separating the building from its foundations. After cutting the brick walls and cutting the cast-iron columns below the first floor level by means of torches, the building was ready to be moved. New concrete foundation walls and spread footings for the columns were built in advance on the new site, the walls being carried 3 ft. above basement floor.

In addition to the main movement to the south, the building had to be moved 6 in. westward to adapt it to the revised building line of Michigan Ave. This lateral movement was effected by placing the rollers at a slight angle across the lines of rails, so that for part of its travel the building moved diagonally or southwest. After the building reached its final position, a brick wall was built on top of the concrete wall between the large timbers and when the masonry had seasoned the weight was transferred to these piers by jacks, the timbers being then removed and the wall completed.

The moving of this large building was planned and directed by the Chicago Terminal Improvement organization of the Illinois Central R.R. of which Daniel J. Brumley is chief engineer. The work was carried out by W. H. Brown & Co., Chicago, with Hugo Filippi as engineer and superintendent in charge.

From Job and Office

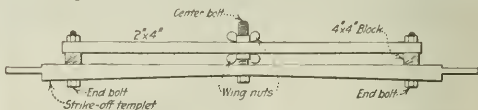
Hints that Cut Cost and Time

Pavement Warped by Adjustable Templet

BY PAUL L. FETHERSTON
Jackson, Michigan

AN ADJUSTABLE templet, similar to the one shown in the cut, can be used successfully in warping the surface of a concrete pavement. This templet can be made by placing a 2 x 4-in. timber over an ordinary split strike-off templet. The ends are raised from the templet by means of 4 x 4-in. blocks and securely bolted in place.

A center bolt is passed through both the templet and 2 x 4 and secured to the former by means of a nut. Wing nuts are placed on the bolt above and below the 2 x 4.



ADJUSTABLE TEMPLET FOR CONCRETE PAVEMENT

The camber of the templet should be about one-half of that required to produce a pavement surface of the normal crown. Then by depressing the wing nuts the 2 x 4 will be drawn down and the templet upward till the desired camber is produced.

On going into a superelevated curve or in any instance where it is desirable to alter or eliminate the pavement crown, the wing nuts are gradually turned upward as the templet is moved forward over the fresh concrete. The two members are thus forced apart and the camber of the strike-off is slowly eliminated.

This brace also serves to hold the templet rigid at all times so that its use insures a more even surface than can be obtained with an unbraced templet which tends to be slightly flexible.

Movable Derrick-Crane Economizes Space

BY DALE R. VAN HORN
Walton, Nebraska

UPON the site of the new Nebraska state capitol building are being used two specially-constructed traveling cranes, which are a combination of stiff-leg derrick and gantry crane. The cranes were built practically entirely on the job.

BUILT-UP CRANE ON NEBRASKA CAPITOL BUILDING

From Job and Office

For Contractor and Engineer

When material handling became an acute problem on the work, recourse to some sort of traveling crane with a long lifting radius was necessary. The usual gantry type, with distance between crane rails of 40 ft., could not be used because that spread between rails was not available. Also, space between rails had to be used to some extent for storage purposes. The stiff-leg derrick type was decided upon, but a type which allowed free movement to all parts of the job. Accordingly the crane herein herein pictured was built.

Deadweights to counteract the pull of the boom are provided on two sets of trucks loaded with stones and earth, and built up as timber cribbing. The weight of each deadweight is about 30 tons, and the distance between the two deadweights is 62 ft. This distance allows the hoisting engines to be set between the deadweights, thereby economizing space. The distance between crane rails is 26 ft. and the tracks are high enough so that a great deal of storage space for steel, timber and other materials is provided between tracks.

The boom of the crane is 106 ft. long. Inasmuch as the crane tracks entirely circle the site of the new structure, which is about 435 ft. square in plan, the cranes give a wide range of usefulness. The cranes are driven by 40-hp. steam engines.

Reclaiming Heavy Plate Girders

By J. C. Lamon

ON A LARGE hydro-electric construction job on the Little Tennessee River one of the railroad bridges was carried out in a flood. Owing to the difficulty of replacing the wrecked steelwork, it was decided to reclaim the bridge. These huge steel girders—68 ft. in length and 6 ft. high, of heavy plate construction—though badly distorted, were reclaimed by ordinary blacksmith methods.

After the wrecked bridge had been hauled out of the water by powerful cranes, the girders were transported to a yard equipped with a 50-ton derrick and sidetracks. Heavy I-beams were laid at regular intervals, and the girders were placed on them with the mid-point of the sag in the girder directly over an I-beam. Then the girders were heated, slack coal, coke and crude oil being used. A long heat was taken at the apex of the sag; the heat was confined by packing slack coal on both top and bottom of the plate. Heavy pieces of coke were placed on both sides of the narrow section of the girder, and with the aid of two powerful blow-torches with air pressure of 90 lb. a slow heat was taken. When the plates were sufficiently heated, the girder was allowed to sag of its own weight until straight at the particular point. This operation was repeated until the entire girder was gone over. The crane, with a sling, held the girder so that it would not be bent concavely. When straightened, it was blocked or jacked. At some stages of the work it was necessary to use both derrick and locomotive crane.

Flattening of the flanges and cover plates was accomplished by ramming with an iron rod 6 in. in diameter and 20 ft. long swung from the derrick.

Where the heats were taken, rivets were, of course, loosened, so they were cut out and new rivets were driven.


PLATE GIRDERS BEFORE AND AFTER STRAIGHTENING

All-Year Railway Painting Program

THAT it is entirely practicable to arrange a railroad painting program covering the entire year, which will result in more efficient and economical work and will enable the railroads to retain their best men as a permanent force, is the conclusion of a committee which reported at the recent annual convention of the American Railway Bridge and Building Association. An abstract of the report is given below.

The general understanding has always prevailed that railroad buildings, bridges and other structures should be painted only during the summer months and therefore it is established practice to organize painting crews in the spring and disband them in the fall. Thus each year the railroads face the problem of finding new painters and in most cases must take on new and inexperienced men and train them. In a measure the railroads become the training school for the local contractors and lose much in economy and quality of work.

The question is: Can a program of work be so planned as to give painters work all the year round? The answer as developed by the investigations of this committee is in the affirmative, and it is being done successfully on some railroads. Outdoor painting can only be done when weather conditions are favorable, but such work as can be protected from the weather or is indoors may be done at any time.

Painting steel bridges is, for the most part, limited to the months of June to September, inclusive, although further south this period is extended. The painting of other steel structures such as tanks, turntables and signal bridges is also limited to about the same period, but the season for painting wooden buildings and structures is somewhat longer as the work may be done both earlier and later in the year. The remainder of the year may well be named the indoor season, and during that period any class of interior painting or the painting of objects that may be brought under shelter may be done. It may be well to note the practice on the Grand Trunk System, as reported by

George A. Mitchell, Superintendent of Bridges and Buildings:

"The practice which has been in force on my territory (something over 2,000 miles) for a number of years has enabled me to maintain a regular force of painters during the entire year. During June, July, August and September our painters are wholly employed in painting steel bridges. During April, May, October and November, and some seasons the fore part of December, they are employed in the exterior painting of buildings. The balance of the time they are employed in painting and decorating the interiors of our buildings. Therefore the work is so distributed in this northern country that we are able to employ our painters the entire year and consequently we have men in our service for many years who become accustomed to and skilled in our particular work."

A painting program could be outlined which would permit the employment of an average crew on a division during the entire year, with the addition of a few men during the outdoor season when there is an unusual amount of bridge painting to be done. The painting crew is equipped with light rigging, easily handled, that will save the expense of building scaffolding and enable the men to make many minor repairs.

Another feature worthy of serious consideration is that painters are good mechanics and are capable of doing other work more economically than crews sent specially for that purpose. For instance, a painting crew working at a station could replace broken glass, take down stove pipes in the spring and clean, paint and store them. They could clean out gutters and conductor pipes and paint them before they begin to rust. In the fall they could take out window screens, clean and paint them, and put them away.

Renewing Railroad Culverts

REBUILDING old culverts, putting in new drain pipes and culverts and replacing old box culverts with pipes is a class of work continually required in railway maintenance, and the following particulars of such work are abstracted from a report of the American Railway Bridge and Building Association:

Trenching—In unstable soil where a temporary opening must be made in the fill, pile bents may have to be driven, sheeting being placed behind them to support the sides of the trench. Piling should be driven only when absolutely necessary, on account of the increased cost.

Where an open trench is used for small pipe it is advisable to transfer the track support to some distance on each side of the trench. One method is to place a 6-ft. length of second-hand bridge stringers flatwise under the ties, under each rail. The trench should also be cross-braced with trench jacks. The Pennsylvania R.R. places a track rail under the ends of the ties, with the head up, and immediately over it another rail on top of the ties, fastening the two rails together with clamps. This provides a strong support at minimum expense, as extra rails are usually available. Where ties are not supported on account of trench excavation, the Illinois Central R.R. places a rail on each side of the traffic rail with hangers that pass under the latter rail and over the extra rails.

If the pipe is large or if two or more pipes are placed side by side, an approved method is to dig a narrow trench under the track at each end of the section to be excavated, set up frame bents and support the track on stringers placed under the track ties. This is a good method to use when removing old or broken culverts.

Tunneling—When the height of the embankment is too great for an open trench it is necessary to drive a tunnel, or the trench method can be used for the ends and the tunnel for the portion under the tracks. One method is to excavate carefully to the proper dimension and place timber or plank sets as the excavation proceeds, placing the mud sill and top first and while holding the top in place with a jack, place the side pieces, after which a strip should be spiked to the top piece to keep the sides from crowding in. Another method is to excavate 3 or 4 ft. wide, set up frame bents and drive lagging over the top of the bents. As only a small force can be worked in a tunnel it is advisable to work from both ends. Tunnel work can be handled best during the winter season. Where small pipe lines pass under several tracks, it is often advisable to sink shafts between the tracks and tunnel under the track between the shafts. If the ground is firm it is often possible to tunnel between shafts without using any supports if the pipe can be placed at once and the backfilling is tamped into place.

Boring and Jetting—On the Southern Pacific Ry. water and gas pipes up to 3-in. in diam. are tunneled through earth embankments with a dirt auger and if sufficient water pressure is available they are jetted through in the same manner as jetting piles.

From Job and Office

Hints that Cut Cost and Time

Chicago, Milwaukee & St. Paul Ry.—We are placing 24 to 48-in. concrete pipe inside of timber culverts 36 to 300 ft. long under fills 6 to 125 ft. in height. Regardless of the size or length of pipe, we slide it into the culvert on a skidway that extends all the way through, and far enough outside to enable the pipe to be rolled onto it. The skidway is made of 2x4 or 2x6-in. timbers with chamfered edge, laid 8 in. apart for 48 in. pipe and a little closer for smaller pipe. The skids, spiked to the bottom timbers of the culvert. They are well greased in warm weather, and in freezing weather they are made wet to form ice. For pipe with bell ends a hardwood shoe is placed under the spigot end to raise it level with the bell end so as to prevent the sharp edges of the pipe from cutting into the skids. Except for the largest pipes we seldom use block and falls as the pipe moves easily on the greased skids. With a crew of eight men we average 50 to 60 ft. of 42-in. pipe, placed, backfilled and tamped per 8-hour day. We haul the backfilling material in a box on runners made to fit the skidway.—T. E. McFadden, Cedar Falls, Wash.

New York, New Haven & Hartford R.R.—We recently renewed a culvert under a single track section over which 29 trains operate per day, located about ¾-mile from the nearest siding where a work train was enabled to clear regular trains. The fill is about 10 ft. high. The culvert carries a small brook and tidewater which interfered considerably with the progress of the work. As the fill was of granite riprap, piles could not be driven; therefore the track was supported by 3-ply 15-in. I-beams 24 ft. long under each rail, which in turn were supported by four 12x12-in. hard pine underlays.

The stone fill was cut by means of hand drills and wedges, and the sides of the excavation braced as the excavation proceeded until a depth of about 11 ft. below base of rail was reached. When the excavation was completed the I-beams were removed and five lengths of concrete pipe were installed by use of a derrick car. Then a sufficient backfill was made to carry the track. This work was done between midnight and 5 a.m. as this was the longest period in the 24 hours during which the track was unused.—E. E. Candee, Waterbury, Conn.

New York Central R.R.—A small stone box culvert which had failed, was replaced with a 42-in. cast iron pipe culvert, 156 ft. long, and 31 ft. deep, under four main tracks. It was necessary to take out the stone of the old culvert, and tunnel through the bank, using 8x8-in. timber frames for a tunnel 5 ft. square. After the tunnel was completed, we put in the first near the middle and backfilled over it, ramming the material in tight. Then, another pipe was drawn in from each end, and connected to the first pipe and material backfilled over each of them, and rammed tight, so that we had a tight culvert, with no place for water to run through outside of the pipe and cause trouble.—R. H. Reid, Cleveland, Ohio.

Delaware, Lackawanna & Western R.R.—We had to renew a timber culvert carrying a double track passenger

From Job and Office

For Contractor and Engineer

line over three pipe lines supplying water to Jersey City. The pipe lines consisted of 36- and 24-in. cast iron mains and an old 30-in. brick conduit, all supported on timber grillage on piles. The tracks carried about 150 movements in 24 hours. The soil was 12 ft. of black mud over clay subsoil. The pipes were about 2 ft. apart and the top of the brick conduit was not more than 18 in. below base of rail. A highway prevented track diversion on the east side and a steel viaduct carrying an electric line over the railroad prevented a double track diversion on the other side. Further there was not space above the pipes to support the track on falsework and leave room for the new reinforced concrete slab.

It was necessary to locate a single track detour for westbound trains and carry the eastbound traffic on a gauntlet track laid on the same ties, thus avoiding the throwing of switches. Train movements were protected by flagmen at each end of the detour with hand-operated home and distant signals. This arrangement permitted the old track to be used in driving the piles to support the new structure and for unloading concrete material. It also resulted in a minimum delay to trains.—F. L. Wheaton, Buffalo, N. Y.

Job and Office Notes

Further Experiments With Rubber Paving Blocks are being carried out in Britain. A street in Manchester is being paved with rubber, the traffic passing over it daily being around 9,000 vehicles and some 1,000 tramcars; the total weight being estimated at 15,000 tons. Instead of the usual method of employing small blocks as in wood paving, large slabs of rubber weighing 600 lb. each will be used. The slabs are reinforced by steel bars in order to prevent the creeping of the rubber, and each slab is secured to the next by steel pins. Creeping is one of the troubles to which rubber roadways are liable. As showing the extent to which they can be moved it may be said that a five-ton vehicle passing over a surface of rubber blocks will spread them half an inch. The slabs will be laid on a concrete foundation, to which they will be attached by a bituminous compound which is impervious to water. The surface of the slabs are corrugated, to give the appearance of small blocks, and thus affords a safe foothold for horses. In addition, the slabs are reinforced at intervals with steel bars, which keep them rigid while retaining the necessary pliability to insure noiselessness.

Inspection of the Formula for Solving vertical curves given in *Engineering News-Record*, Sept. 13, p. 443, "indicated the familar parabola," writes H. S. Martin, of Cope Rand Means Co., Engineers, San Francisco. "I computed the point of elevations for the complete curve by the method outlined," he continues.

"The result was a series of point elevations that bore no resemblance to a vertical curve connecting two tangents, and when platted, a line drawn through them crossed the forward tangent produced between 11 + 50 and 11 + 75 and got back to 12 + 50 only by exceeding the grade of the following tangent for the last two chords. I then extended the forward tangent back to 10 + 00 which gave a new value to D of 5 ft. instead of 7.5 ft. Computing in the reverse direction I obtained an entirely new series of point elevations, equally in error but not so conspicuous when platted. The fault, however, does not lies in the formula but in the application, or at least in the apparent assumption that it can be applied to locations having unequal tangent distances. If the curve is properly located, i.e., with the P.C. and P.T. established at points equi-distant from the grade vertex, the formula will give a true parabola from either tangent. In the example illustrated D would have its true value of 6.25 ft. for a curve of 250 ft. long and of course be the same from either tangent. I see no advantage in the given formula for working from one tangent over the essentially same one from both tangents. Errors in numerical work are not easily discerned in either. For universal application I prefer to establish the P.C. and P.T. elevations from the tangents and then compute from one to the other along the curve, for the chord points, by the rate of grade change method and thereby secure a check on the computations. This is also, I believe, the least tedious method when grade rates and elevations have several decimals; conditions very frequent in rectification of grade work."

Liquid Oxygen Explosive Has Been Successfully Used in Colorado by the Department of the Interior in experimental mine blasting and road construction work at a cost of approximately one-half that of the gelatin dynamite required to do the same work. The experiments were conducted by E. D. Gardner, mining engineer of the Bureau of Mines, in co-operation with a representative of the Compressed Air Corp. A liquid oxygen explosive consists of gas black, wood pulp or some other carbonaceous material made up into cartridges and soaked in liquid oxygen. This explosive can be detonated similar to ordinary dynamite with cap and fuse or with electric detonators. The liquid oxygen was obtained from a plant designed to furnish oxygen gas and was shipped to the point of use in dewar flasks, which are made on the same principle as thermos bottles. The first Colorado tests made by the Bureau of Mines were conducted with cartridges made in Germany, but later cartridges manufactured at less cost in Denver proved very much more satisfactory. As the use of this explosive is new in this country, numerous tests and experiments were necessary to find a low-priced carbonaceous material which would have the desired qualities and to learn the technique of blasting with this new material. Hand steel holes were blasted in granite on a road construction job above Idaho Springs, with results similar to those obtained with 40 per cent gelatin dynamite. Trees were also cleared from the right-of-way and a 200-ton cliff blasted down successfully. Instantaneous electric detonators and blasting battery were used for this work and no misfires occurred and no holes failed. Disregarding express charges on the oxygen, the cost of liquid oxygen was about half that of gelatin dynamite.

It is Almost an Axiom Among Paving Contractors that industrial outfits are not adapted to grades in excess of 4 per cent, and frequently contractors owning industrial outfits have been unable to bid on work due to the existence of steep grades. C. M. Hathaway, engineer of construction, Illinois Division of Highways, Springfield, Illinois, recalls one instance wherein a contractor operated his industrial outfit on a "down grade" of 6 per cent for a distance of about 1,000 ft., this grade being located a short distance from the unloading plant so that all trains were compelled to make the grade while loaded. In this instance the contractor had suffered a wreck on account of his train running away, whereupon he contrived a rather novel device to protect himself from further accidents. An ordinary block pulley was installed at the top of the hill and held in place by means of a deadman anchored in the roadside, and a wire cable running through the pulley was attached to the rear end of the train descending the hill. The other end of the cable was attached to a motor truck at the foot of the hill and as the loaded train descended, the truck was automatically drawn up, acting in the nature of a counterweight. At the same time the operator of the truck kept his engine running in order that he might produce additional resistance by throwing his engine in gear, if necessary. The scheme was very simple and effective, and in addition the truck pulled the cable back to the top of the hill for another train load as soon as disconnected from the descending train.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Earth Dams Require Study

Sir—The failure of the Apishapa Dam, concerning which there has been considerable comment in recent numbers of *Engineering News-Record*, may not have been in vain if it results in the giving of more attention to a careful selection and study of materials to be used in earth embankments.

You have already favored me by publishing in your issue of March 1, 1923, a brief reference to work which the Division of Agricultural Engineering of the U. S. Bureau of Public Roads has been endeavoring to undertake. I say "endeavoring," because the co-operation that has materialized from engineers generally up to the present time, excepting the engineers of the U. S. Reclamation Service, has been very disappointing, only two or three even expressing any material interest in the subject.

It is interesting to note that practically every engineer constructing earth dams who has replied to letters addressed to him upon the subject has taken the position that the dam which he himself was constructing was so well designed that there could be no doubt as to its absolute security and it was therefore unnecessary to make further investigations, possibly forgetting that data regarding the perfect dam are the data most desired. It is also interesting to note in this connection the fact that no two of such dams referred to have been even closely similar in design. In no instance that has been called to my attention, moreover, has any critical study been reported to me as having been made of the soluble matter contained in the soils, the best and most efficient moisture capacities of the soils, the expansion or shrinking of the soils when exposed to alternate saturation and drying out under normal storage conditions, the most effective mixture of earth materials available in a given locality, or of a number of other studies that ought to be made in so important a matter; nor has any provision been made, so far as I am informed, for a study of percolation through, or of the hydraulic pressure under, any earth dams that have been built recently or are to be built in the near future, excepting in one instance.

A long experience with and rather careful study of the problems involved demonstrates to me that even in connection with minor structures, such as backfilling earth for headgates, flume ends, and in the construction of small dams as well as large ones, different soils must be treated in very different ways. Some soils must be thoroughly saturated and rammed into place, practically puddled, while others are most satisfactory with what is known in soil studies as the field carrying capacity of moisture. It is such studies as these that it was, and still is, although somewhat less optimistically, hoped that the Division of Agricultural Engineering, as referred to above, might be able to study in detail.

Permit me to direct your attention to a very valuable article on this subject, written by Dr. Alex L. DuToit, geologist, entitled "Some Experiments Upon the Contractions of Soils in Application to Earthen Dams," which appeared in the July, 1923, number (Vol. 2, No. 3) of the South African Irrigation Department Magazine. The author calls particular attention to the complicated nature of the questions that may arise in excessive wetting, and the subsequent shrinkage, of soils, particularly those of a clayey nature, and gives us the results of some investigations that have been made in the West Indies, on a limited scale.

So far as I have been able to discover in studying the details of construction of the Apishapa Dam, no careful studies were made at any time of the proportion of soluble elements contained in the soil, of its optimum moisture content, of either the co-efficient of expansion or shrinkage under varying conditions, or by making of any analysis, either chemical or physical, to determine what, if any, commingling of the soils to be used was needed. In the construction of a concrete or masonry dam, the cement, the sand, the gravel and the water, and combinations of these ingredients of the concrete, are studied with the utmost care. Such study is fully as important, perhaps even more so, in the study of the earthy materials of which it is planned that a dam shall be composed. The fundamental trouble is that in the construction of a masonry dam, the fact is recognized that an *experienced* engineer, reasonably well paid, should have charge, but in the case of an earth dam it is assumed that any one who can run a level is competent to direct, whether he has ever before had anything to do with such a structure or not.

It is my opinion also, based upon my study of a number of earth dams that have failed, and also of many dams showing no signs of failure, that no dam, the failure of which could in any way endanger the public safety or welfare, should be permitted to be constructed without requiring that all possible safeguards, such as have been mentioned herein, be thrown around it by those in authority.

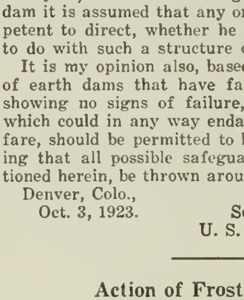
Denver, Colo., Oct. 3, 1923.

A. LINCOLN FELLOWS,
Senior Irrigation Engineer,
U. S. Department of Agriculture.

Action of Frost on Foundations

Sir—I have seen your article "Action of Frost in Heaving Concrete Piers" in *Engineering News-Record* for Aug. 30, 1923, p. 360, wherein is described one of the many cases in which frost has shown its bad influence on engineering works.

It may be of interest to you and some of your readers to hear that in Sweden, and especially in its northern parts, where the frost penetrates one or two meters in the ground, we insulate almost all foundations of houses, retaining walls, etc., by means of such materials as steam coal ashes, peat and so on, which have small capillarity and heat conducting power. In this way it is possible to avoid the heaving of subsoils which are sensitive to frost. Without such precautions the water-soaked earth filling will adhere strongly to the foundations, as if the whole were one solid block, which would irresistibly follow the physical law that frozen water takes greater volume than unfrozen. If such an insulation had been arranged around the described pier and an ordinary drain had been laid down at the bottom, the heaving should never have occurred.



The sketch shows the method of insulating the foundation of a house in northern Sweden.

If you are interested in the above question I may also refer to my report, No. 8, at the international highway congress in Seville this spring, in which report I have tried to treat the question of the influence of frost on the highways. There you will also find some notices about our insulations of the railway tracks in northern Sweden.

In reference to the intricate question of highway construction I am almost convinced that it will not be brought to a satisfactory conclusion until we highway engineers have succeeded in deeply penetrating the secrets of the frost action.

GUSTAV DAHLBERG,
Civil Engineer

Stockholm, Sweden,
Sept. 20, 1923

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

A Civil Engineer Degree at the Age of 81 years was the unusual record of Frank L. Weaver, who in 1871 found it necessary to leave the engineering class of the University of Kansas and go to work and who in 1922 went back and took up his unfinished course with the result that on Oct. 1, 1923, he won the degree of B. S. in civil engineering from that institution.

Canadian Road Construction Expenditures of $15,000,000 are reported for this year's season ending Nov. 15, the Dominion government contributing 40 per cent of this. Up to the end of April last a total of $11,350,000 of the $20,000,000 federal highway grant had been paid out, and this year's payments will be about $4,000,000 additional.

Preliminary Work Is Being Rushed on the Island Falls power project of the Hollinger Consolidated at Timmins, Ontario. The work will require a spur line from the northerly extension of the Temiskaming and Northern Ontario Ry. Contractors are already engaged in clearing the right-of-way and clearing the site preparatory to the commencement of excavation.

Work on the Power Structures at Muscle Shoals is 60 per cent complete. Due to the favorable season, great progress was made during September and October. On Nov. 1, 630,000 cu.yd. of the concrete work had been completed. In all, 1,300,000 yd. of concrete must go in. While only half of the concrete work has been done, the job is more than 50 per cent complete since all the cofferdams are in, all of the plant installed and all of the construction buildings completed.

Electrification of the State Railroad between Stockholm and Goteburg is to be undertaken at an estimated cost of 6,000,000 crowns ($1,578,000). The Swedish State Railways estimate the amount needed for new construction work during the ensuing fiscal year at 15,800,000 crowns ($4,154,400) which includes the electrification project and also includes expenses for a number of operations for which funds already have been appropriated. The amount of new appropriations needed is about 9,000,000 crowns ($2,367,000).

Repair Work on the 100 Miles of the Alaska Railroad damaged by high tide and heavy storms that put the line out of commission has proceeded to such an extent that traffic has now been resumed. The two large bridges that were washed away near Spencer Glacier and Bartlett Glacier have been replaced by temporary pile bridges and the washed-out embankments and cave-ins have been reconstructed. In order to prevent the congestion of freight due to the suspension and delay of traffic a regular weekly boat schedule to Anchorage has been arranged.

U. S. Reclamation Service Further "Reorganized"

A new order by Secretary of the Interior Work on Nov. 6 changes the administrative system of the Bureau of Reclamation (the former Reclamation Service) by removing the operation of the projects from engineering direction. After Dec. 1 the chief engineer of the bureau is to confine the work of his office to investigation of proposed projects, design and construction, while operation and management of the projects is to be in the hands of a field commissioner. The present field commissioner is Miles Cannon, a politician. F. E. Weymouth is chief engineer. Statements given out by the department claim that the change with the elimination of an assistant commissioner and the assignment of the photographic laboratory to the Geological Survey will save $10,000 a year in salaries.

New Railroad Across the Niagara River

The American Niagara Railroad Corp. has been authorized by the Interstate Commerce Commission to construct 10.36 miles of track from a connection with the New York Central in Tonawanda to the international boundary where it will connect with the Canadian Niagara Bridge Co. which has been authorized by the Canadian government to construct a line from the international boundary to connect with the Canadian Pacific Ry. The cost of the new line, including the double-track main line and yards, is estimated at $18,000,000. It is to be owned jointly by the New York Central Railroad Co. and the Canadian Pacific Railway Co., the New York Central holding the majority of the stock.

Denver Water-Works Program of Construction

Plans for the following major improvements provided for in the recent bond issue are being prepared by the engineering department of the Denver Board of Water Commissioners: Relining and covering Ashland reservoirs, $100,000; building a 66-in. conduit from Marston Lake to the city, $840,000; constructing filters on the north side of Marston Lake, $1,250,000; extension of a 60-in. pipe line from Kassler to Marston, $750,000; extension of a 54-in. pipe line from Massey Hill to Wynetka, $450,000; increasing the efficiency of the slow-sand filters at Kassler, $500,000; total, $3,890,000.

Late in October the board authorized additional large distributing mains in the city estimated to cost nearly $750,000. Work on these mains will proceed with all possible speed, according to an official bulletin of the board.

Earning accounts for 1922 totaled $1,906,375. Operating and maintenance expense was $755,827, and interest on bonds was $639,799 leaving a balance in net income of $510,749 expended in capital improvements and extensions.

Sewage Plant Operators of Iowa Discuss Problems

Operation and Maintenance of Septic and Imhoff Tanks, Filters, Pumps and Siphons

More than fifty sewerage-works operators and others interested attended the fifth conference of Iowa operators on sewage treatment problems held Oct. 22 to 24 at Iowa State College, Ames. Septic tanks, Imhoff tanks, sand and sprinkling filters, each came in for a session with special papers on siphons, pumping stations and sludge handling. After a subject had been presented by a series of papers, C. H. Currie, consulting engineer, conducted a question-and-answer discussion.

H. V. Pedersen, state sanitary engineer, opened the conference with a statement of the present status of stream pollution and efforts to abate it by the 191 plants in the state, serving a population of 325,000. About 30 per cent of the domestic sewage of the towns having sewerage systems is treated to a non-putrescible state. Aside from the Des Moines and Cedar Rivers the rivers within the state are short and small. They are so polluted as to make bathing dangerous and fish life impossible. Mr. Pedersen held (1) that there is a growing sentiment demanding that streams be kept fit for bathing, (2) that to do this definite limits of pollution must be set, (3) that public opinion must back up the department intrusted with the duty of setting the limits and seeing that they are not exceeded and (4) that the Legislature must provide the necessary organization within the State Board of Health.

Following this paper J. J. Hinman, Jr., chief of the water laboratory division, Iowa State Board of Health, indicated the relation of sewage treatment to water supply.

Septic Tank Problem

Prof. C. S. Nichols, Iowa State College, presented the septic tank problem, giving first a resume of its history, design limits and what a tank is supposed to do. He emphasized the point that any tank is only a preliminary process as it can be expected to handle but one-third of the soluble organic matter which is usually but one-half of the total amount, the remainder being solid matter.

Prof. Earle L. Waterman, Iowa State University, in his treatment of Imhoff tank practice, stated that there were 6[illegible] Imhoff plants in Iowa and 80 per cent of all those being designed were of the two-story type. After noting design features he gave a schedule of operations which include (1) daily cleaning of screens and grit chambers, (2) weekly cleaning of sides and bottoms of settling chambers, (3) removing floating material from settling chamber, to prevent septic action, (4) equalizing sludge deposits, (5) breaking up scum on gas vents, (6) observing depth of sludge, drawing and drying it. Difficulties arising from inefficient operation

are septic action in settling chambers, clogging of slots and sludge pipes and foaming at gas vents. If the schedule is followed Prof. Waterman held that the troubles would be largely eliminated.

Stanley Pinel, Engineering Extension Department, Iowa State College, in discussing the disposal of sludge, was optimistic as to its use for fertilizer by farmers. One operator indicated that he had no difficulty in getting Imhoff sludge taken away and contemplated making a minimum charge which he thought would make the sludge even more sought after.

Dr. Max Levine, Iowa State College, has been working on creamery wastes and finds that they can be handled by the activated-sludge process but it requires 50 to 60 cu.ft. of air per gallon and 6 to 12 hours' time. This, however, is not impracticable for the amounts are usually not large. An operator of a much-complained-of creamery plant at Sioux Center outlined his troubles. Undoubtedly he will soon be blowing air through his wastes, thus benefiting directly from the conference which brought the results of experiments to him.

Lafayette Higgins, consulting engineer, outlined trickling filter practice, largely by a description of the two-year old plant at Indianola. Major Edward D. Rich, chief engineer, Michigan State Board of Health, did the same for sand filters by a résumé of the operation of plants in Michigan. Aside from private plants for institutions there are 31 sewerage-works of all kinds in Michigan, the present status and operation of most of which were described by Major Rich. Cultivation or hand raking to overcome clogging of sand filters seems to be standard practice.

The last day's program consisted of a laboratory demonstration of ordinary plant tests and an inspection of the treatment plants for the college and town.

"Design, Operation and Care of Pumping Stations" was the title of a paper by C. S. Timanus, with Burns & McDonnell, consulting engineers. L. E. Rein, of the Pacific Flush Tank Co. in his talk on siphon troubles, said 90 per cent of them were due to air leakage. Soap and a shaving brush were the handiest tools to test for leaks.

Ten North Carolina Road Contracts Let

On Oct. 10 the North Carolina State Highway Commission let contracts for ten projects, upon which 97 bids were submitted; the projects composing three bridges and seven road jobs. There were 57.02 miles of roads let, costing with the bridges included, $1,336,582, exclusive of the usual 10 per cent for engineering and contingencies. Of this mileage, 19.9 miles were of standard concrete surface, and the average cost per mile was $33,406.53 which included grading, draining, paving, reinforced-concrete bridges and culverts and all other items of construction; 7¾ miles of this pavement were 18 ft. wide and the remainder was 16 ft. in width. Of the remaining mileage 37.12 miles were of earth, or topsoil construction and cost $11,005 per mile. The bridges and culverts cost $433,364 of which one bridge over the Cape Fear River cost $204,201.

Birdseye Party Successfully Surveys Grand Canyon

Col. C. H. Birdseye, chief topographical engineer of the U. S. Geological Survey, who led a party of engineers reported in distress while making a survey of the Colorado River, at a luncheon given Oct. 29 in Denver by the Denver chapter of the Colorado Society of Engineers, described the survey trip as follows:

"We knew nothing of the worry of the outside world, until we reached Diamond Creek Oct. 3. Here we were handed copies of newspapers and saw that the whole thing had been greatly exaggerated. We never had a boat bearing the initials U. S. G. S., therefore we cannot say anything about the empty boat found floating bearing those initials. On Sept. 19, the night the flood started, the party was camped just above Lava Falls in the Grand Canyon. We were forced to move camp several times, the water rising 18 in. an hour, the total rise in the 24 hours being 21 ft."

The trip consisted of 455 miles. There were four boats in the party, and when the water was at flood stage they made between 35 and 40 miles a day. Twenty-five rapids were encountered in Marble Canyon, while ninety rapids of major size were found in the Grand Canyon proper. Previous to the flood the party was in touch with the outside world, by wireless, the principal points heard were Los Angeles, Denver, Colorado Springs and Chicago.

Regretting the worry caused, Colonel Birdseye admitted that while so many were worried the party was peacefully at work making the necessary surveys. The work started at Lees Ferry, Ariz., in August.

All Because of a Broken Main

THE photograph herewith shows what happened when a water main, under heavy pressure, broke in Wilmington, North Carolina. M'Kean Maffitt, superintendent of public works, sends in the picture with these words: Broken water main under 100 lb. pressure; a washout; a Ford; a splash; no damage.

Failure of Morris Canal Bridge Caused by Collision

Further investigation into the cause of the failure of the Morris Canal bridge at Garrison Ave., Jersey City, N. J., reported in *Engineering News-Record*, Oct. 11, 1923, p. 614, has revealed that thirty-five minutes before the bridge collapsed under a truck which with its load weighed over 14½ tons (the load limit was plainly marked as 8 tons), another truck had collided with the end post of the center truss, damaging both it and the truck.

The end post was of cast iron, octagonal in section, its lower end encased in masonry close to the edge of the bridge seat, and its upper end forming a cap on which the main shoe of the truss rested. The truss apparently was not bolted or fastened to the end post in any way so that in case the end post received a heavy side blow the support of the truss would be destroyed. All evidence points to this as being exactly what happened; the first collision damaging the bridge up to the point of failure.

The time of the accident was at noon on October 2 and not at midnight as previously stated.

New Joint Sewer District Formed in Los Angeles County

More than a dozen towns and small cities in southern California, between Los Angeles and the ocean, are planning to obtain an adequate sewerage system through the formation of the South Central Metropolitan Sewer District. A large number of property owners have signed a petition calling upon the county supervisors to create a sanitation district for the area involved, under the provisions of Assembly Bill No. 191 passed at the last session of the legislature.

This act authorizes the formation of certain joint sewerage districts and the issuance of district bonds under the direction of a board of directors composed of the mayors of each city involved, and at least one county supervisor, which board has authority to employ engineers.

In the district involved sewer systems serve less than one-third the present population and the move underway has two primary objectives, namely, "(1) to protect public health from cesspool conditions which are rapidly becoming alarmingly serious and (2) to prepare the district for a large increase of population."

On the basis of cost alone, it is stated in literature urging the move, the sewerage plan is justified because the "30,000 active cesspools represent an annual outlay [operating expense?] of $500,000 which would retire the interest and sinking fund on an investment of over $8,600,000. Such an amount would more than pay for a comprehensive sewer system to say nothing of saving vast sums in the future."

After a hearing before the board of supervisors the next procedure would be the organization of a board of directors and finally the holding of a bond election. The district as now being formed includes Compton, Watts, Willowbrook, Huntington Park, Maywood, Monterey Park and other communities.

North Jersey Moves for Joint Water Supply

Wanaque-Ramapo Development of 150 m.g.d. May Be Required—Talk of Buying All Private Companies

At a hearing held by the North Jersey District Water Supply Commission at Newark on Nov. 1, the fact was brought out that applications in hand and in sight for a share in the Wanaque water development now being carried out by the commission, will absorb the entire safe yield of that stream within a few years and that in addition other communities that are now turning toward the commission to invoke its services in providing for their future water needs will make it desirable, if not imperative, for the commission to develop a second source of supply. Present indications point to the Ramapo as this second source, especially since Bayonne, which had been granted a right of 50 m.g.d. in the Ramapo by the State Board of Conservation and Development, was recently enjoined from carrying out this plan because the courts held that approval of the North Jersey District Water Supply Commission as well as of the State Board of Conservation and Development was essential.

The hearing developed the fact that, acting upon the advice of Robert Spurr Weston, consulting sanitary expert, Boston, Mass., the city authorities of Bayonne would probably apply to the North Jersey District Water Supply Commission within a short time for 20 m.g.d. with the understanding that the Ramapo source would be developed as well as Wanaque. It appears that the safe yield from the two collecting areas would be at least 100 m.g.d. and 50 m.g.d., respectively.

Wanaque Development

After joint negotiations between Newark and some of the other municipalities to the north looking toward the filing of applications with the North Jersey District Water Supply Commission for the development of the Wanaque, some time back, had come to nothing, the city of Newark alone applied to the commission for this development up to 50 m.g.d. As a result, the Wanaque Dam has been under construction for some time past, with foundations sufficient for raising the dam to store the entire yield of the stream, and work has been started on a conduit therefrom to Newark. Recently the town of Montclair applied to the North Jersey Water Supply Commission for 3 m.g.d. from the Wanaque. Since then the serious shortage of water in the districts to the north and east of the Newark-Montclair-Paterson area seems to have stimulated other municipalities to apply for rights in the Wanaque. Applications actually filed up to Nov. 1, together with three about to be filed, follow: Newark, 25 m.g.d.; Paterson, 25; Passaic, 16; Kearney, 15; Bloomfield, 4; Montclair, 3; Glen Ridge, 1; total applications actually filed 89, to which may be added the proposed applications from Clifton of 6 and from Harrison of 9 m.g.d.

Bayonne notified the commission that it would like a month longer in which it might apply for 20 m.g.d.

The consensus of opinion at the meeting, both on the part of the municipalities represented and those of the North Jersey District Water Supply Commission, was that the commission should immediately make estimates on the cost of a joint Wanaque-Ramapo development along the general line recommended to Bayonne by Mr. Weston. Strong sentiment was also expressed in favor of giving careful consideration to the acquisition by the commission for the various municipalities in North Jersey of the properties of the East Jersey Water Co. and its associates, and also of the Hackensack Water Co. which supplies altogether some 50 municipalities.

The representative of Hoboken stated that his city had just made a contract with Jersey City for five years under which the latter would supply Hoboken, the price to be $77.50 p.m.g. against $138 p.m.g. for water from the Hackensack Water Co. which has supplied Hoboken for a number of years past. Bayonne is now supplied from the Little Falls filter plant of the East Jersey Water Co.

$108,000 Available to Study Engineering Education

The Carnegie Foundation has authorized the appropriation of $108,000 to be spent in a study of engineering education under the direction of the Society for the Promotion of Engineering Education. The resolution of the Foundation reads as follows: "Resolved, That the sum of $108,000 be, and it hereby is, set aside for the purpose of making possible a study of engineering education under the direction of the Society for the Promotion of Engineering Education; that of this sum the following amounts be, and they hereby are, made available to the society; $24,000 during the present fiscal year, $12,000 during the fiscal year 1924, with the understanding that if, in the judgment of the executive committee, substantial progress shall have been made in this study by Jan. 1, 1925, the balance of the $108,000 will be made available to the Society as follows: $24,000 additional during the fiscal year 1924, $48,000 during the fiscal year 1925."

Philadelphia Sewage-Works Put in Operation

Special Correspondence

The first unit of Philadelphia's extensive new sewage-works was put in operation on Oct. 29. The plant is known as the North East Sewage-Works, and is located on the Delaware River, between Erie Ave. and Lewis St. It consists of 32 Imhoff tanks and 80 sludge drying beds, and has a capacity of 60 m.g.d. The plant is designed to provide for 300,000 people, and is one of four similar units to be constructed at the North East works, which will have a total daily capacity of 250,000,000 gallons. The cost of the new plant was $1,830,000.

Besides the North East plant, the city will build two others, known as the South East and the South West sewage-works. The capacity of the three plants will be 800 m.g.d. The South West plant is under contract.

San Francisco Engineers Discuss Needed Contract Changes

Lower bids on construction work could be secured if owner and engineer would prepare contracts and specifications with more regard to the contractor's point of view; this was the keynote of discussion at a meeting of the San Francisco Section of the American Society of Civil Engineers on Oct. 16. The paper of the evening was "The Contractor and the Engineer," read by H. Nunn, general manager of the Contractor's Association of northern California and former state highway engineer of Oregon. Both engineers and contractors entered into the discussion but the contractor's point of view was presented and defended by both sides, indicating that changes in contract forms which would relieve the contractor of undesirable limitations would be generally welcomed.

Mr. Nunn's classification of all highway contractors in Oregon showed that half of them had engineers in charge of their work or were formerly engineers themselves. If the reverse of that could be true, it was pointed out, a better relationship between engineer and contractor would obtain. Points emphasized during the evening were as follows:

The contract forms themselves are most urgently in need of improvement and the administration of contract terms follows as a close second. The contractor must bid high enough to cover the cost of work plus a profit, a profit commensurate with the risk the specifications impose.

When a contractor makes a competitive bid he must base his figures on the minimum cost the specifications will permit. Specifications should therefore be definite as to what will be accepted.

Considerable discrepancies between the engineer's estimate and the contractor's bid may be due to hazards imposed by contract forms. The engineer makes his estimate without any uncertainty about administration of contract terms, while the contractor's bid must take into account all hazards expressed or implied by the contract.

East Jersey and Associated Water Companies Consolidate

A merger of the East Jersey, Passaic, Aquackanonk, Montclair and Kearney Water Companies under the name of the Passaic Consolidated Water Co. has been effected. The merger was approved on Oct. 30 by the Public Utility Commissioners of New Jersey. It is reported that the new companies will apply to the commission for authorization of $8,000,000 of 6 per cent mortgage bonds and $3,500,000 of capital stock, as against book assets on Dec. 31, 1922, exceeding $13,000,000.

The five companies jointly own water diversion rights, pumping and filtration plants at Little Falls, a large trunk main and a storage reservoir, together with the water distribution systems that supply Paterson, Passaic, Clifton and Montclair, and have contracts for supplying water in bulk to other communities. In March of this year the entire property was valued at $11,500,000 for rate-fixing purposes.

Iowa Water-Works Men Discuss Dozen Topics

Well Supplies for Small Water-works, Records, Inspection, and Publicity Draw Lively Interest

Engineering News-Record Staff Report

Water-works operators and others interested in water supply from eight Middle West states attended the ninth annual meeting of the Iowa Section of the American Water Works Association, Oct. 24, 25 and 26, at Ames, Iowa. While the papers ran the whole gamut from finance to laboratory control of quality, together with "fringe" subjects of electrolysis and city grading for insurance rates, the livest discussion revolved around well supplies and tastes and odors. The latter subject was on the program only as a "round table" discussion but it was good for a full hour and a half, winding up in a detailed account of troubles with filters in the fall due to surface sand clogging and methods to lengthen runs.

A paper on "Operation Records for Small Water-Works" by Earle L. Waterman, associate professor of sanitary engineering, State University of Iowa, led to the appointment of a committee to co-operate with similar cimmittees of the national association or of other sections. Prof. Waterman estimated that of 500 plants in Iowa 490 deliver less than 3 m.g.d. and 464 less than 0.5 m.g.d. In this last group the memory of the plant superintendent is too often the principal repository of records and what the old operator knows is not inherited by a newly appointed one. Reports are required at frequent intervals by the State Board of Health and the State Public Utilities Commission. If daily records are kept these periodical reports are not a burden.

Publicity Methods

J. J. Hinman, Jr., associate professor of sanitation and chief of the water laboratory division, State Board of Health, University of Iowa, in his paper on "Publicity at the Water Plant" described educational and publicity methods used in taking the public into the confidence of the water-works officials. If the people knew the truth about their own supply they would object less to what they call "chemical doping" for their own protection. An exhibit of the small amount of alum necessary to coagulate 1,000 gal. or of liquid chlorine in a tube to disinfect the same amount of water will usually disarm the most confirmed complainant.

The Ames college and town shallow well supplies described by P. F. Hopkins, city engineer, and C. S. Nichols, professor of sanitary engineering, Iowa State College, came in for much discussion, particularly condemnatory discussion of the college supply, which consists of wells in experimental hog lots on low ground between the town and college, with a sewer (having poor joints) on one of the sloping banks. While the original 100-ft. wells always showed an absence of pollution, an additional well, driven during the war was found full of gas-forming aerogenes and some B.coli by the college water analyst when he returned from service. No analyses were made during the war. No attention was paid to his warnings nor to his insistence that the well casing must be leaking. In fact, the validity of his tests were attacked although all of the old wells continued to show the usual excellent results. Finally the casing had to be drawn because it became clogged with sand. Nearly every joint was found defective. Daily analyses are now routine and the sanitary engineering department hopes some time that the aesthetic's objections to hogs around the well houses may be removed though it is conceded that it will probably be easier to "pull up the wells and sell them for post holes" than, under the political control of grounds supervision existing, to re-allocate the hog pens and pastures.

Dr. Max Levine, associate professor of bacteriology, Iowa State College, and Clair S. Linton, research assistant, have been working for several years on 123 bacterial strains of soil and intestinal origin to differentiate B.coli from B. aerogenes. Satisfactory methods based largely on reduction of various carbohydrates have been developed, rather than the former methods of the inhibition of attenuated strains by bile and phenolated broth.

The well discussions followed papers by Dr. Edward Bartow, head of the department of chemistry, State University of Iowa, H. V. Pedersen, state sanitary engineer, and Dr. S. W. Beyer, dean of industrial science and head of geology, Iowa State College. Dr. Bartow described an unusual seasonal variation of iron in the well water supply of Benham, Ky., from 1.5 p.p.m. in December to 65 p.p.m. in February. Mr. Pedersen emphasized location and proper precautions against surface and pump-pit contamination. Dr. Beyer sounded a warning against the dangers of ground-water depletion by extravagant waste.

George W. Fuller, president of the national body, spoke on his recent inspections of European water and sewage plants. Double filtration seems to be on the increase both in England and on the Continent.

The newly elected officers of the section are as follows: Chairman, H. F. Blomquist; vice-chairman, Dr. Max Levine; directors, L. O. Minor and Thomas Healey. By constitutional requirement the next meeting will be held at Iowa City.

A. G. C. and Road Builders To Meet Jointly

A joint meeting of the Associated General Contractors and the American Road Builders' Association will be held in Chicago on Thursday, Jan. 17, 1924, to discuss various matters of importance to the membership of both organizations. This joint meeting has been made possible by the proximity in dates of the annual meetings of these organizations in Chicago. The 1924 conventon of the Amercan Road Builders' Association will be held Jan. 15 to Jan. 18 inclusive. while the Associated General Contractors meet the following Monday, Tuesday and Wednesday. All the officers, the executive committee and the heads of the twenty-eight chapters of the Associated General Contractors will, however, be in Chicago the previous week. Many of the members of the organization also will be in Chicago that week attending the convention and road show of the American Road Builders' Association. Plans accordingly have been made for the joint meeting. Details of the program will be announced shortly.

Random Lines

Making Railroad Service Attractive to the Engineer

Extract from Letter to a Recent Technical Graduate

Sir—In reply to your application I wish to advise that at present there is a vacancy for a rail inspector on the Blank Division of the Blank R.R., which pays a salary of approximately $83 per month.

The duties are to make daily inspections of the track structure for defects and failures, together with frequent assignments to field and office work of the engineering corps. This position should be of interest to a young technical graduate who is desirous of starting in a railroad engineering career as the general experience gives a practical first-hand knowledge of track and other structures and should be of lasting benefit as he progresses, through promotion, to the various grades in the engineering department, which are rated as follows:

Chainman	$110 per month
Rodman	120 " "
Inspector & Draftsman	140 " "
Transitman	165 " "

(Signed) ———
Division Engineer.

Extract from Report of Interstate Commerce Commission Wage Statistics, Steam Roads in the United States.

Title	Average Monthly Earnings Per Employe
Maint. of Way General Foremen	$244
Maint. of Way Inspectors	173
Masons, bricklayers, etc.	152
Gang foremen	162
Laborers	78

* * *

More Definitions

Display Engineers—San Francisco window trimmers.

Correspondence Engineers—Baltimore, Md., "The Better Letters Co."

Automotive Painting Engineer—"No talent or education necessary," apparently an ideal vocation for morons. Advertised in *Popular Mechanics.*

Box Engineers—Our old friend the "packing engineer" under another name. Advertised this time in *The Nation's Business.*

* * *

The American Society of Exterminating Engineers has a member in Bristol, Pa., who is an undertaker by vocation. That's service for you. Kill 'em and bury 'em for the same fee and with the same organization.

* * *

"Stops Water Pollution By Bathing in Canals" says a headline in the September *Reclamation Record* (now being run by business men). What's the use of spending money on purification plants or chlorine; just hire a crowd of boys.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga., Nov. 12-16.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Meeting, Washington, D. C., Nov. 13-15.

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 10-11, 1924.

AMERICAN ROADBUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 14-18, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York, Jan. 16-18, 1924.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Chicago, Ill., Jan. 21-23, 1924.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich. Annual Meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

Western Society of Engineers at a luncheon on Oct. 26 was addressed by A. A. Sprague, commissioner of public works, Chicago, on the subject of "What the Engineers Can do for the City."

The South Carolina Chapter of the American Association of Engineers held its annual meeting at Columbia, S. C., Oct. 26, with an attendance of 64. Officers for the coming year were elected as follows: President re-elected, L. M. Fisher, associate sanitary engineer of the United States Public Health Service, Columbia, S. C.; vice-presidents, L. S. LeTellier, head of the department of engineering, the Citadel, Charleston, S. C., and Harwood Beebe, municipal engineer, Spartanburg, S. C.; and secretary-treasurer, Perry M. Teeple, associate professor, school of engineering, University of South Carolina.

Personal Notes

EDWARD M. CRAIG, JR., Wanaque, N. J., is now sanitary engineer for the North Jersey District Water Supply Commission, engaged in providing water supply for metropolitan New Jersey, under direction of Weston & Sampson, consulting sanitary engineers, Boston, Mass. Mr. Craig until recently was assistant sanitary engineer with the Alabama State Board of Health.

THOMAS A. MARTIN, Los Angeles, Calif., is connected with the Lynch Cannon Engineering Co., as engineer in charge of erection of Union Pacific railroad shops. He previously was in charge of construction work for Whitehead & Kales Iron Works of Detroit, Mich.

A. P. SMITH, Charlotte, N. C., formerly engineer for the Nashville Bridge Co., Nashville, Tenn., is now engineer for the Southern Engineering Co., Charlotte, N. C., whose business is structural steel construction.

EDWARD B. DARLINGTON has been appointed project manager of the Minidoka project of the U. S. Reclamation Service in Idaho, with headquarters at Burley, Idaho. He will have local charge of the irrigation works in that vicinity, including the Minidoka dam, power plant, pumping station and canal system. Mr. Darlington for several years has had charge of operation and maintenance of the Twin Falls-Salmon River irrigation project, and later was chief engineer of Twin Falls North Side Land & Water Co., at Jerome, Idaho. During the past year he has investigated several irrigation projects for the State Bond Commission of Idaho.

DAVID ANDERSON, chief engineer of the Armored Concrete Construction Co. of Malmo, Sweden, recently came to this country for a two months' tour of eastern United States, Canada and the Middle West, to be devoted to the study of engineering and construction work in general and reinforced concrete in particular. Besides the firm he represents, he travels also in behalf of the Manufacturing and Industrial Society of the City of Malmo.

RANDALL E. EVANS, Queens, Long Island, N. Y., has changed from structural engineer with McClellan & Junkersfeld to the same position with Stevens & Wood, engineers, New York City.

J. B. JONES, Houston, Texas, is now doing field engineering work in the valuation department of the Southern Pacific R.R. He was formerly a draftsman in the maintenance-of-way department.

C. CLIFFORD CLARK is now associated with the Roxana Petroleum Corp., Arkansas City, Kansas, as drainage and sanitary engineer. He was previously a draftsman with the Marland Refining Co., at Ponca City, Okla.

W. E. BARLOW, formerly assistant superintendent of the H. P. Burgard Co., is now superintendent on concrete construction work for Rock Bros. & Griffin, at Lowville, N. Y.

NORMAN EAGER, Carbondale, Ill., has been made a junior highway engineer. He previously served as draftsman on highway work in Pennsylvania.

HERBERT HOEFER has changed his association from engineer with Temple & Burrows, Davenport, Iowa, to engineer with the Building Products Co., Toledo, Ohio.

GEORGE D. HALL, Auburn, Ala., has become superintendent of construction for the Opelika Lumber and Construction Co., Opelika, Ala., after having done similar work for the West Point Iron Works, West Point, Ga.

WALTER E. GILLHAM announces that BENJAMIN F. COOK and W. EMERY WHITE, who have been associated with him for a number of years, are now members of the firm, which is now known as Gillham, Cook & White, consulting engineers, and which is now located at 409 Interstate Bldg., Kansas City, Mo.

T. J. STRICKLER, formerly chief engineer of the Empire Gas & Fuel Co. of Bartlesville, Okla., is now associated with F. C. Hamilton, consulting engineer, 60 Wall St., New York City.

STUART B. OVER, formerly senior assistant engineer in the Valuation Division of the Interstate Commerce Commission, and FRANCIS TINGLEY, formerly supervisor of overhead lines for the Washington Railway & Electric Co., Washington, D. C., have formed a partnership under the name of Over & Tingley to do general engineering, the address being Upper Darby, Pa.

PHILIP P. SHARPLES, formerly manager of the General Tarvia Department of The Barrett Co., has entered private practice in highway engineering. He has been retained as consulting engineer by the Palos Verde Co. to design and construct roads and pavements in their development at Redondo Beach, Calif.

Obituary

MORTIMER S. SMITH, assistant division engineer of the New York State Highway Commission and for 28 years associated with the state engineer's office in New York, died Oct. 29 at his home in Rochester, N. Y., after a short illness; he was 51 years of age. Mr. Smith was born in Rochester and educated in private schools. He spent four years in Scranton, Pa., as resident engineer for the Delaware, Lackawanna & Western R.R., otherwise his work was all in Rochester.

EDWARD E. SANDS, consulting engineer of Fort Worth, Texas, and for five years city engineer of Houston, Texas, died at the home of his father in Milwaukee, Wis., Oct. 27, aged 46 years. A native of Columbus, Ohio, Mr. Sands was graduated from the University of Wisconsin with a B. S. degree in civil engineering in 1900, receiving his C. E. from the same institution in 1906. During the two years following his graduation he was an instructor in civil engineering at the university, spending his summers as city engineer of Sparta, Wis. In September, 1902, he entered the U. S. Reclamation Service. He became designer and builder of the South Canal of the Uncompahgre Valley project in Colorado, later was in charge of the Uncompahgre project, and was project engineer on the Grand Valley project. Leaving the Reclamation Service for a few months in 1910, he became associated with J. G. White & Co. as construction superintendent in Washington State. Mr. Sands returned to the Reclamation Service in 1911 for a year, then went to Canada as supervising engineer on Canadian Pacific irrigation development. From there he went to Houston, Texas, as city engineer, resigning in 1918 after five years' service to enter private practice. While in Houston he designed and built the city's activated sludge plants, the largest of their kind, and designed most of the terminal facilities for the Houston ship channel. Since Oct. 1, 1922, he had been a member of the consulting firm of Hawley & Sands, designing and supervising water and sewerage plants for many Texas cities, among which was the Fort Worth $1,250,000 sewage disposal plant. Mr. Sands was a member of the American Society of Civil Engineers and past-president of the Texas section of the society.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Manufacturers Oppose Ban on Trade Statistics

Important Issues Involved in Tile Maker's Case Now Before Dept. of Justice

In the draft of a proposed consent decree in the case of United States vs. Tile Manufacturers' Credit Association et al., it is proposed by the Department of Justice to enjoin the defendants in the mentioned case from collecting certain types of statistical and other information. It would be provided, however, that such association might receive and compile, for transmission to any government agency, such information and statistics as such government agency might request as to production, stocks on hand and prices. However, such association would be restrained from distributing information so collected among its members. The permissive features of the proposed decree follow the general lines of the consent decree entered in the case of the Gypsum Industries Association, which made no mention of the subject of statistics.

Through its counsel, Nathan B. Williams, the National Association of Manufacturers has urged that in the public interest the draft of the decree be modified by the elimination of all reference to government departments. The collection of information by government departments, it is pointed out, is properly controlled by statute. The association has further urged that in the description of permissible activities of trade associations cost-accounting be included and that such decree carry the following paragraph relating to the subject of statistics:

Record of Facts Wanted

"To periodically or otherwise collect and make currently and otherwise available to those interested the facts relating to capital employed, power used, wages and [or] taxes paid, fuel consumed, machinery employed, and like pertinent trade information, production, sales, shipments, and stocks on hand of tiles and the prices obtained therefor, all of such being a record of accomplished facts."

In further recognition of the public interest to be protected the manufacturers' association has suggested that in addition to the availability of such statistics to those interested a prohibition might properly be contained in such decree against the misuse of otherwise legitimate activities and information in furtherance of any agreement or conspiracy to fix prices, limit production, restrict sales, divide territory, or in any manner restrain lawful competition in commerce.

The manufacturers' association has pointed out the vital necessity of business information and the serious consequences to the business fabric if the proposed decree should be entered in its present form. Such a decree would, Mr. Williams states, serve notice upon all trade associations that the Department of Justice regards the collection of statistical and other trade information, because occasionally misused, within the condemnation of existing law, and to be prohibited in so far as the Department of Justice was able to accomplish that end.

Slate Producers Investigate Nailing Problem

The National Slate Association, as part of its program to assure the public satisfaction in uses of slate, is conducting an investigation to determine the proper kind of nails to use for applying slate roofts. Architects, engineers, roofers and manufacturers of nails of all kinds are co-operating in this work. Results of this survey will be made known at slate industry meetings in New York in January.

Sixteen Companies Fined $20,000 for Sherman Law Violations

Fines aggregating more than $20,000 were imposed Oct. 30 for alleged violation of the Sherman anti-trust law upon sixteen heating and plumbing defendant companies of the Middle West by the Federal Court in Chicago, in the case of the United States vs. James B. Clow & Sons, et al, Attorney General Daugherty was advised by Roger Shale, special assistant to the attorney general, who, under direction of Mr. Daugherty, has been in charge of the case. The sixteen companies entered pleas of guilty.

The government at the same time the court imposed the fines dismissed the first of the two counts of the indictment returned against the defendants. The companies involved and the fines imposed follow:

James B. Clow & Sons	$4,000
Standard Sanitary Manufacturing Co.	4,000
Kellogg Mackey Co.	3,000
L. Wolff Manufacturing Co.	3,000
Weil-McLain Co.	2,000
Western Plumbing Supply Co.	500
Davies Supply Company	500
National Plumbing & Heating Supply Co	500
Whitney & Ford	500
Illinois Malleable Iron Co.	500
Enterprise Plumbing Supply Co.	500
Walworth Manufacturing Co.	500
Hoelscher Bros.	200
S. Deschauer Co.	100
Quinn Supply Co.	100
Weir & Craig Co.	100
	$20,000

The second count of the indictment against the firms charged the defendants with having conspired to fix and maintain uniform and non-competitive prices for plumbing and heating apparatus and fixtures sold to retail dealers and master plumbers in several states in the Middle West. The scheme forming the basis of the second count was said to have been carried out largely through the instrumentality of a publication known as the "Clow Bulletin." This bulletin, the Department of Justice said, embraced several of the objectionable practices engaged in by so-called open-price associations. The bulletin was distributed and used by approximately 4,500 master plumbers, 415 jobbers and 100 steamfitters.

Hydraulic Turbine Business Taken Over by Newport News Company

An arrangement has been effected between the Wellman-Seaver-Morgan Co., Cleveland and Akron, Ohio, and the Newport News Shipbuilding & Dry Dock Co., Newport News, Va., whereby the latter company has taken over the future hydraulic turbine business of the Wellman-Seaver-Morgan Co., including the patterns, drawings, data, patents, patent applications, developed and undeveloped inventions and complete records, the results of their years of experience in the hydraulic turbine business. The sales offices of the Wellman-Seaver-Morgan Co., in New York, San Francisco and Birmingham will continue to function as heretofore and will represent the Newport News company in hydraulic turbine work. The Wellman-Seaver-Morgan Co. will complete its present hydraulic turbine contracts without reference to the Newport News company. Future contracts will be taken by the Newport News company.

This change in policy according to a joint statement of the presidents of the two organizations, Edwin S. Church and Homer L. Ferguson, will enable the Wellman-Seaver-Morgan Co. to handle all its other lines of work to better advantage and will enlarge the work of the Newport News Shipbuilding & Dry Dock Co.

Cut Made in Varieties of Hollow Building Tile

Manufacturers of hollow building tile together with representatives of distributors and consumers of this commodity met Oct. 19 in the Division of Simplified Practice of the Department of Commerce, Washington, D. C., and unanimously adopted as the future standard line 11 sizes of load-bearing wall tile, 6 sizes of partition tile, 1 size of furring tile, and 1 size of book tile. This action reduces former sizes from between 40 and 50 to 19.

A standard weight for each standard size was also adopted. This in itself is a further simplification, as heretofore there has been a great variety in weights of tile of the same size. Agreement was also reached that the permissible tolerance or allowable variation in weight shall not exceed 5 per cent over or under the standard; also that maximum variation in the major dimensions—length, width, and height—shall not exceed 3 per cent plus or minus.

The general adoption of these standards by architects, engineers, and builders will facilitate their work and tend to lower construction costs. The action of the conference marks another step forward in Secretary Hoover's program for eliminating waste in industry through reducing variety in commonly used commodities.

Cast-Iron Pipe Production

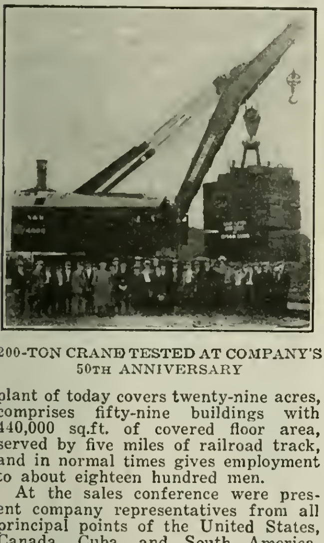
Based on returns from twelve establishments in the United States and confined to bell and spigot pressure pipe, statistics on the production, orders, sales, and shipments of cast-iron pipe for the month of August, 1923, have been issued by the U. S. Department of Commerce. Production during the month totaled 84,588 tons, while shipments amounted to 84,843 tons.

Industrial Works Celebrate Fifty Years of Crane Manufacture

In commemoration of its fiftieth anniversary the Industrial Works, Bay City, Mich., manufacturers of locomotive cranes, buckets and piledrivers, held a celebration, sales conference and banquet last month. Addresses were made by William L. Clements, president, C. R. Wells, secretary and treasurer and Ernest B. Perry, general manager. The attendance of members of the organization and guests was about 300.

W. L. CLEMENTS

The records of the beginning of the Industrial Works in 1873 show a working force of about 30 men operating in a 75 x 100-ft. factory building. The plant of today covers twenty-nine acres, comprises fifty-nine buildings with 440,000 sq.ft. of covered floor area, served by five miles of railroad track, and in normal times gives employment to about eighteen hundred men.



200-TON CRANE TESTED AT COMPANY'S 50TH ANNIVERSARY

At the sales conference were present company representatives from all principal points of the United States, Canada, Cuba, and South America. During the conference the representatives witnessed the testing of a 200-ton Industrial crane for the Norfolk & Western R.R., one of the largest cranes in the world.

Business Notes

BARRETT CO. announces the resignation of Philip P. Sharples, technical adviser, after a period of 20 years of service with the organization. Further details will be found in the "Personal Notes" column of this issue.

MORRISON & RISMAN CO., Buffalo, N. Y., dealers in railway track equipment, announce the establishment of a district sales office in the Ulmer Building, Cleveland, in charge of R. B. Morrison. Warehouses are being equipped at Cleveland, in addition to those already in service in Philadelphia, Buffalo and Lebanon, Pa.

Too Little Time Allowed for Preparing Bids

Equipment Manufacturers Receive Scant Opportunity for Study of Problems on Proposed Work

BY CHARLES G. RICHARDSON
Builders Iron Foundry, Providence, R. I.

In the following discussion Mr. Richardson calls attention to a practice which is objectionable from many angles. How can the maker and user of equipment co-operate to prevent it? Comment is invited from other manufacturers and from engineers or state and city officials suggesting remedies.—EDITOR.

WE manufacturers of municipal equipment have a grievance: it is the shortness of the time interval usually allowed between the contract advertisement and the date of receiving bids. Engineers often and properly take many months in the preparation of their plans and specifications and the majority of these are admirable examples of draftsmanship and clearness. But once this work is done the time for the preparation of the contractor's proposal apparently receives scant consideration.

I am referring particularly to contracts for waterworks, sewage disposal and filtration. Perhaps two weeks is the average interval between the advertisement and the final date for bidding. Within this time the manufacturer must send a deposit for the plans and specifications, requiring frequently nearly a week for their receipt, and there is left only two or three days to study the various problems involved, perhaps design special equipment, prepare drawings and specifications, and get them all, together with formal prices and deliveries, into the hands of the inquiring bidders in time for the latter to make use of them.

Meanwhile the bidders themselves are in an even worse turmoil in figuring the complete contract and the total result is all too often a proposal far less complete and acceptable to every one concerned than would have been possible under a longer time allowance. Four weeks is none too long to give manufacturers and bidders on such contracts a chance to prepare a carefully considered offering, one not only satisfying to the conscientious manufacturer of equipment but also most suitable for the job.

Isn't there some way, by a little more forethought, of avoiding this rush, typically American, in work which is highly deserving of careful and detailed attention?

Weekly Tips for Manufacturers in Construction News

Heretofore reports on machinery and building materials have been published in the Unclassified columns of Construction News. Beginning next week such reports will be found in Construction News under the heading Materials and Equipment. This week's items are as follows, all verified:

PROPOSED WORK

Rock Asphalt — New Orleans, La.—W. Ball, purch. agt., City Hall, soon takes bids 300 tons Uvalde rock asphalt. A. Black, comr. Dept. Pub. Property.

Rock Crushing—Manitowoc, Wis.—Plans to purchase rock crushing outfit during 1924. $6,000. A. H. Zander, city clk.

Steam Roller or Street Scarifier—Faribault, Minn. — Plans to purchase steam roller or street scarifier. E. Johnson, city clk.

BIDS DESIRED

Cement, Etc.—New York, N. Y.—Nov. 13, by J. Miller, pres. Manhattan Boro, Municipal Bldg., 5,000 bags Portland cement and 2,000 cu.yd. asphaltic wearing surface sand.

Dragline Bucket — Covin, Ala. — D. W. Robins in market for one dragline bucket.

Gravel—Baton Rouge, La. — Nov. 13, by State Hy. Dept., Reymond Bldg., furnishing 30,849 cu.yd. 60% sand clay gravel or as alternate 10,286 cu.yd. washed gravel and 20,563 cu.yd. 40% sand clay gravel, for surfacing Federal Aid Project 81, Sects. A and B, St. Francisville-Mississippi Highway, West Peliciana Parish. J. M. Fourmy, ch. engr.

Paving Brick—Youngstown, O.—Nov. 15, by Director Pub. Wks., 250,000 paving brick. $8,000.

Crushing Plant—Owatonna, Minn.—Nov. 13, by Steele Co., 1 portable combined gravel, screen and crushing plant, 8 x 36 in. crusher. R. W. Hosfield, Owatonna, engr.

Scraper—Plano, Tex.—J. L. Aldridge taking bids Fresno scraper.

Sluice Gates—Exchequer, Calif.—Nov. 20, by Directors Merced Irrigation Dist., Merced, 2 sluice gates, 277 static head operated under 100 ft. 28-30 ft. to discharge, 6 ft. diam. sluiceway, for Exchequer Dam, here. Starr-Thebo-Anderton, Sharon Bldg., San Francisco, engrs.

Railroad Ties—North Bay, Ont.—Temiskaming & Northern Ontario RR., North Bay, in market for 350,000 railroad ties, $300,000. S. B. Clement, ch. engr.

BIDS RECEIVED

Road Surfacing Material — New York, N. Y.—See "Streets and Roads."

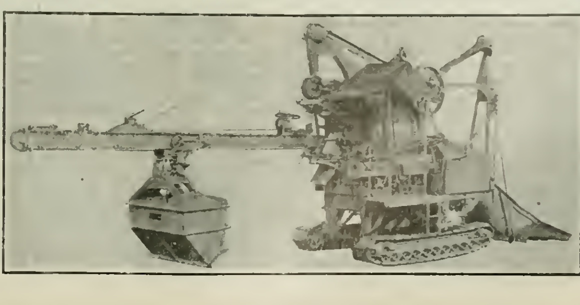
CONTRACTS AWARDED

Street Sweeper—Hanford, Calif.—Motor driven street sweeper to S. S. Smith, 62 Market St., San Francisco, $7,200. Noted Oct. 20.

Equipment and Materials

Paving Mixer for City Work Designed for Low Headroom

For city paving work where a large capacity paver is desired, the Koehring Co., Milwaukee, has developed a special design of headframe on its 21E paver.

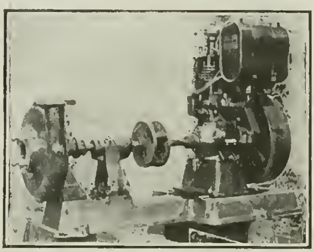


The uprights supporting the sheaves through which the charging skip cables run are bolted and hinged in such a way that after the bolts are removed the upper framework may be tipped back by the skip hoist clutch, thus reducing the height of the machine, and allowing it to pass beneath low telegraph wires and other obstructions.

The minimum height from ground of the paver with this special frame is 10 ft. 9¼in. with truck wheels, 10 ft. 11¼ in. with half-length multiplane, and 11 ft. 2¼ in. with full-length multiplane. This arrangement also permits the loading of machine on a flat car for shipment without any dismantling further than the boom and skip.

General Purpose Pumping Unit

A contractor's general purpose pumping unit, consisting of a standard 2½ in. American centrifugal pump direct-connected to a New Way gasoline engine, the whole outfit being mounted on a cast-iron base, has recently been placed upon the market by the American Well Works, Aurora, Ill. Among



the advantages claimed for it by the manufacturer is the connection of the pump to the engine through a flexible coupling, the shaft being supported on a pedestal bearing. This feature is designed to insure long life for the equipment. In addition, a thrust bearing is provided to meet the most rigorous conditions of general service.

The cast-iron casing of the volute type may be swung on its bolts so that the discharge opening may have any of eight positions. The suction nozzle is cast in the casing and companion flanges are furnished for suction and discharge openings. The impeller is of cast iron, machined and balanced.

The unit is made in only one size and is designed for heads up to 75 ft., with a delivery, under field conditions, of from 50 to 250 gal. per minute. Under a 50-ft. head the pump, operating at 1,000 r.p.m., delivers 120 gal. per minute. The manufacturer emphasizes the compactness of the unit which occupies a floor space of 3 x 1½ ft.

Publications from the Construction Industry

Truck Loaders—George Haiss Manufacturing Co., Inc., New York, presents information on its path-digging truck loaders in a 28-p. illustrated pamphlet just published. The equipment consists of an endless chain of buckets mounted on a crawler-driven chassis with special material-gathering and discharge features. Operating data are presented to indicate the working capacity of the machine and the design of the loader is explained in detail.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

The Industrial Situation as Shown by Industrial Expansion

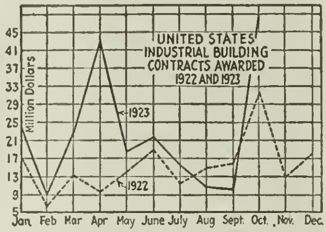
Whether business is good, bad or indifferent can best be judged by the rate at which industrial building is going on. When plants and factories are multiplying and expanding it is reasonable to suppose that the owners look with confidence to the future. Heavy industrial building not only gives employment to construction men, but also means many orders for machinery and equipment. If, on the other hand, industrial expansion is below normal the reverse is of course true.

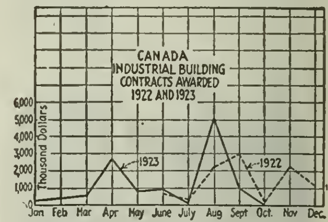
Contracts awarded on industrial projects in the first nine months of 1923 amounted to $187,648,000, against $133,178,000 in the same period of 1922, according to *Engineering News-Record* which published awards of $40,000 and over. This is an increase of $54,470,000 and will probably place this year's total above that of last year. But it is noteworthy that most of this increase occurred in April, when $43,000,000 worth of work was placed under contract. May, June and July awards were heavier than those of 1922 and followed the same trend, as shown by Chart 1. Since August, however, the contracts have been notably lighter than in the same period last year.

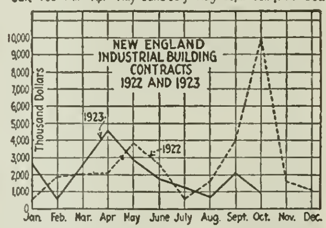
This falling off in industrial construction is quite general throughout the United States and Canada, the exceptions being the South and the region west of the Mississippi. The following table shows the situation in each section:

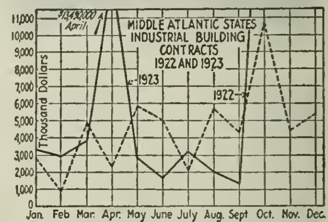
	1922		1923	
	No.	Value	No.	Value
N. E.	158	$20,765,000	175	$20,680,000
Mid. Atl.	282	37,991,000	236	36,813,000
South	53	18,325,000	82	10,605,000
Mid. W.	334	40,792,000	437	62,128,000
W. of Miss. ..	70	7,703,000	170	40,982,000
Far W.	60	7,602,000	126	16,440,000
U. S. Total.	957	$133,178,000	1,126	$187,648,000

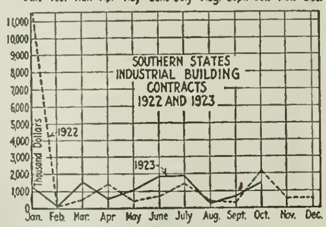
(*Concluded on p. 785*)

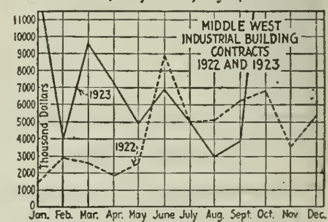


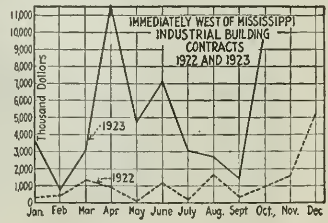


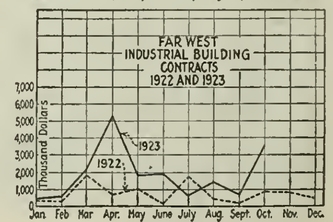












Production and Materials Stocks in Eleven Cities

Plenty of Brick, Cement, Lumber and Other Materials—Slight Drop in Steel Output

Steel—Production of steel ingots during October averaged between 3,000,000 and 3,200,000 tons, against 3,159,283 for the month preceding. This slight drop is seasonal and indicates satisfactory production conditions. Mills are operating at about 80 per cent of capacity. Demand, though low, is much better than was expected several months ago. No indications, however, point to a heavy production schedule for the coming Winter.

Lumber—The total output is now about 2½ per cent above normal, against 6 per cent above, one month ago and 2 per cent below normal one year ago. Production, shipments and orders, however, for the four weeks ending Oct. 20, show substantial gains over the preceding four weeks and also over the corresponding period in 1922. While shipments of Western fir to the Eastern states have declined somewhat owing to Japanese demand, Southern pine, which furnished 36 per cent of all lumber cut in the United States in 1922, has been able to meet the demand and to prevent any danger of lumber shortage. The lumber movement, according to the National Lumber Manufacturers' Association, is shown in the following table:

	Four Weeks Ending Oct. 20, Ft. b.m.	Four Weeks Ending Sept. 22, Ft. b.m.
Cut	1,113,268,502	1,076,178,223
Shipments	1,006,228,403	939,801,763
Orders	1,022,862,571	977,305,153

Cement—Production during the first nine months of this year totaled 101,016,000 bbl., against 81,563,000 for the corresponding period in 1922, according to the Geological Survey. With a gain of 23 per cent in production and only 18 per cent in shipments, a total of 5,492,000 bbl. were available, as a reserve stock for the nation, on Oct. 1, as against 4,724,000 on hand one year ago.

Brick—The report of the Common Brick Manufacturers' Association of America as of Oct. 1, shows 307,633,000 burned brick on hand at yards throughout the country, compared with 250,176,000 for the preceding month. Orders on books have increased during the last thirty days and production is preceding at an unprecedented rate in the face of the fact that 18,953,000 brick have been imported from Canada, Holland and Germany during the three months ending Sept. 30.

San Francisco—Stocks of building materials are large and easily obtainable, with the exception of blue annealed and black steel sheets and rivets.

Los Angeles—Demand steady and supply sufficient in all materials.

Denver — October lumber reserves largest of any month this year. Brick stocks 80 per cent heavier, compared with month ago.

Minneapolis—Ample stocks of all building materials, with some lightening of demand for brick and tile.

Detroit — Lumber dealers' stocks somewhat decreased. Several days required on large deliveries of hollow tile. Only a moderate supply of brick in local yards. Scarcity of Bermudez asphalt.

Chicago—Sewer pipe supply low; deliveries on some sizes take from three to four weeks.

Cincinnati—Plenty of all materials. Cement deliveries fair, compared with scarcity of a month ago.

New Orleans—All building materials in light demand. Stocks of all character are sufficiently abundant, with the possible exception of 4-in. sewer pipe.

Atlanta—Slightly more cement, steel, asphalt and lime on hand, than a month ago.

New York—Brick stocks 50 per cent heavier than winter reserves in any recent year. By the time Hudson River navigation opens up next season, plants along the river will have 600,000,000 brick ready for the spring market.

The Industrial Situation as Shown by Industrial Expansion

(Concluded from p 784)

Average value in 1923 was $153,000, compared with $139,000 in 1922.

The actual trends and current conditions in the various sections are given by the charts. Last year October was the banner month, following a slow, fairly steady improvement. This year's peak also occurred in October ($48,985,000) but there was a high point of $43,031,000 in April. Since June the curve declined until October, when the $20,000,000 Kearny, N. J., power project of the Public Service Corporation, swelled the total.

In the last four years the total and the average monthly value of industrial contracts in the United States in this nine-months period were as follows:

1920	$408,779,000	$45,419,000
1921	83,160,000	9,240,000
1922	133,178,000	14,797,000
1923	187,648,000	20,849,00

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 253 to 263, are the following:

Station and Office, Louisville, Ky., Louisville R.R. Co., $1,250,000.

Tunnel, Oregon, Southern Pacific R.R. Co.

Bank and Office, Dayton, O., $1,500,000.

Bridge, St. Paul, Minn., Ramsey Co., $1,500,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 253 to 263, are the following:

Hotel, New York; N. Y., M. Gerschlesser, $1,250,000.

Hotel, Hot Springs, Ark., to Ault & Burden, Little Rock, $2,100,000.

Bank and Office, Richmond, Va., to J. T. Wilson, $1,000,000.

Apartment, Hollywood, Calif., to Hennessy Bros., Los Angeles, $1,000,000.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Common brick, Denver, 9,000,000); time required for delivery of carload lots to city job, example: (Sewer-pipe, Atlanta, 4 to 5 days); and stocks on hand in general terms, example: (Hollow tile, Cincinnati, plenty.)

	San Francisco	Los Angeles	Denver	Minneapolis	Detroit	Chicago	Cincinnati	New Orleans	Atlanta	Philadelphia	New York
Sewer Pipe	Large and easily obtainable	No shortage	Supply low	Ample	Plenty in sizes up to 36 in.	Supply low; del. on some sizes take 3 to 4 weeks	Stocks large	Scarcity of 4-in. gauge	Del. take 4 to 5 days	Enough to supply demand	Mill shortage on 15 to 36-in., double strength
Cement	Fairly well supplied	Sufficient; foreign shipments arriving	Enough	Plenty; del. prompt	Ample for present requirements	Very good supply	Del. fair	Plenty	About 65 cars	Shipped from mills as needed	Plenty; dealers' stocks small but mill del. prompt
Lime	Well stocked	Plenty	Sufficient	Enough	Supply good; del. good	Plenty	Enough	No shortage	About 75 cars	Sufficient	Market well supplied
Common brick	Large reserves	Demand being met	9,000,000	Demand lighter; plenty	Moderate supply in local yards	Sufficient	Ample	Sufficient	Plenty	No reserve stocks	600,000,000 to be ready for Spring del.
Hollow tile	Good and easily obtainable.	Supply equal to demand	Stocks low	Large reserves; demand falling	Several days required on large deliveries	Del. take one week	Plenty	Enough	Del. take 4 to 5 days	No reserve supply	No scarcity
Lumber	Very large reserva	Demand not greater than supply	15,000,000 ft.; largest this year	Supply larger owing to slackening of demand	Dealers' stocks decreased	Del. take 30 to 60 days	Sufficient	Stocks ample; pine in light demand	Plenty pine	Stocks in good shape	Del. take 5 weeks from mill
Asphalt	Unlimited native supply	Native reserves large	Sufficient	Ample	Del. good on Mex.; scarcity of Bermudez	Plenty	Ample	No market	About 70 to 80 cars	Sufficient to meet increased demand	Heavy reserves in N. J.
Structural steel	Plenty structurals; low on sheets and rivets	Sufficient	Warehouses well stocked	Enough in ware houses	No shortage of local warehouse stocks	Users' stocks low on bars and plates	Warehouse stocks large because of slower demand	Normal	About 4 cars	Supply ample for small tonnages	Demand for structurals active; warehouse stocks sufficien

Tariff Commission Drops Investigation Covering Duty on Logs

The Tariff Commission, by a vote of four to two, has decided that it lacks jurisdiction to investigate costs of production of fir, cedar, spruce or western hemlock logs, mentioned in paragraph 401 of the tariff act of 1922.

Paragraph 401 imposes a duty of $1 per M. ft. b. m., on these logs, with the proviso that such logs shall be duty free if imported from any country which within a year has not imposed any embargo or restriction upon its own lumber exports. This conditional duty was aimed at export restrictions imposed by Canada.

The majority opinion held that the flexible provisions of the tariff act did not apply because upon certain conditions the logs could be entered free of duty.

Less Reconstruction in France. Four out of five largest American concerns operating in France, have withdrawn from the field because of belief that present French financial situation is unfavorable to building. Work is not extensive enough to further attract American builders and French claim ability to operate at lower costs.

Finland proposes to spend $16,500,000 on public works, railroads, harbors and hydro-electric resources. Recently $10,000,000 of Finland bonds were placed on the American market.

Conditions in Japan show that the reconstruction program will cover a period from 5 to 7 years. This will radiate prosperity to all part of the Empire.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities The last complete list will be found in the the issue of Nov. 1; the next, on Dec. 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.00
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.25	5.30	5.00	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.38	3.20	3.45	3.85	3.65	4.10	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	+40%	43%	47%	53–5%	36%	33.2@42.2%	35%	47.43
Cast-iron pipe, 6 in. and over, ton	63.60	+54.75	61.00	—57.20@60.20	60.50	69.00	—61.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	—2.95@3.05	2.60	2.05	2.20	2.50	2.84	2.61	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	1.85	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	2.00	2.00	+1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	—61.00	39.00	+54.75	—57.50	44.75@45.75	48.00	41.00	29.50	70.00
Lime, finishing, hydrated, ton	18.20	25.00	23.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.60	—1.85	1.50	1.50	2.70	2.10	2.80	9.50
Common brick, delivered, 1,000	—21.45@23.65	11.00	—11.00	11.00	—16@18	12.00	15.00	15.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	—.110	.0724	—.075	.065	....	.11	.115
Hollow partition tile 4x12x12, per block	.1179	.102	—.110	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.98	—.97	1.08	1.14	—.99	1.12	—1.08	+1.15	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.50@.55	.35@.50	.50	.62½	—.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93⅜c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.70). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in., $119.

Changes Since Last Week

The current market is characterized by irregularity both as to prices and conditions. The recent recovery in the stock market; an acceleration of retail trade; and the declaration of an extra dividend by the U. S. Steel Corporation are favorable indications.

These are offset, however, by the lack of development in steel demand; lower pig-iron prices, also due to falling demand, a sharp increase in the domestic business mortality; and curtailment in certain manufacturing industries.

Instances of price irregularity are shown in the recent advances in both steel and cast-iron pipe in Atlanta as compared with declines in San Francisco and Chicago. Pine timbers, at the same time, advanced $2.50 in Dallas and dropped $1 per M ft. in New York and Chicago. Linseed oil (an indicator of the paint trade) dropped 3c. in Atlanta, Minneapolis and San Francisco and rose sharply in Seattle. Lump lime, common brick and hollow tile, however, declined consistently in Dallas and Minneapolis as did cement, yellow pine lumber and common brick in New York.

The iron and steel situation may be described briefly as follows: No. 2 foundry iron quoted as low as $20@$21 per ton at Birmingham. Buyers not quite satisfied that bottom has been reached in iron prices. Coke declining with pig iron. Steel bars still $2.40, with structurals at $2.50 per 100 lb., Pittsburgh. Steel consumers show tendency to believe that prices have stabilized at present levels. A very small amount of cutting under is reported, mostly on steel sheets.

A Consolidation of Engineering News and Engineering Record

McGraw-Hill Company, Inc.—James H. McGraw President

Engineering News-Record

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor
Frank C. Wight, Managing Editor

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Tax Economics

THE best test of a tax is the return it brings. Secretary Mellon has shown that the excessive supertaxes defeat their own purpose in that the large incomes are annually paying less to the upkeep of government. That these supertaxes are also encouraging tax-exempt bonds with accompanying municipal, county and district extravagance is secondary though important. The Secretary of the Treasury puts the question squarely up to Congress. Shall we continue our present system of taxation and pile up a Treasury surplus at the expense of a proper industrial expansion and out of the pockets of the middle class salaried man, or shall we continue to bow down to the class antagonism which demands a theoretical high tax out of large incomes whether that tax brings in any return or not? Economics and sound finance are on the side of the Secretary of the Treasury. Whether politics is remains to be seen.

Temporary Football Stands

COLLEGE football gatherings last week produced in one day two failures of temporary seating stands, which sent several score spectators to the hospital with serious injuries. Failures of this kind have become increasingly frequent as the assembling of large crowds at sport events has increased, and on the present record temporary stands must be set down as a distinct danger to public safety. Unlike permanent stands, they usually do not receive engineering attention in design and construction. They are decided upon in haste and are entrusted to the rule-of-thumb methods of a carpenter boss; and, representing a speculative expenditure for one-day service, they are apt to be bargained for at lowest price. While such conditions might seem to be most hazardous in the case of a private promoter's enterprise, the irony of fate makes the amateur football stand much the greater hazard. Engineering and architectural skill is ready to hand, in a college town, but it does not seem to be made use of when temporary stands are wanted. From the outsider's viewpoint it is the obvious duty of college authorities to make sure of the safety of their temporary stands before throwing them open to the visiting football crowds. But we fear that under present circumstances, if a stand collapse were to be investigated searchingly to determine how the authorities had carried out this duty, they would not make a wholly creditable showing.

Reinforced-Concrete Roads

THE case for reinforcement of concrete roads is well argued in this issue. There will not be entire agreement of engineers that wire mesh is the superior form of reinforcement, but this may be passed in the satisfaction that engineers, who have long urged that steel had a useful place in pavement slabs, will gain in having their practice so vigorously supported by Mr. Breed's discussion. Great strides have been made in three years in concrete road slab design. The separation of the slab into two spans by a longitudinal joint, the doweling of all joints, the thickening of the edges of slabs, and, above all, reinforcement itself are all common practices today. And none of these new practices has been more widely taken up than reinforcement. Each year has seen those states which began with a light mesh of steel to check cracking increasing the weight of metal used in the body of the slab and strengthening points of local stress with supplementary bars and frames. There is less need now than a few years ago to bring proof that reinforcement has its use in pavement for rural roads but there is still a world of knowledge required concerning the principles and technique of pavement reinforcing. These subjects both need more consideration than they are receiving in the everyday practice of road design.

Engineering Plus Adventure

RARELY has a group of engineers had a more spectacular or exciting three months than had Colonel Birdseye and his associates this summer at the bottom of the canyons of the Colorado. The running story of the trip in this week's issue is as absorbing as any tale of adventure. It satisfies, as few engineering reports do, the fictional notion of the engineer's life. But more than that it is the initial story of an exceptional engineering investigation carried out under the most adverse circumstances with what appears to be satisfactory success. The Colorado River is to be the scene of some of the most important engineering work of the next generation but that work cannot even be projected properly until more is known of the nature of that practically untraversed canyon, a part of which has become famous for its scenic beauty. This knowledge the Birdseye party set out to supply insofar as a reconnaissance could supply it. This voyage down the Colorado was in reality a preliminary survey with a line of levels carried through with remarkable accuracy, and included a study of dam sites and a record of stream flow, in addition to a fair amount of topographic mapping. When it is remembered that the trip itself, devoid of any of the surveying accessories, has been made only two or three times and, with the exception of the pioneer Powell trip only as an adventure, the Birdseye expedition becomes a notable addition to the annals of engineering.

Work for Engineering Schools

INDUSTRY is going to need 400,000 more persons for positions of responsibility by 1930 besides the replacements in the 1,500,000 administrators and technical experts now employed. This is the conclusion of the National Industrial Conference Board from an extension of current statistics and a consideration of the growing complications of industry. These figures are easy to believe but the collateral assumption that this means a

proportionate burden on the engineering school is not so convincing. It is no doubt a fact that industrialists generally are beginning to have a much better appreciation of the advantages of a technical education in the administration of industry but engineers should not delude themselves into believing that the future executives are all coming from the engineering profession. The report of the Board, abstracted in this issue, partakes of the common failing of industrial leaders of considering the problem of engineering education mainly the most efficient production of human material to fit into the major gears of the industrial machine. Insofar as the changing industrial process is to call for more and more engineers to do strictly engineering work the Board's conclusions are sound. Engineering schools must prepare for a growing increase in that demand. As to the necessity for an engineering training for the future administrator it depends on what one calls an engineering training. From the Board's report and the suggestions of similar nature that industry occasionally offers the proposed training is industrial rather than engineering. It may be that the engineering school can furnish such training better than any other but it should be clearly understood that the products of it are not so much engineers as they are industrialists.

Another Study of Education

THIS problem of fitting engineering education to the needs of the future is so important that engineers will welcome the decision of the Carnegie Foundation to spend $108,000 to supplement the earlier study made by Dr. C. A. Mann some years ago. The new investigation will be made mainly by the colleges themselves under the direction of a man exceptionally well equipped for the job. Mr. Wickenden has had the dual experience of being an engineering teacher and an industrial leader and in both capacities has made a brilliant record as a student of personnel and training. Any study under his lead, therefore, will have both solid foundation and vision, both of which are sorely needed today in engineering education. One word of suggestion only may be made. The proposed study, though initiated by the Society for the Promotion of Engineering Education, has been surrounded with a good deal of the same kind of thinking that marks the report noted in the preceding paragraph. The men back of it apparently have had the promotion of industry foremost in their thoughts. This is admirable but those who are to spend the Carnegie Corporation's money must not forget that after all there is an honorable and necessary profession of engineering which cannot be made merely the handmaiden of production. If it were to become so the progress of the world would be seriously retarded.

Engineers in Public Service

ENGINEERS in Chicago recently got a layman's frank view of themselves and their profession that was both appreciative and inspiring. Col. A. A. Sprague, commissioner of public works, chief of staff of the Thirty-third Division during the war and president of one of Chicago's largest commission houses, in addressing a noonday meeting of the Western Society of Engineers stated that no men were more needed in the activities of a city than the engineers, but the entire absence of engineers from all bodies selected directly by the citizens he deplored as unfortunate both for the city and the profession. Mr. Sprague asked if there were some inherent restraint in the engineer tradition that kept engineers from elective offices or whether it was merely choice. By this time engineers must realize they must work out their own destiny. If engineers want to get into public life individual engineers must do it and when they do attempt it the profession must stand back of them. The muddle in the Reclamation Bureau is a point in question.

As to inspiration and activation, Mr. Sprague made four points: The engineer can develop *honest* fact-finding; he best can apply those facts to the proper growth and development of a city; he can help obtain public approval and he can and must co-operate with men who are not engineers without intellectual or technical snobbery. On these last two points Mr. Sprague gave some very wholesome advice which the 300 engineers who overcrowded the room took without wincing. "When engineers are able to humanize their ideas so that the public can understand them, accept them and sense their benefits it will be a progressive step of far-reaching importance, but remember," he said, "you have got to be real human beings yourself before your words will be human. You men have got to help bridge all these human difficulties which are based on human misunderstandings that can be improved. The human factor in all labor and in all achievement is a part of your problem. It lifts the profession out of the mechanical and material and into one of those vital professions which are most worth while."

With leadership like this it is easy to see why the engineering department of the City of Chicago, for the first time in years, is happy, contented and has become once more a "good place to work."

Power and the People

LAST week the voters of the State of New York defeated by an overwhelming majority an amendment to the constitution permitting the development of water power on the state lands in the Adirondack forest. The vote was important to New York because it holds back for an unknown period the imperative development of the power resources of the state, but it is more important as an indication of the temper of the people in this critical issue of power. If this temper is general—and there is no reason to believe that New Yorkers are unique in this respect—the vote is most significant and the kind of thinking it represents must be studied and reckoned with by all concerned with power development.

The present constitution permits the use of 3 per cent of the Adirondack state lands "for the construction and maintenance of reservoirs for municipal water supply, for the canals of the state and to regulate the flow of streams." The proposed amendment provided that this same 3 per cent could be used "for the development of water power for the public benefit, and for the construction, maintenance and operation thereon of ponds, structures, conduits and appurtenances necessary for that purpose." Such development might be by the state or by a lessee of the state under state regulation. Transmission lines were specifically included in the appurtenances but manufacturing or business was prohibited on the state lands. There are about two million acres in the state domain, but by any plans now known only about 2,000 of the permitted 60,000 acres could be used for the power purposes outlined in the amendment. In other words, an extremely small part of the wild land of the state was to be utilized, possibly by the state

itself, possibly by private interests whose profits and rates would be controlled by the state, to develop about a million horsepower by the formation of a few artificial lakes in a country already spotted with natural ponds, the erection of some sightly power houses and the construction of some transmission lines along narrow lanes cut through the forest.

The opposition to the amendment came from two sources—first, the group of nature lovers, made up partly of the private owners of Adirondack land, mostly wealthy men with large forest preserves inaccessible to the general public, and partly of the vociferous minority who make a holy cause of any practical utilization of nature's resources and second, the advocates of state owned power, who are also the opponents of any private power development. The arguments of the two groups were in many respects in mutual opposition, but this they calmly disregarded and worked together to such good effect that practically every influential newspaper in the state came out against the amendment and its only public defenders outside the power companies were a few engineers who have been studying the power resources of the state.

In effect, the arguments against the amendment were as follows: (1) It might prejudice the state's future ownership of its water power; (2) it would destroy the beauty of a state park by the erection of disfiguring power houses and appurtenances and (3) it would permit the exploitation of public resources by private interests (for publicity purposes known in all the literature as the "water power barons") with no compensation therefor. Here is, of course, a curious mixture of state ownership and the nature lover. Just how a state owned power plant is to be less disfiguring than one privately owned was not made clear—but at any rate, and this is the significant thing, enough people accepted one or the other view to defeat the amendment by half a million votes.

The campaign against the amendment and the vote make one thing very clear—there is need of a vast amount of education in the matter of power development. In spite of the experiences of the past few years the people generally take as an amiable scientific prophecy that there will be no more coal in a few generations. It apparently has about the same effect as the recurring predictions of the diminution of the sun's heat. There is, besides, a dense ignorance of the real nature of hydro-electric development. It has not penetrated the general intelligence that for widespread electric transmission economic design requires that steam generation must accompany water generation and that during this period of growing scarcity of coal it is only by the tying in of the available water power to properly located steam stations that electric energy can be delivered at the lowest cost. Further than that, many scattered hydro plants must be tied together to take care of the variations in flow and demand. It follows therefore that for the greatest economy the state, if it develops its own water power most economically for the public good, must either co-operate with the private companies in the distribution of energy or operate its own coal burning plants.

It is possible, of course, that in time our social development may lead to one of these two contingencies but we very much doubt if that time is near or that many of those who voted against the amendment desire either one. Most of them were obsessed with one of two notions, that power development in the Adirondacks means a ruthless destruction of natural beauty or that even with state control there is inordinate profit in the private development of water power. Neither of these two notions has any basis in fact, but merely to state that has little influence with the public. They need to be educated in the elementary principles of power development, so that they can judge more wisely when such issues as this one arises. If in the long run the people of the United States want publicly owned power they are going to have it. That is what democracy is. But it behooves those who believe that for the next fifty years at least the general good is to be better served by private development to do all they can to put the facts before the people so that they will not be governed by such silly and contradictory arguments as prevailed in New York last week.

A Record and a Promise

LAST spring when everything else seemed to point to a season of unusual prosperity it looked as though the railroads, through their inability to handle the increased traffic, would put a costly check on an otherwise successful year. They were still years behind on their normal betterment program, behind on their maintenance work, without capital for new work, and lacking the ability to raise much new capital because of their low earning power. But the American Railway Association, realizing, probably, that the success or failure of the performance of the railroads in the ensuing months would largely determine the attitude of the new Congress towards them, and realizing as well that if the situation was to be handled successfully it must be done through increased efficiency, set out to increase the number of cars available for the transportation needs of the country by increasing the miles per day per car and the load per car, and also decreasing the number of bad-order cars and engines waiting repairs. In addition to this the railroad companies took advantage of equipment trusts as a means of purchasing rolling stock.

The record of how well this program of increased efficiency was carried out is now a matter of history; approximately 115,000 new freight cars and three thousand engines, a smaller percentage of engines and cars in need of repairs than ever before, the average mileage per car per day increased from 22.5 for the first nine months of 1922 to 27.6 for the same period in 1923, and an increase of 31 per cent in the ton-miles per day.

This is a record of which the railroad companies may well be proud but the best part of it is that it has spurred them on to outline a more comprehensive plan for next year. This plan includes a field of co-operation and use of joint facilities never tried before. Its success will largely depend on the continued confidence of the railroad operating officials in the security of their properties and their ultimate return to a paying basis. As long as they feel that in the near future they will be able again to invite new capital to invest in the railway field so long will they work toward more efficient operation. But once they feel that that their companies are going to be kept from earning a fair return on the capital invested just so soon can the American people expect the collapse of their great railroad structure. The railroad performance in the past ten months has demonstrated that the Transportation Act is, on the whole, fairly just and workable. The incoming Congress will do well if it devotes its attention to its improvement rather than to its destruction.

Reinforcement in Concrete Roads Worth Its Cost

Experience and Experiment Both Give Proof of Increased Strength and Endurance — Quantity and Distribution of Steel Main Problem —Fabric With Edge Bars Best

By H. Eltinge Breed
Consulting Highway Engineer, New York, N. Y.

REALIZATION of the basic value of concrete roads and concrete bases has made highway engineers seek zealously to eliminate their defects. Comparison of the use of concrete in highways with its use in structures directed attention at once to the value of steel as a method of giving additional strength. In concrete structures such as buildings and bridges, the use of steel for reinforcement was accepted good practice, and the theory of relative quantities to secure a given strength had been worked out to precision. Obviously, the use of steel in the concrete would give additional strength to highways. But would the expense be justified? It was argued that it would not; that whereas in buildings steel was a necessity to give them rigidity, it was not necessary on a flat surface that had the bearing power of the whole earth beneath it. But meanwhile cracks were developing in the concrete and concrete-base roads, and it became apparent that the bearing power of the whole earth varied widely on different portions of its surface. Other remedies having been tried without success, small quantities of steel were introduced to try to bind together the slab. The results were so encouraging that the use of steel as a binding agent in concrete roads has become general.

Experiment having indicated that the use of steel was advisable as a binding agent in concrete roads, the problems remained of how much steel it was advisable to use, and of how best to distribute it.

Distribution—Cracks first occur when the cement is setting. When cement hydrates the chemical action involved generates heat, and shrinkage inheres in the process of cooling after setting rather than in drying out as was formerly thought. During shrinkage a binding steel is insurance against the progression of cracks, and the greater its distribution the more effective it will be. For instance, in wire with a 6-in. spacing a crack starting at the center of the mesh can progress only 3 in. before it strikes a steel binder that checks it. Thus reinforcement insures against the spread of any cracking that may be started by the stresses involved in the setting-up and curing processes. With the greater distribution of metal there is greater uniformity of strength in the concrete.

Whereas wire fabric provides uniform reinforcement, the tendency of the slab itself is to weakness at the edges. It is wise therefore to give edges additional strength by the use of a steel marginal bar or a thickening, and to hold the slabs together with an interlock or dowels so as to prevent unevenness at the joints and consequent impact.

Amount—For several years opinions varied about the amount of reinforcement it was advisable and economical to use. Two types came into general use, wire fabric and bars. Wire fabric weight for weight and area for area gives greater bond strength than bars on account of the fact that it has a greater superficial area. That wire fabric has more strength than bars weight for weight and area for area has been demonstrated by tests of the Pittsburgh Testing Laboratory. In these tests:

Three ⅜-in. round bars of 0.1093 sq.in. average area showed an average strength of 66,663 lb. per square inch, while five No. 8 wires, with a total area of 1.005 sq.in., showed an average strength of 83,490 lb. per square inch, or 25 per cent greater strength. Similarly, three ½-in. round bars with an average area of 1.982 sq.in. showed an average strength of 60,063 lb. per square inch, while eight No. 7 wires showed a total of 0.1944 sq.in. of area and an average strength of 81,237 lb. per square inch or 35 per cent more strength.

Small units of wire fabric reinforcement, because of more complete distribution of the metal, have greater tensile strength and bond strength than larger units of the same total weight and area spaced more widely.

There are other practical advantages of wire fabric that recommend it as a method of reinforcement, such as ease in handling, insurance of full quota of metal, greater facility on making street cuts through the pavement, closer approach to surface, and direct contribution to strength of pavement.

Placing—Most specifications now require that the wire fabric be supplied in sheets. These sheets are shipped in bundles and deposited by the roadside. The wires that bind them together are snipped, and two men, one at each end, lift each sheet and place it. With material woven into a web, no opportunity is afforded to omit any part of it. The engineer on the job is probably on his rounds before the wire fabric is covered, or if he has been absent and wishes to ascertain that it has been laid, he need only drop a hook through one place in the green concrete.

Since the surface is the area of disintegration, the support should be laid as close to it as is consistent with protection from abrasive wear. The generally approved depth at present is 2 in. below the top. It is extremely important that the fabric be *laid in place* at this depth, and not be simply dropped anywhere in the slab to find its own abode. The carelessness of the latter method has been found by test and experience materially to decrease the value of the reinforcement in preserving the integrity of the slab.

Proper placing of the reinforcement may be accomplished in two ways. The earlier, still most widely-used method is to screed off the pavement at the required depth, usually 2 in. below the top. This is done to remove any irregularities that would prevent the fabric from lying smooth. Then the fabric is placed on this bed and covered with the specified thickness of concrete. There is no opportunity for the metal to bridge or for voids to form under any part of it. There are, if the contractor wishes, two machines now on the market to strike off below the surface. The laying of the concrete above the fabric is accomplished equally well by either the chute or bucket type of discharge, requiring only a little more rapidity in its distribution, which means ultimately a saving in the

contractor's time. If, however, he wishes to avoid the extra operation of screeding, although it is done by men in the time when they would otherwise idly be waiting their turn in operations, he may use the new method of laying.

This second method involves only one pouring and no additional screeding. The wire fabric is laid on a support of thin iron plates set on edge to the desired position. The concrete is then poured through the wire to the required depth and above it to the surface. Then the iron plate supports are slid along by the movement of the mixer, to which they are attached, to be in position to receive the next section of reinforcement.

Openings—Where street openings must be made through the pavement, the rupture of the wire can be accomplished instantly with a pair of wire cutters. A 5- or 6-in. margin should be left between the edge of the opening and the ends of the wire mesh, so that the wires cut may be bent back into loops to which new fabric may be attached when the disrupted area is repaired. When sections of pavement must be torn up, a simple inlay thus renders intact the strength of the reinforcement.

Cost—It would seem that so far as service goes the concrete road reinforced with wire fabric meets the increasing requirements of modern traffic. How about the cost?

We know that reinforcement data compiled by the Ohio State Highway Department show the annual cost of maintenance of plain concrete as compared with reinforced concrete roads. *Engineering News-Record* for July 12, 1923, says that the total yardage of plain concrete roads built in Ohio prior to Jan. 1, 1923, was 4,767,366 sq.yd. The total maintenance cost for the year 1922 was $106,986, or an average cost of $0.0223 a square yard. This would be an average cost of $209.33 for each mile of plain concrete pavement 16 ft. wide. Of concrete reinforced circumferentially and with wire fabric there was laid up to the same date 2,921,002 sq.yd. with a total maintenance cost of $14,289 or an average of $0.0043 a square yard. This would mean $40.36 for each mile of 16-ft. pavement, a clear saving of $168.97 for every mile, every year.

Actual experience moreover, indicates that the reinforcement prolongs the life of the pavement at least one-fifth. Taking the general average of the life of a concrete pavement to be 20 years, the reinforced pavement will last 25 years. Multiplying the life of the reinforced pavement by the yearly saving in maintenance, we have a saving of $4,225 to offset the $1,120 it originally took to reinforce that particular mile, a clear saving of $3,105. With that in view it behooves any municipality whose annual maintenance charges are over $0.14 a square yard to consider the wisdom of making a capital investment that will be refunded in maintenance savings.

The conclusion is then that from the standpoint of the public, of road-builders and of engineers, concrete pavement or base, reinforced with wire fabric with edges strengthened and with joints interlocked or with dowels at the joints, adequately meets the requirements of modern traffic.

Bates Road Tests—The truth of this conclusion is sustained by both experiment and experience. The experiments made on the Bates experimental road in Illinois have been of world-wide significance. In July, 1922, the writer inspected the road. At that time five series of loadings had been run over many different types and variations of pavement laid contiguously, and the destruction of many sections had resulted. It was evident then that plain concrete bases under 6 in. thick were not adequate; even one section 6 in. in thickness showed the beginning of failure.

Since then traffic has been continued, with increased loadings, until a total load of 16½ tons has been used, 13,500 lb. on each rear wheel, in the final runs. In all, over 1,000,000 tons of traffic have been carried. On July 17, 1923, with two more days of the test still to run, only one section with an 8-in. concrete base as foundation for other types of surfacing than concrete was left intact. Definite conclusions should be drawn only from the results of the full test which are not yet available, but this much is evident: the top surface does not protect the base slab from ordinary stresses; and the contrast between the plain and the reinforced-concrete sections of the same thickness and proportions indicates that reinforcement in the bases would be a decided help.

On July 17, 1923, the Bates road had still in service a 6-in. section reinforced with 45 lb. per 100 sq.ft. of wire fabric reinforcement. After subjection to 1,000,000 tons of traffic with loadings up to 16½ tons, this slab is in good condition. The one break in the corner that developed last year was due to impact caused by the failure of the adjoining slab 5 in. in thickness. The cracks that have developed are fine and in four instances have stopped without progression through the slab. All of the cracks are well held together with no spalling or breaking down. The present condition of this slab indicates strength from the fabric reinforcement adequate to the test, which was extraordinarily destructive, half of the total tonnage running on the edge of the pavement, which had no edge strengthening.

Reinforced Bases—That the results of these tests is confirmed by experience is shown by recognition by many engineers who are specifying that their bases under asphalt, brick, wood and stone block, etc., shall be reinforced. High Holborn Road, London, is being rebuilt with a 9-in. reinforced concrete-base using a wire fabric reinforcement for a wood-block pavement. Fulham, London Metropolitan District, is laying wood-block pavement on a 9-in. and 10-in. concrete base reinforced with wire fabric. Holborn, London Metropolitan District, is laying a first-class paved road with a 2-in. asphalt top on a 9-in. concrete base reinforced with a wire fabric.

In this country concrete bases are being reinforced in Richmond, Va., where 40 lb. of wire fabric is being used in a 5-in. concrete base under brick, durax, and asphalt surfacings. In Hudson County, New Jersey, a reinforced-concrete base is laid under granite block across the soft marshes of the Jersey meadows. Other cities like Augusta and West New York are using the reinforced-concrete base.

Examples—The writer's observation and experience corroborate the results of experiment. In 1920, in a pavement in Bennington, Vt., he used 40 lb. of wire fabric per 100 sq.ft. on the narrow sections of the street on either side of the car track under medium to light traffic. Three years later, after an unusual increase

in traffic, there are very few cracks with no opening up. The maintenance has been $0.002 per square yard per year.

Other reinforced-concrete roads that he inspected nearly three years ago were the Fort Lee Turnpike in New Jersey and the Kearney County Road; the William Penn Highway in Pennsylvania; the Grand River Road in Wayne County, Michigan; the Albany-Schenectady Road in New York; the Babylon-Bayshore Road on Long Island; and city streets in Paterson and Ridgefield, N. J., and in Beacon, N. Y. *Engineering News-Record* of Dec. 23, 1920, gives details of these pavements and others.

In every one, the three years' additional service has made more apparent the beneficial effects of reinforcement. The reinforced-concrete pavements have held better than near-by plain concrete pavements under similar conditions. This was to be expected. The significant point is found in the cost data. As far as the writer has been able to obtain it in detail, it shows that the lower maintenance of the reinforced pavement offsets within half its life the additional cost of the reinforcement.

Conclusion—Considerations of theory, practice and use lead to a tentative recommendation for what is vaguely known as the "average" case. From the "average," each highway problem will vary in respect to some factors still indeterminate such as bearing power of sub-soil, moisture content, temperature stresses, etc. Where sufficient basic facts have not yet been ascertained, we still have to design on empirical generalizations based on observation of the trial-and-error method. Varying conditions require corresponding variations in treatment, to be determined in each particular case. To apply a blanket recommendation to all highway conditions would provoke disaster as certainly as would the taking of a general cure-all for every known ailment. The following applies to the reinforced-concrete base as well as to the reinforced-concrete pavement.

First consider the country road. Service conditions and test roads have shown conclusively that the unsupported corner is the weakest spot in the slab. Next comes edge weakness, and then longitudinal weakness of slab when subjected to beam action. Provision can be made for edge weakness and the unsupported corner by thickening the edge or using the marginal bar. The bar should be turned across the pavement at the ends of the slab. Continuity of the slabs is secured by tying together the slab ends by ¾-in. plain dowels, 4 ft. long, spaced 2 ft. on centers, with one end encased to allow them to slip or by interlocking. To strengthen against beam action a division of the roadway can be made by a central division plate with the addition of fixed dowels to hold the two slabs together, which increases the beam strength of the half slab four times that of the full slab.

Cracking caused largely by variable factors, cannot be prevented entirely with any amount of metal we can afford to use. The use of a wire fabric reinforcement however checks the extent of the cracks, distributes them and interlocks the different sections of the slab into a unit, so that it prevents the cracks from becoming a destructive factor and reduces maintenance to a minimum. For this result 35 to 65 lb. of metal per 100 sq.ft. has proved effective in actual service for periods exceeding five years. Service conditions have shown also that a fabric with a ratio of two to one or three to one laid longitudinally in the pavement gives good results in the divided slab but the general tendency is for an equal distribution of the reinforcement in all directions.

The city or village street presents a different problem from that of the country road. In the former the same edge and corner weakness is less likely to cause destruction both because of the loads are rarely so near the edge, and because the sidewalk, curb, gutter and storm drainage keep the subgrade covered and free from excessive moisture changes.

The treatment of the slab design depends on the way the pavement is divided from curb to curb and the width of the street. With good foundation conditions 6 in. would be a minimum of thickness with 42 lb. of metal per 100 sq.ft. of surface corresponding to a 6x6-in. spacing of No. 6 wire placed 2 in. below the surface, giving equal distribution in all directions. The slab ends should be tied together with dowels or by interlocking as for country roads. In addition to this, edges of the slabs subjected to traffic should be strengthened by the use of a marginal bar, thickened edge, or both, as the conditions require.

The advantages of the reinforced-concrete pavement are practical and obvious. Beyond them lies a deeper satisfaction. There are many tendencies in American life that are cheap, extravagant, pretentious and ugly, but there is a steadily increasing force of opinion demanding intensive worth and sound value rather than extensive display. Working in harmony with that force, one is building for a better future. It is that hope that encourages us to look beyond supplying the immediate needs of transportation to promoting permanent improvement in highway work.

North-South Railway for Australia

A railway connecting the well-settled part of Australia along the south coast with the thinly settled section on the north coast, which has been projected at intervals for many years, is again under consideration. One purpose is to open certain inland sections for development, although part of the country is desert, but a secondary purpose is to develop northern ports and thus give shorter steamer routes to other countries. There is already a transcontinental telegraph line. From Port Darwin, on the north coast, in federal territory, a railway extends south to Katherine, about 200 mi. From Port Augusta a line of the South Australian Government Rys., connected with the general railway system, extends north to Oodnadatta, 478 mi. Between these two lines there is a gap of about 1,000 mi., and the cost of a railway is estimated at $68,500,000. Alternate routes have been proposed. A recent parliamentary committee has recommended a 150-mi. extension south from Katherine to Daly Waters and a 300-mi. extension as a light railway north from Oodnadatta to Alice Springs, which extensions are expected to be sufficient for several years. The lines are to be of 3½-ft. gage, laid with 60-lb. rails and probably with steel or concrete ties, if prices are reasonable, owing to the destruction of timber by white ants in the territory traversed.

Determining the Responsibility of Contractors

Determining His Acceptability as a Risk by a Reputable Surety Is Determining the Contractor's Responsibility

By E. W. Bush
Engineer, Aetna Casualty & Surety Co., New York, N. Y.

The committee on ethics of the Associated General Contractors, as noted in Engineering News-Record, *Oct. 11, 1923, pp. 583 and 616, are studying the elements that determine the responsibility of a contractor. The question is of importance to engineers when receiving bids or awarding contracts to "the lowest responsible bidder," also to contractors when placing sub-contracts. We have asked E. W. Bush, engineer of the Aetna Casualty & Surety Co. to give us the viewpoint of the sureties on this subject. His reply follows.*—Editor.

REPUTABLE sureties desire to write surety bonds on construction contracts for responsible contractors only, and the various bond-application forms, the financial-statement forms and the information schedules which are used have been prepared to disclose the contractor's responsibility. From the information received the surety forms an opinion of the client's responsibility and then, if the opinion is favorable, backs it with its financial strength and assumes the obligations of suretyship on the contract bonded. The underwriting of a contract is, as a matter of fact, the determining of the contractor's responsibility.

The Associated General Contractors' Committee has listed the following elements of responsibility:

1. Financial condition, bank credit and bank references.
2. Experience of person who will manage or direct the construction operations.
3. Plant available for the project.
4. Construction performance record.
5. Personal references for successful construction service.

The five elements listed are important, but, in general, they are not sufficient for sureties to act upon. Before being committed to the bond on important contracts they like the following additional facts, which, as explained later, are also elements in determining the desirability of the business, hence the "responsibility" of the contractor, for the project being considered.

6. Information regarding the proposed work, giving the kind of work, the location, the amount of the contract, the bid prices, and the other bids, if the bids have been opened. A copy of the contract documents is desired, also the names and addresses of the sub-contractors and the kind of work and amounts that will be awarded to them.
7. List of the other contracts on hand giving in regard to each the amount, kind, location, and approximate percentage completed, also whether or not each job is progressing satisfactorily and on a profitable basis.

Contract bonds are not liability insurance but are a form of credit because they increase the financial strength of the contractor to the owner by the amount of the bond. They are underwritten on much the same basis that a bank uses when extending a loan to the contractor—and for the same reasons. A bank meets with losses but never makes a loan if it thinks there will be a loss; in the same way a surety never writes a bond if it thinks the contractor will not be able to complete the contract without the owner calling on the surety.

There is a limit to the amount of bonding credit a reputable surety will extend to every contractor just the same as there is a limit to his banking credit. Assuming that the contractor is honest, experienced in the kind of work considered, bears a good reputation, has adequate plant and organization, and the work is ordinary in character, this limit is fixed by the relationship existing between:

(a) The contractor's net quick assets;

(b) His total net worth; and

(c) The volume of work to be performed. (The new work plus the incompleted portion of any contracts on hand.)

As a general underwriting rule, many reputable sureties like to see (a) not less than 10 per cent and (b) not less than 20 per cent of (c). With the same assumption regarding the contractor, the above makes a very good working rule to determine the contractor's responsibility in regard to any particular project or for work up to a certain aggregate amount.

Sureties frequently vary this underwriting rule depending on the size and nature of the work, the adequacy of the price, the previous success of the contractor in estimating and performing similar work, the profits being obtained on the other work on hand, whether or not the labor or material markets are stable and whether reinsurance can be obtained from other sureties. About the only underwriting rule that never changes is this one, namely, "The more favorable information the surety has about a contractor the greater will be his bonding credit." Reputable contractors and reputable sureties are both interested in eliminating the irresponsible bidder, and this will eventually be done if the best contractors will encourage the sureties to make a full investigation before writing the bond and they will give the sureties full information regarding their affairs. They can stand the investigation, whereas the irresponsible ones cannot.

A word is in order regarding financial statements because the net quick assets is an essential element in determining responsibility. The nature of the business requires contractors frequently to borrow large sums from banks in order to avoid a default and the amount that can quickly be raised is determined largely on the contractor's net quick assets. The quick assets consist of the cash, the earned accounts receivable and retained percentage, notes receivable, the securities possessed by the contractor, and the materials on hand that will go into contracts on hand. Against these are placed the notes and accounts payable and debts incurred to the date of the statement. Other assets of a slower nature would include real estate, materials that will not be required in contracts on hand, and plant, also any claims against others.

A mortgage against real estate is a slow liability, but while the plant is a slow asset a note given in payment for plant should be included in the quick liabilities because if it is not paid the contractor must go into the hands of a receiver. Money cannot be quickly raised on second mortgages nor on investments in speculative enterprises, and many notes receivable cannot be discounted. A contractor's plant is something he needs in his business, therefore he cannot sell it to finance his work. Banks, sureties, and others dealing with credits

are apt to scale down asset items which are obscure or of doubtful value, so it is desirable that a full explanation accompany each financial statement in order to have it appraised at its real worth.

The writer refers those interested in this subject of responsibility of contractors to the 1922 volume of the "Transactions of the American Society of Civil Engineers." E. A. St. John, vice-president of the National Surety Co., has an article on contract bonds, starting on page 1052; and E. C. Lunt, then vice-president of the Fidelity & Casualty Co., has a similar article starting on page 1058. F. S. Greene and H. S. Sisson have short articles on pages 1066 and 1068, respectively, that touch somewhat on this question, and the writer contributed a discussion to be found on page 1091.

Seven Plants Fabricate Steel For Chicago Building

Contract for 12,000 Tons Is Divided to Expedite Construction—Heavy Column Sections on Large Foundation Piers

Dividing the steel fabrication contracts among seven firms to insure rapidity of progress was the unusual step taken in the construction of the 32-story Straus Building now being erected for S. W. Straus & Co. at Michigan Ave. and Jackson Boulevard, Chicago. For 22 stories this building will be 172x161 ft. in plan, with a central light court about 56x50 above the fifth floor. Above the 22-story structure there will be a 10-story tower with a pyramidal roof surmounted by a 28-ft. sculptured group whose top will be about 475 ft. above the street level. The exterior finish will be of Bedford stone.

FIG. 1—GRILLAGE FOR COLUMN IN STRAUS BUILDING, CHICAGO

Two courses of plate girders and top course of I-beams with steel slab for column footing.

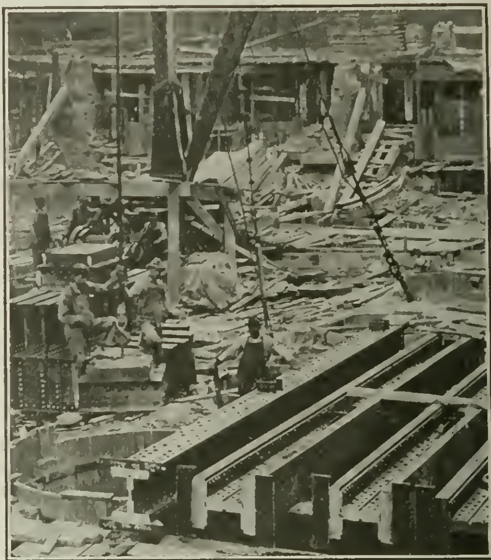

FIG. 2—HEAVY COLUMN SECTIONS AND GRILLAGE

When the work was being planned early in the spring of 1923, it was found that it would be impossible to have any one plant fabricate the 12,000 tons of structural steel work within the required time so that the building would be ready for occupancy by May 1, 1924. To meet this condition, the owners divided this part of the work into sections and placed the contracts with seven fabricating plants in five states, each plant being required to have its material ready by a certain date. In this way, the general contractor is assured a steady supply of material so that the work can go forward as planned.

These divisional contracts were not placed on a tonnage basis but on a tier or floor basis, so that the structural details could be completed with a minimum of delay. Each tier embraces two stories, except that the third tier includes three stories. In order to insure systematic and steady progress it was essential that an erection program should be arranged and that each successive contract should be completed by a specified date. In the accompanying table is given the approximate tonnage of each steel fabrication contract, with the date for completion of delivery of material.

All the steel is furnished by the Inland Steel Co., Chicago, and the way in which the fabrication contracts for structural material are divided is shown by the following list: Grillage for footings, Lakeside Bridge & Steel Co., North Milwaukee, Wis. Steel slabs for column bases, Hansel-Elcock Co., Chicago. First tier, Morava Construction Co., Chicago. Second tier, Vanderkloot Steel Works, Chicago. Third tier, columns, spandrel and interior girders, Minneapolis Steel & Machinery Co., Minneapolis, Minn.; other girders, Lakeside Bridge & Steel Co.; vault, Duffin Iron Works, Chicago; floor beams, Morava Construction Co.; two 68-ton 53-ft. girders over the main entrance, Phoenix Bridge Co., Phoenixville, Pa. Fourth tier, columns and

STEEL FABRICATION CONTRACTS FOR STRAUS BUILDING

Section	Material	Contractor	Approximate Tonnage	Date for Completing Delivery
Grillage	All	Lakeside Co.	540	Aug. 1
Slabs	All	Hansel-Elcock	60	Aug. 1
1st tier	All	Morava	1,000	Aug. 10
2nd tier	All	Vanderkloot	1,250	Aug. 20
3rd tier	Columns and girders	Minneapolis Steel	1,000	Sept. 5
3rd tier	Girders	Lakeside	500	Sept. 5
3rd tier	Floor beams	Morava	300	Sept. 5
3rd tier	53-ft. girders	Phoenix	150	Sept. 5
3rd tier	Vault	Duffin	150	Sept. 5
4th tier	Columns and girders	Kansas City Struct	600	Sept. 15
4th tier	Floor beams	Morava	300	Sept. 15
5th tier	All	Vanderkloot	850	Sept. 30
6th and 7th	All	Hansel-Elcock	1,500	Oct. 5 to 15
8th to 12th	All	Morava	3,050	Oct. 20-Nov. 20
Tower	All	Vanderkloot	650	Dec. 5
Total			11,900	

court spandrel girders, Kansas City Structural Steel Co., Kansas City, Mo.; floor beams, Morava Construction Co. Fifth tier, Vanderkloot Steel Works, Chicago. Sixth and seventh tiers, Hansel-Elcock Co., Chicago. Eighth to twelfth tiers, Morava Construction Co. Ten-story tower, Vanderkloot Steel Works.

Grillage for the column footings is composed of two or three courses of plate girders and I-beams, varying in size according to column loads. A complete grillage with steel slab for column footings is shown in Fig. 1. In the lower course the girders are 24 to 36 in. deep and in the second course they are 20 to 36 in. deep. When there is a third course, 15-in. I-beams are used. Steel slabs varying in thickness from 4 to 8 in. and of a size to suit the columns, with a maximum of 32 x 36 in., are placed on the grillage to support the first column sections, which are approximately 30 ft. in height. These bottom sections of the columns were placed before the interior excavation was made for sub-basement and lower sub-basement spaces. The columns are of I-section, built up of web and cover plates and four angles. Some of the bottom sections

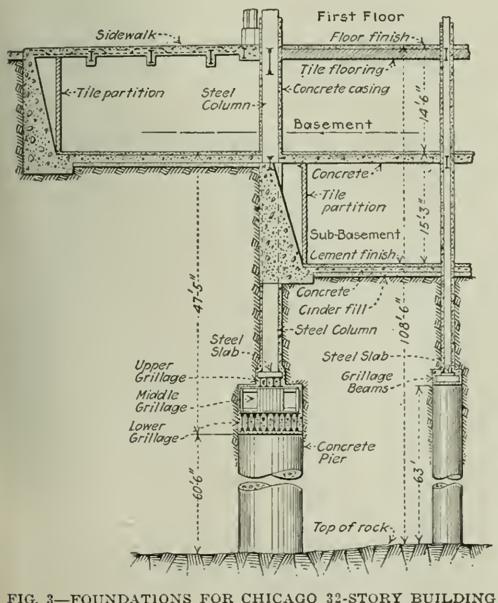

FIG. 3—FOUNDATIONS FOR CHICAGO 32-STORY BUILDING

are very heavy, as will be seen from Fig. 2. The bottom is planed to give a level bearing on the steel slab and has two angles bolted against the cover plates to hold the anchor bolts. Two steel guyed derricks with 123-ft. masts and 110-ft. booms are used in the steel erection.

Two other features of engineering interest in the construction of this building are the foundation piers, locally known as caissons, and the underpinning on the south and west sides of the site. The foundations consist of 78 concrete piers built in open wells sunk through the clay to bedrock at a maximum depth of 115 ft. below street level. Two of these piers are 11 ft. 9 in. in diameter and are said to be the largest ever built in Chicago foundation work. The concrete piers are about 60 ft. high, surmounted by the steel grillage and columns, as shown in Fig. 3.

Underpinning the old seven-story Leschin Building on the south side was particularly difficult, since the owners of the Straus Building were required to place piers on the property line to support a double party wall. Thus the wells had to be sunk under the existing wall. In the more general practice in cases of this kind, the piers are placed at a convenient distance from the property line and the wall is carried by cantilever girders. For the Leschin Building the underpinning was of the usual type, with transverse steel needle beams placed through the wall and supported by heavy timbers on the inside and outside of the building. These timbers in turn were supported by closely spaced screw jacks on timber blocking or cribbing. At the west end, some underpinning of the foundations of the Illinois Theater was necessary, but this was not difficult, particularly as an alley extends between the theater and the new building.

The new Straus Building is owned by the firm of S. W. Straus & Co., which will occupy the first six floors for its investment banking business. The architects are Graham, Anderson, Probst & White, Chicago. The Thompson-Starrett Co., Chicago, has the general contract. In direct charge of the construction are C. E. Harvey, superintendent for the architects, and N. J. Provost, superintendent for the general contractor.

Pier Construction on Rigolets Bridge

A correspondent reading the article entitled "Rigolets Bridge Built to Stand Hurricanes," in *Engineering News-Record*, Oct. 18, 1923, p. 626, was somewhat concerned about the possibility of damage in the concrete pier after the steel shell, in which the concrete piers were cast, rusts away. He felt that the steel angles bracing that shell would then be exposed to corrosion and being embedded in the concrete might set up forces which would break down the concrete on the face of the pier. Inquiry was directed to W. H. Courtenay, chief engineer of the Louisville & Nashville R.R., which built the bridge, and he replied that the whole of the 34-ft. diameter of these piers will be sunk below the bottom of the Rigolets and will be surrounded by sand and clay. The 28-ft. diameter shaft is built within concrete forms which are removed as the shaft is built up. This building up is done during the process of sinking. Upon completion of the sinking of these piers there will be no steel exposed to the action of the water except the steel of the 16-ft. diameter well shaft which has no angles entering the concrete.

Many Engineering Graduates Are Needed in Industry

400,000 More Trained Executives Needed for Industries in 1930—Should Be Well Grounded in Fundamentals

THE FIELD of the nation's manufacturing activities has been surveyed by the National Industrial Conference Board with the idea of determining the needs of the next generation in order to suggest improvements in the educational plans for today. The results of its survey are given in its special report No. 25, on Engineering Education and American Industry.

In approaching this subject the board has attempted to answer three broad questions: (1) Do the industries of the United States need more or fewer engineers than the number now being graduated from engineering schools and colleges? (2) What kind of men do the industries require from the engineering schools and colleges, and what should be the nature of their education? (3) What are the responsibilities of the industry in this matter?

The report cites the fact that the expansion of industry during the past few decades has been accompanied by vastly increased complexities of industrial operations, and the grouping of greater numbers of workers in corporate units has placed upon employers an increased social responsibility towards their employees and towards the life and affairs of the community. All of these changes have created problems of human, social and political relationship in which industry and society as a whole have become increasingly dependent upon trained technical and administrative leaders. The present demand of American industry for men with effective educational training for such leadership may be fairly gaged by the present ratio of persons in positions of responsibility to the total number gainfully occupied in the United States. Of the 41,600,000 persons who were gainfully employed in 1920, less than 4 per cent planned the activities and directed the energies of the whole working force. This 4 per cent includes major officials, officers, superintendents, technical engineers, designers, draftsmen, inventors, architects, chemists, assayers, metallurgists and auditors, together with one-quarter of the number of foremen, overseers and inspectors in agriculture, mining, manufacture, instruction, trades, transportation and public service. The report assumes that three-quarters of the foremen, overseers and inspectors are not sufficiently distinguishable from the group of wage earners and workers to be included in the category of those who plan, supervise and administer the business of the nation. According to these figures, approximately 1,500,000 positions in the business structure of the United States must gradually be taken over by youths who have the ability and who shall have received training which will enable them to assume the responsibility of various forms of major and minor leadership.

Looking Into the Future—The board finds that if the records of the past fifty years can be taken as a criterion, the 1,500,000 will be increased to 1,900,000 in 1930. Its study shows how rapidly since 1870 the number of administrators, supervisors and technical experts has increased; in 1870 the number was only 170,000, or 1.25 per cent of the total number of persons gainfully occupied. This increase has been particularly rapid since 1890, when the era of mass production began. The outstanding fact of this study is that the country must not only supply replacements for the 1,500,000 administrators and technical experts, but must also supply 400,000 more persons for positions of responsibility by 1930. The reason for this growth in the demand for experts and leaders lies in the change of methods by which industrial work is performed; methods of mass production greatly increase the amount of product per worker, but require a relative increase in the proportion of planners and administrators.

Talent Needed—Some idea of the kind of talent necessary for the industry can be obtained from the fact that 600,000 of the 1,500,000 administrators and technical experts in 1920 were engaged in manufacturing and mechanical industries, and it is estimated that 150,000 of the men and women classified as in professional service in 1920 are employed in or associated with these industries, so that a total of 750,000 persons, or approximately half of the total number in positions of responsibility, are connected with manufacturing and mechanical industries. A reclassification of these 750,000 persons indicates that they make up 5.79 per cent of the total of 13,000,000 persons engaged in manufacturing and mechanical industries, and that 4.51 per cent of the total are classified under owners of small establishments, superintendents of medium sized establishments, engineers, salesmen, and foremen. As the bulk of the men who rise to the chief executive positions of the medium sized and larger establishments work up from the lower group our engineering schools should provide education necessary for entrance into this group. Service in this group in competition with other college men and with the greater number who lack the advantage of higher education, but have the will to win, enables the engineering graduate to progress rapidly and to develop under observation of his chief. Contrary to the popular impression held by many young men, the positions in the upper groups are not attained by a short step from college but only through training in the groups at the bottom. Students and educators must realize that progress in this group requires sufficient time to get a proper insight into the methods of business, and the educators should co-operate with industrialists and aim to make the base groups adequate in every sense.

At present the demand for administrative talent is more pressing than for technical experts, but in the conditions of international competition now developing, research will be of the utmost importance. Success will lie in the improvement of technical processes, utilization of by-products, and reduction of waste as well as in better methods of production and distribution. The supervisory and administrative leaders in our industrial structure exceed the technical experts numerically, at least four to one, but no one should lose sight of the fact that both groups are essential and that in each there are positions of highest responsibility and honor.

The important thing is that the natural talent of each person be found and that the industrialists as well as the educators stimulate its development and use to the highest degree.

At the present time our engineering schools are turning out about 9,000 graduates per year, many of whom go into occupations outside of the manufacturing and

mechanical industries, so that it is difficult to tell how many act as replacements in the base group in these industries, but it is obvious that the number of replacements required and the number of new positions created annually constitute a demand far in excess of the number of graduates who desire such positions. Add to this the waste due to turnover of the personnel of the base group and to maladjustments and it constitutes a demand which, if it is to be supplied with proper material, will require improved methods of selection and training in schools and industries in order to cut down the time lost and the expense of getting men placed in their logical positions. This is a great educational problem.

The Educational Problem—In spite of the fact that many industrialists have concluded from their personal experience that the only effective industrial education is that obtained within the industry itself, the conference board believes that many more are coming to the realization that education in colleges and engineering schools and association with intelligent instructors and

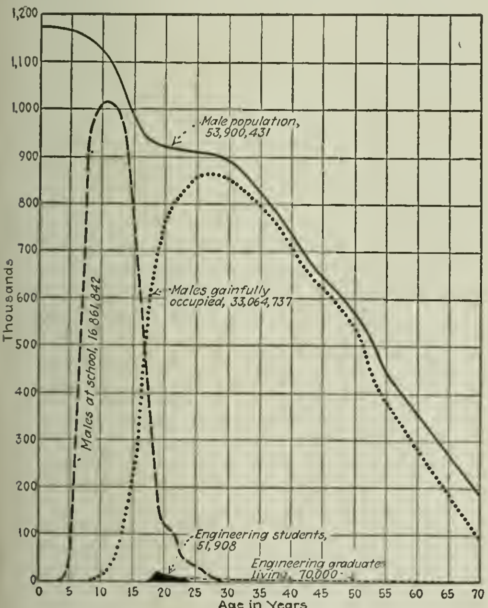

FIG. 1—RELATION OF EDUCATIONAL SYSTEM TO WORKING POPULATION

students exercise a strong influence upon the capacity of young men to advance rapidly to positions of responsibility. Fig. 1 represents graphically the relation of our educational system to the working population and to the total population of the country. It should be noted that the data in this figure pertain to males only, whereas the previous data included both males and females; also that the figures showing totals are represented by the areas between the curves and the base lines.

According to the best information available to the conference board, there are about 350,000 living male graduates of colleges and engineering schools and only a part of them are in industrial, financial and commercial occupations. The total number of engineering

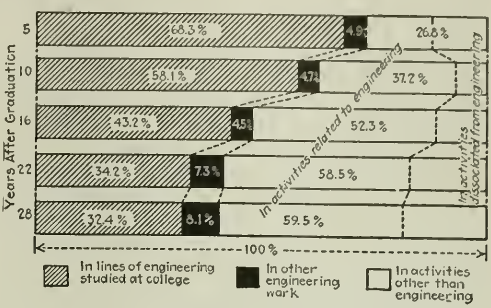

FIG. 2—CLASSIFICATION OF POSITIONS HELD BY ENGINEERING GRADUATES

graduates is about 70,000. The line representing these engineering graduates on Fig. 1 lies so close to the base line as to be hardly distinguishable, and the smallness of their proportion to the total gainfully occupied is apparent.

Since it is the boys and men between the ages of fifteen and twenty-five, both in schools and gainfully occupied, who come chiefly into the problem of correlation of industry and education, the problem requires the broadest survey of our educational system and its relation to the industrial situation. The phase of this problem which is naturally receiving most of the attention of the engineering schools, and which is the main consideration of the conference board's report, is illustrated as to numerical magnitude by the dark triangle at the bottom of Fig. 1, representing 51,908 students in the engineering courses of the colleges and technical schools in 1920. It is obvious that much depends on the method of selection and training applied to this group.

The Engineering School—Engineering education in the United States is now about 100 years old, and throughout this period of development the field of activity for engineering graduates has expanded continually and has shifted them more or less from the lines for which they were specifically prepared. This condition is well illustrated in Fig. 2. The figure is made up from a classification of the positions held by graduates from one of our engineering schools when they have been out of college from five to twenty-eight years. Graduates were classified in three main groups: (a) the men who are still in the field of engineering work studied in college; (b) the men doing engineering work in some other field than that studied; (c) the men who have shifted from strictly engineering work to executive or commercial activities. The latter group is subdivided by a dotted line to represent the number of those who went into activities totally dissociated from engineering.

One important question is as to how many of the shifts from engineering to non-technical pursuits have the nature of an advancement and how many were due to failure or a discovery that the graduate was better suited for some other activity. The report points out that after a swing toward greater specialization in undergraduate work in the engineering schools, there is now a general movement toward unification of courses. The colleges are now providing more and fuller courses in science, and the engineering schools by concentrating on the fundamentals rather than on technical training are following the traditions of the col-

leges, and it is becoming more evident that the schools are training young men to become fertile and exact thinkers, guided by common sense, who have a thorough knowledge of natural laws and the means for utilizing natural forces; and that the engineering schools now aim to produce not finished engineers but young men with great capacity for becoming engineers.

The National Industrial Conference Board summarizes the recommendations of sixty-eight industrial executives, thirteen railroad executives, four engineers, three educators, one editor, and six governmental officials as follows: That the method of selecting men for admission to colleges be improved; that the student be trained broadly and thoroughly in the fundamentals; that the colleges do more to stimulate initiative; that the instructors in technical subjects have more practical experience, and be selected for vision and high ideals; that the students be given practical training in industrial establishments either (a) by serving an apprenticeship before entering college, or (b) by industrial work during vacation, or (c) by supplementary industrial training after completing the theoretical course, or (d) by practical training in industry incidental with theoretical training in college.

The board calls attention to the fact that these recommendations apply broadly to the preparation for all branches of industry and that the industrialists are more interested in the general character and ability of their recruits than in the specific knowledge required in any particular industry. It also points out that while there is general agreement that engineering education should concentrate on fundamentals, there is a wide variation in the interpretation of "fundamentals."

The board emphasizes the fact that, although there is room in industry for more graduates than the engineering schools are now turning out, it is more important that a greater proportion of these young men be of high quality than that the total number be increased, and recommends that the requirements for admission should place a premium on intelligence, self-mastery, resourcefulness, courage, vision, open-mindedness, patience, resistance, critical judgment, integrity, and other elements of character as well as the knowledge pre-requisite to the college course.

Responsibility of Industry—The report points out that every industrial corporation of any considerable size must have a well thought out educational policy for the development of its interests, and that such a policy involves a measure of assistance to the engineering schools and colleges in the development of their courses of study and in providing opportunities for practical experience for the students. Such a policy involves adequate methods of training within the industry. As many engineering schools are rich in buildings and equipment but need help in improving the effectiveness of their teaching forces, industrialists can assist in finding and developing men for this service and can increase the esteem in which educators are held. They can also provide the opportunity for instructors to maintain contact with the industry and its needs and to become acquainted with the latest industrial methods and practices. They can also assist by devising ways and means of adequately testing the boys in preparatory schools and in making clear to the educators how young men with different types of mind and different kinds of training fit into the industrial order.

Through the Reclamation Country

By F. E. Schmitt

THIS is the seventh of the series of letters written by Mr. Schmitt during a journey recently made through the West in which he visited irrigation projects, studied developments, and interviewed builders, operators and settlers, in order to present to our readers the actualities of reclamation as revealed to an unprejudiced investigator.

The series of letters began in the issue of October 4.

Calexico, Calif.

SEEING THE largest irrigation district in the country—the great Imperial Valley, which is hardly more than half farmed although nearly a quarter century old—brings forcibly to mind two common but erroneous assumptions, (1) that the federal reclamation projects are unsuccessful, and (2) that this is due to their having been handled less efficiently than other irrigation projects. The fact of the matter is that the reclamation projects are fully as successful as the others. (I am going to call these others private projects, regardless of whether they operate as corporations or as quasi-municipal districts.)

Irrigation development takes time. But even though the reclamation projects are younger than the Imperial district, their condition shows that taken all together they are equally successful. This district has the same troubles in respect to settlement, speculative ownership, failures, insufficiently high productivity, waterlogging and drainage, and complaint over high operating cost. Yet no one can call the Imperial district unsuccessful. It is a busy, peaceful farming community that manages to pay its taxes and its bonds; and its 55,000 population, 800,000 acres of area on both sides of the Mexican line, 500,000 acres of actually cultivated area and $50,000,000 annual production make it the most notable single agricultural feature of the Southwest. If it had been built as a federal reclamation project it would be no less successful than it is, I am sure—and anyone can convince himself of this by looking at the much less favored but more maligned Newlands project. But if the Imperial were a federal project its present engineer-manager would probably be denounced along with the whole engineering force of the Reclamation Service as an incompetent, responsible for running it into the ground, and the politician momentarily at the head of the Department would send a lame-duck product of state politics to direct him.

An Interview With J. C. Wheelon—That private irrigation projects are subject to almost precisely the same conditions as the federal projects was made very clear in an instructive interview given me a couple of weeks ago by John C. Wheelon, the veteran engineer who is general manager of the Twin Falls Canal Co., the operating organization of the South Side Twin Falls district in Idaho (noted among all northern projects as a prominent success). Mr. Wheelon said:

"We have just as many worries here as they do on the reclamation projects. Our people are the same kind as theirs, and settlers come to our project without any money just as they do to the reclamation projects.

"We started out with the idea of getting the successful renter, the man who wanted to become independent.

Under this plan settlement was so slow that we moved the line of our main canal downhill from one to four miles. But soon afterward the plan of settlement was changed, selection of settlers being eliminated; then the project settled up so fast that we built an upper canal on the original location in addition, a big increase in investment.

"The men that came were chiefly the failures elsewhere, middle-aged men, men who were fighting in the last ditch. We had the same experience in the Bear River valley; that project, now nearly thirty years old, is not yet out of debt, just getting on its feet. There as well as here it took three crops of settlers to make the project a success. It's not much different elsewhere, regardless of irrigation or natural supply of water; they say that in Kansas it took ten years to raise the first crop of corn, and sixty years to make it the garden spot of America, and Kansas isn't out of debt yet.

"Not all of our original settlers are here, by a good deal. Among those who are still here, there are some who came with capital to start in—as for instance, one family that came with $10,000—and have lost it all and may soon have to walk out. Others came broke and made a success. But not all that have left the project were failures; some Illinois men came here who were good farmers there and became good farmers here, and later on they sold out at a good profit.

"Our irrigation system cost about $26 to $27 per acre to build; we charged $26, a figure fixed in the beginning when we thought it would be ample to cover the cost. Our losses were made up on townsite lands, however. The low cost of the project is due to the remarkably favorable topography and to the ingenuity of the layout, which took full advantage of the topography. No drainage cost is included, as drainage was not done by the land company but is being carried out by the operating company in conjunction with the land owner, on a division of work which puts about 90 per cent of the cost on the company and 10 per cent on the farmer. But, despite the low cost, if this had been a government project there would have been the same amount of complaint howling that the reclamation projects get. Little politicians are the bane of reclamation.

"Irrigation farming looks pretty when you're traveling through it; but when you've got to live with it, for thirty years, it's different. The difficulties and hardships show up more strongly. It is not the same as farming in the East. When you come on to irrigation you find that it takes a better mechanic, a higher-class farmer, to handle the work successfully.

"That is why a weeding-out process is inevitable. Proper leveling of the land before the settlers came, or leveling and cultivating, might eliminate one of the three crops of settlers. But if 90 per cent of those who go into any occupation make failures, how can you expect 100 per cent to succeed in fighting the battle of the sagebrush desert?"

Private Irrigation—It may be worth while in this connection to remind the Easterner, who is apt to think of reclamation as being the whole of Western irrigation, that something over 20,000,000 acres is irrigated, west of the Missouri River, and only one-tenth of this is federal reclamation. Reclamation is 21 years old, but modern irrigation in these western valleys goes back three times as far, not counting the prehistoric irrigation in the Southwest revealed by remains of ancient canal systems, perhaps built in very early Indian days. With respect to success, private irrigation has less authority than its age and size would suggest, for systematic procedure (other than simple group co-operation) began less than 40 years ago, with the famous Wright Act of California and the later Carey Act of Congress. Further, the financial side of irrigation has been in an unhappy tangle until quite recent years. It shows so consistent a record of failure that the blackest picture ever painted of federal reclamation would by comparison shine with the brightness of success. Disappointments and financial losses without number have proved that irrigation is a very dubious field for money-making enterprise.

Irrigation as an Investment—One man's statement of the case, "As an investment, irrigation is simply not in it," has been widely endorsed. Nevertheless, a generation ago, capitalists saw big profits in irrigation development, and a few bond houses thought there were opportunities for making money by selling irrigation bonds. One or two successes were made, but then the bond market gave out, land sales and settlement decreased, and the industry ran onto the rocks. These troubles of the promoters (and of investors in bonds, who lost most of their money) delayed the development of stable systems of operation, but do not affect present-day comparisons of private with federal projects. Thus, the Imperial district here is operating with complete success, though the California Development Co., which promoted it in the early days, went bankrupt; and the same is true of many wholly successful irrigation districts not only in this state but throughout the West, where the records show case after case of a 20 to 80 per cent loss of the original bond investors through non-payment or a scaling down of the bonds, though at the present time the operation of most of these districts is nearly as smooth and uneventful as the operation of a city water system.

Since irrigation conditions necessarily differ much, comparisons can be made to show almost anything. But closely adjoining projects are usually fairly comparable. Such a case can be found at the North Platte reclamation project, near Mitchell, Neb., where the federal project covers the upper part of the valley slopes and has a rather costly reservoir and canal system, while the lower slopes are occupied by private ditch systems much cheaper and simpler to build. Other cases occur in the Uncompahgre River valley, near Montrose, and in the Colorado River valley near Grand Junction, Colo. (Grand Valley project); and it may be noted that in the latter instance one of the private projects is rated as the most successful irrigation district in the state. Equally good comparisons can be made in the Snake River valley in Idaho, where alongside the federal Minidoka project there is much private irrigation, including the South Side Twin Falls project.

Reclamation Successful—Facts and figures in cases of this kind show clearly that: (1) federal projects compare favorably with private projects in first cost; (2) federal projects have an ample and dependable water supply, while private projects are apt to have an inadequate supply; (3) federal projects are well planned and well built, usually much better than private projects; (4) if there is any difference in fairness and efficiency of operation and care of maintenance, it is in

favor of the federal projects; (5) the operating cost of federal projects is lower than that of private projects.

Summarized, these points mean emphatically that reclamation has been done remarkably well and that the Reclamation Service has made a thorough-going operating success.

This latter is in large part due to the engineer operators—the project managers and the engineering organization of which they form a part. But the headless talk that has been coming out of the Interior Department to the effect that engineers are not fit to operate irrigation districts is shown to be frivolous not only by the performance on the projects themselves, but also by such facts as that engineers manage the three most remarkable and probably also most successful districts in the country—the Imperial Valley in California, the South Side Twin Falls in Idaho, and the Salt River Valley in Arizona.

As to First Cost—The five points above stated give opportunity for any quantity of discussion and dispute. Without undertaking to prove them here, I want to cite one or two illustrative cases. A good comparison of first cost may be made on the North Platte project, where the Tri-State ditch, (owned by the Farmers Irrigation District, originally a corporation project) and the reclamation or Interstate ditch, much farther up the hillside, are parallel; the Tri-State ditch system, without storage and *without laterals*, cost $42.50 per acre, while the government ditch, with a much longer canal system, much more scattered land, and a costly storage reservoir, and lateral canals to each farm, cost $71 per acre. Similarly, the South Side Twin Falls project, with a remarkably favorable topography and layout, cost $27 per acre, without storage; the North Side Minidoka project, less favorably located, cost $42 per acre with storage, and this includes a considerable item for drainage, while at Twin Falls the drainage cost is being met out of operation charges.

Reclamation moneys were spent with exceptional efficiency and honesty, and the farmers' spokesmen who charge that the project costs are too high would learn much, if they cared to, by examining the costs of private projects in their neighborhood, including the cost of making up for premature decay or the short life of fantastic hillside flume systems—some of which the Reclamation Service has had to take over in order to save the farmers from utter ruin even after the outside investors had given up their own investment. It has to be considered also that the low lands, of best quality and easy to irrigate, were taken up before the government came into the field, so that reclamation in most cases deals with the costly, uninviting and sometimes decidedly forbidding propositions, while private development always is concerned with inherently promising cases. Also, that reclamation in all cases is based on a supply assured by very costly dam work when necessary, while private development is usually content to take chances with a doubtful supply, in order to save cost. As to needlessly high-grade work, I had an engineer tell me that the Service made a mistake in building concrete-lined canals where clay lining would have done; but a water users' manager complained to me that the Service had not built well enough, so that the district now is "practically reconstructing the whole system," an absurd exaggeration of normal maintenance needs which is valuable only as neutralizing the statement just preceding.

Operating Costs—Operating costs are the reclamation farmer's special bugbear. He says they are too high and blames this fact on the high overhead of the Service. "We have to support those offices in Denver and Washington." The facts are against the farmer. He gets cheaper service in operation and maintenance than the private-project farmer. To take a case: the Grand Valley project, in Colorado, has an operation and maintenance (O & M) charge of $0.75 per acre-foot or for 3 acre-ft. per season a total of $2.25 per acre. The much cheaper private development on the lower valley slopes, the Grand Valley Irrigation Co., has an annual O & M charge of about $1 per acre; but this system operates only the main canals, which is less than half the total O & M cost. The Palisade Irrigation District, close by, has an O & M charge of $1.75 to $2 per acre (leaving out interest and sinking fund). Three other districts adjoining (Mesa County, Orchard Mesa and East Palisade) have charges respectively of $3.20 to $4.80, $6 to $8.50, and $18 to $27, the latter case being a very small district (646 acres total) and having heavy replacements to make out of its operating income. Similar comparisons, each qualified by taking note of many special conditions, can be made anywhere; and even a comparison of reclamation costs with exceptionally low private costs, as Minidoka and Twin Falls (North Side Minidoka, gravity supply, operated by water users, $1.90 per acre; South Side Minidoka, high-lift pumping supply, operated by government, $1.95; North Side Twin Falls, private, $1.10; South Side Twin Falls, private, $1.12 for O & M excluding drainage or interest) strengthens rather than weakens the comparison. To make the case still more definite, the alleged high overhead of the Reclamation Service is in fact a lower percentage than that of private operation.

One further point may be made in favor of the success of the Reclamation Service work. An active antagonist of the Service, a water users' official who has declared himself an enemy of engineer operation of the Service and who is pretty constantly engaged in guerrilla warfare with it, in writing to another water users' official who had asked for advice gives the following pretty testimonial to the Service: "I do not know of any organization more competent to construct drainage and flood protection works than the Reclamation Service. . . . Our experience is that it is able to do construction drainage work far cheaper than private contract; we have tested the matter very carefully. . . . I have never heard of any graft or charges of graft. In my personal opinion the Service is the most efficiently conducted department of our government, as well as the most economical." These remarks were written prior to Secretary Work's entrance upon the scene.

Second Trent River Lock Completed

The second of the four locks being built to improve the Trent River in England has been completed at Stoke Bardolph. The plant is to render the Trent navigable the year around for large type barges as far as Nottingham. The first lock is at Holme Pierrepont. It was completed a year ago. The other locks are at Gunthorpe and Hazelford, and work is well advanced.

Federal Land Reclamation: A National Problem

4. Twenty Years of Reclamation

By F. H. NEWELL
Formerly Director, U. S. Reclamation Service

The Fourth of a Series of Articles on the History and Performance of the Great Government Adventure in Irrigation of the Arid Lands of the West.

TWO DECADES in the life of a nation are relatively short, yet these last two decades have been so crowded with experiments in governmental ownership and operation of public utilities of various kinds that they afford illustrations of the trend of governmental affairs greater than during the preceding century. To students of political and social science there are perhaps no more interesting examples of the strength and weakness of government ownership than are afforded by the history of the Reclamation Service since its inception in 1902 to its conclusion as a Service in 1923. Advocates or opponents of governmental interference in local affairs find many excellent illustrations of good or bad conditions. On the whole it must be admitted that whatever theory may be urged, the material results are highly commendable and reflect credit upon the men who initiated this work and placed it upon a high plane physically and morally.

During the twenty-one years of existence there have been created, as stated in a previous article, opportunities for 33,000 self-supporting small homes, affording a livelihood for at least 150,000 people. The gross crop production has been $50,000,000 per year and over. The homes thus created have a value to the community and to the nation out of proportion to their mere number because these are located in what were previously barren wastes, now converted into highly productive oases. By their presence they make possible a development of many industries which could not otherwise have existed and they have raised the general standard of comfort and prosperity of the more sparsely settled states.

In all these undertakings under the Reclamation Service, perhaps the most interesting are those which have had to do with the human factors as contrasted with the purely physical. These include the influence or effect of the work on social institutions, and upon the opinions of men regarding governmental affairs. In one sense, the work of the Reclamation Service has been a practical exemplification of state socialism in that the government has used its own funds and employed its own servants to build works for the benefit of its citizens and has operated these works for many years at its own expense, losing the interest on the investment.

The men who advocated and organized the Reclamation Service believed implicity that it was practicable to conduct work of this kind under a government organization and with an efficiency comparable to that of a well organized corporation. They did demonstrate this fact. The outcome shows that with a nearly ideal organization and with a high degree of efficiency it has been possible to achieve nearly ideal results wherever the mass of the people concerned have been endowed with the ideal degree of energy and ability. In proportion, however, as the land owners under the reclamation projects have been lacking in ability, strength, experience, good health and other essential qualifications, to that degree the results have fallen below the standards set.

As previously stated, wherever good farmers have chosen good land under the reclamation projects, and have practiced a good system of farming adapted to the climate and markets, there the results have been such as have justified the most optimistic statements. Where, however, the inexperienced or poor farmer has been unsuited to his method of farming and so handled the land and water that the soil has deteriorated in productivity, and especially where he has become discouraged and moved to town, renting his land to itinerant tenants, there the results are disappointing and can be pointed to as showing the ineffectiveness of governmental control.

Comparison with Private Irrigation

It is to be noted that the work by the government in reclaiming lands introduced few novel features other than those which grew out of the fact that the operations were conducted by government officials, working under the limitations imposed by a century of accumulated rules and regulations. There had already been built works bringing water to over ten million acres of land at the time the reclamation act went into effect. Most of these earlier works were extremely simple because the easier enterprises were naturally taken up first. There remained for the government the more difficult—in fact, it may be said that in 1902 investors had come to learn through bitter experience that the building of reclamation works, especially those involving water storage and the settlement of the land, could not be made a matter of profit.

By 1900 all the larger private or corporate irrigation enterprises, with hardly an exception, had gone into bankruptcy or had been reorganized with almost complete loss of the original investment. The strong argument for the government's taking up this important work was that, under private or corporate auspices, it had not been and could not be put upon the basis of earning 6 per cent interest on the investment, much less of obtaining a profit. Thus land reclamation and settlement in the West was practically at a standstill and it looked as though the West would remain largely undeveloped unless some way was found of inducing the government to assume the load and to lose the interest on the investment. It was argued that such loss would be made up, or more than compensated for, by the indirect gains which necessarily come to the community, to the state, and to the government itself through the creation of homes on the land.

The assertion is made that the government, that the whole body of taxpayers, can well afford to lose the interest on its investment for at least 10 years, or,

to put it in another way, can afford to give this as a bonus or subsidy to the land owners under the projects as compensation in part to them of the hardships and uncertainties of pioneering.

In the matter of the original investment in reclamation works and in their economical construction, there is little but commendation to be given. This much can be claimed for governmental ownership, that in expenditure of funds for construction it is possible for the employees of the government to reach and maintain a high degree of efficiency. When, however, we turn to the other side, that of operation and maintenance, a different story may be told. Here it is not a question of expenditure of moneys to secure a certain definite result, planned out in advance; the large and crucial factor is not the economy of use of materials and forces but it is the effectiveness of dealing with large numbers of persons, individually and collectively, in matters pertaining to their most intimate personal affairs. Here governmental methods have not yet been developed to a point where it can be claimed that a degree of efficiency can be secured at all comparable to that of private control. Here is where the government official is seriously handicapped. He cannot exercise the same discretion in dealing with voters that he can when, as an employee of a corporation, he is doing business with individuals. Here is what at present seems to be the insuperable obstacle to success in governmental operation, and here is where the reclamation laws should be so amended as to require that the reclamation works, when built, shall be put under the control, at the earliest practicable date, of responsible well organized land owners of the community whose existence depends upon the maintenance and operation of these for all time to come.

Problems of Reclamation Service

Legislative Difficulties—While there has been a progressive improvement or evolution in economy and efficiency in engineering and industrial or business details, there has been under congressional control a lack of forethought, a failure to meet future needs, that tends to frustrate the object of the law. In each recent Congress, engrossed in other matters, a few interested men have struggled, against the general indifference, to secure certain personally important objects, often incongruous with the making of homes on the land. On no one leader has fallen the mantle of the late Senator Newlands; none has voiced his inspirations toward achievements of country-wide benefit.

The most conspicuous of these activities urged before Congress have had to do not with the carrying out of the larger objects of the original reclamation act in home-making, but more with the attempts to secure minor adjustments to meet the demands of individuals or groups of land owners who have not been able to utilize their lands in such way as to produce average results in the way of crops. Under private projects the owners or managers necessarily possess full power and authority to deal with such individual land owners who are found to be unfortunate or are unqualified as farmers. Of necessity they must make individual exceptions and adjustments, helping one man to let go and stimulating or encouraging another man in accordance with his individual capacities. The agent of the government, however, cannot exercise anything like the same degree of discretion, even though he may be better qualified to do so. He must treat all alike and must endeavor to carry out the requirements of law whether these are applicable or not. What really results is that the ultimate decision by the "powers that be" is that in order not to oppress any one citizen, all others who might make payments or comply with general conditions are excused from so doing.

Thus, due to the attempt to meet individual difficulties, there have been passed in succession a number of general relief acts, the most notable of which extends the time of payment of the capital investment from ten years without interest to twenty years without interest. Now the proposition is still further to extend this time to forty years, also without interest. No community or no country has ever granted conditions as liberal as these nor has imposed upon other taxpayers the corresponding burden in the way of subsidy granted indirectly to land owners under reclamation projects. This bonus or subsidy given by Congress and levied upon the general taxpayers has been estimated at about $6,000,000 per year. This is figured on the assumption that for reclamation purposes $140,000,000 has been kept out of the treasury. An equivalent amount is being borrowed for purposes of the government on which 4½ per cent is being paid. Many taxpayers are beginning to ask whether this is fair in consideration of the fact that whenever land owners, other than those on reclamation projects, secure any loan directly or indirectly from the government, such as through the federal farm loan banks, they are required to pay 5½ per cent interest plus 1 per cent amortization. They are asking why the landowners on reclamation projects, who claim a larger average crop production than other parts of the country, should be thus favored.

Imperfect Policies—Congressional control, or perhaps more properly, lack of a definite policy established by Congress, has led to the taking up of an infinite number of minor details which might better be left to local enterprise. It has already been pointed out that the proponents of the act did not contemplate applying it to the smaller distributaries or to the tens of thousands of small structures which, on private projects, up to that time had been left to the individual land owners. Neither has Congress expressly authorized or forbidden the leveling of the land and getting the farm into such condition that the newcomer might get to work to produce a crop.

There are still two distinct schools of thought in reclamation and settlement policies: one, the older, contends that the best results will ultimately be attained if the government confines its efforts to building the larger structures, such as can not be built by private enterprise and leaves to the individuals, or rather to the community or to the state, all of the matters of roads, distributing systems, leveling the ground, and getting ready for immediate cultivation of the land. The advocates of the other course point out the self-evident fact that the quicker the pioneer can get his farm into good condition the better for him and for the community at large. This is true if he is qualified to utilize these advantages, but if not then there is a question as to whether the hard struggle of the pioneers in developing a farm, each man for himself, is not an essential prerequisite to success through the early elimination of the unfit. Much can be said on both sides of the question and usually the

manager of the reclamation project, where most has been done to facilitate settlement, believes that the other course would have been better and vice versa. Neither is satisfied with the actual results.

The reasons for success or failure lie not so much in climate, soil, or markets, but rather in the character of the landowner, his experience, strength, health, and especially the "will to win," or possession of qualities which distinguish the pioneer. Unfortunately, the law does not permit any selection of the men, and their families, who are to enjoy the bounty of the government. The theory of the law is that the old rule is to be followed, "first come, first served." It makes no difference whether the applicant is young or old, strong or weak, single, married, or widowed, a hopeless invalid, or a giant in strength, he or she is allowed to take the land, if available. In the case of two or more applicants for the same farm the matter is determined by lot and not by any question of merit or ability other than that ex-service men and their widows are given a preference.

Results of this Method—Results of this haphazard method have been the same as if the army or an industrial organization should be recruited in the same way. The strong husky laborer might get a place as copyist and the weak, frail widow the job of furnaceman, the officers being selected by lottery. The process of elimination which must follow any such course has been heartbreaking and has tried the nerves of every one connected with the Reclamation Service. Each governmental employee has felt a certain personal responsibility in these matters. If he were free to exercise his judgment and to act as could the employee of a private concern, he might greatly help or at least he could prevent many of these people from getting into difficulty, but as an employee of the government he must of necessity stand by, report conditions, and wait for instructions.

The worst results, as above noted, have come not from physical conditions of soil, climate or markets, but from the lack of adaptability of the land owner and especially of his family to the peculiar conditions on each piece of land. The good farmer, the man of experience, on coming to a project, has not been willing to spend his time or money on land of inferior grade. The inexperienced man coming perhaps from the city, and knowing nothing regarding soil, has seized upon every available acre, has importuned the man in charge to include lands obviously unfit, and because of his inexperience has not been able to bring these lands up to a high degree of fertility, but on the contrary has allowed them to deteriorate.

It should not be inferred, however, that it is possible in advance to judge unerringly of the value of soils and of the effect of water upon the soil. It is only within a few years that the notable work of Carl S. Scofield and others has begun to reveal some of these mysteries of soil becoming "worn out." He has shown that as a broad generalization, "soft waters make land hard, and hard waters make land soft" or tillable. He has also brought out more strongly than was before assumed, that while in most cases excessive use of water is injurious, in some cases it is absolutely necessary in order to wash out the accumulated salts. It is not proper to attribute any blame or want of judgment either to government officials or to the settlers in many of the cases where lands have deteriorated or become less productive.

The error which has prevailed through all private enterprises and has affected government work as well, was that of assuming that the large areas of reclaimed land could and would be settled upon immediately. Experience has shown that an agricultural community, like a tree, cannot spring into full bearing at once. Years of slow growth are essential; especially where there has been no selection of the settlers there must be a rapid turnover. Many families must come and go before there is a fairly complete adaptation to local surroundings.

Taking the United States as a whole, including new and old farming localities, there has been a turnover during the last year of 6 per cent in farm ownership and 27 per cent in tenancy. If the reclamation projects were on the same average with that for the rest of the country, there should have been a complete change in ownership during the past sixteen years. This normal change in part has been retarded by the well meaning attempt on the part of Congress and of the executives to induce the early settlers to remain by granting easier and easier terms of payment. As a matter of fact, as shown by experience on similar private enterprises, it is a matter not only of good business but of fair dealing to enable the rapid turnover in land ownership which ultimately results in getting people who are better qualified farmers.

These imperfections or errors have resulted in a stimulation of speculation. This in turn has been followed by tenancy and the accompanying evil of soil deterioration. Speculation has been promoted by the easy terms of payment. Many a man controlling a piece of land given away on condition of settlement and furnished with water at cost at government expense, and without interest payment, has preferred to hold on to this piece of land. Perhaps his wife has a similar farm; also his son and daughter. He may thus in the name of others control several farm units. He prefers to move to town and try to rent these and gain a profit through the increase in land prices. Some have succeeded. The majority have failed. The blame, if any there be, is not that of the management, but rather of the well-intentioned members of Congress who have urged more and more lenient terms in the law regarding repayment of debts owed to the government.

Irrigation Troubles—When the government went into the business of reclamation of lands by irrigation, there was little in the way of accurate facts recorded regarding irrigation methods. It was only after the government had embarked upon this enterprise that the experts of the Department of Agriculture began to give out the results of their observations. The owners and operators of private projects were unwilling to admit the existence of certain difficulties, believing that these were local in character, but as time went on and they became better acquainted with the difficulties, more and more these were brought to the front, especially as the methods of remedying the troubles became apparent. For example, the swamping of areas under irrigation was known, but the explanation generally given was that gross carelessness had been used; careful observation demonstrated that even with the most economical handling of water there has

been some swamping of cultivated fields, requiring the construction of drains, and that thousands of acres have deteriorated, usually with the appearance of alkali on the surface, but occasionally without any apparent cause.

Enough was known about the necessity of drainage to justify the preparation of plans for drains from the very outset of governmental reclamation. Some of the main line drains were built, others were projected with the thought that the land owners would build these at their own expense, as the need developed through the complete settling up of the country. Experience showed, however, that it is not possible in advance to lay out an economical drainage system because it is impossible to ascertain the texture of the underlying soils or to predict with any considerable degree of success what effect the percolating waters will have on this complicated texture. Thus drains built in advance of irrigation sometimes have been found to be wholly ineffective. In other places, where the underground sands or gravels seemed to indicate that drainage would never be required there, it has been necessary after a few years to construct large drainage works. Many of these matters are covered, as above stated, in the review of the subject by Scofield.

Observation also has changed somewhat radically the conceptions as regards the so-called duty of water, that is the amount of water required to furnish adequate moisture to a given area. Popularly it is assumed that a cubic foot of water flowing continuously throughout the irrigation season will furnish adequate water for one hundred acres. In other words the water duty is expressed as one hundred. A more accurate way of setting the duty is in terms of the total amount of water applied to the land, that is, thirty inches in depth during the irrigation season. For many years the remedy suggested for every evil was to increase the duty, that is, to increase the number of acres which could be irrigated with a given quantity of water, but, as above stated, scientific research has shown that this is not always a safe rule.

Political Management and Land Speculation—During the first decade, following 1902, the control of affairs was under men who drew up the reclamation act and fought for it, who had the vision of service. Then came new men, who had not argued for these great objectives, who viewed the law simply as an established fact, as an opportunity to stimulate local business immediately by spending federal funds, in contrast with the original ideals of future permanent benefits. There was a reaction from idealism to so-called practical considerations. Liberal concessions were made to the speculative interests, to the lawyers, merchants, tradesmen, or mechanics, who had acquired one or more pieces of government reclaimed land, ostensibly for a future home, but more directly in the hope of selling at a profit. These landowners, living in town, rented their farms. Tenancy rapidly increased, accompanied by "mining" the soil and crop decline. Speculation in land, the desire to capitalize the future, to get the unearned increment of value, is a strong temptation to all citizens. The speculative element is made up of wide-awake men, keen in local affairs, usually more active than the man out on a farm, who is busy with crops and livestock.

It is true that the *bona fide* homemaker does complain that the non-resident land owner is favored, that itinerant tenants are not desirable neighbors, that the neglected fields—of the speculative owners—are infected with plant and insect pests, that roads and schools cannot be kept up—but his voice is relatively feeble. The fact that the "town farmer" has greater influence in getting more favorable terms of payment, still further increases the speculative tendency. In short, it is the relatively well organized minority, the men who have the time and inclination for discussion and letter writing, who make the greatest impression on the law-makers.

The attitude of the states in which the federal reclamation projects have been built has been rather favorable to speculation. The state lands, within the projects, in many instances have been held out of use for years and at prices which are so high that purchasers are wary. The conditions of sale of state lands have been such as to further speculative holdings instead of enforcing the requirement of actual cultivation and settlement. The highest result in land reclamation and settlement can be attained only when the public demands that state officials co-operate fully in these matters and maintain a higher ideal of the use of the state lands in making homes as contrasted with making money.

Borrowing by Farmers—The greatest difficulty in connection with the successful operation of any reclamation project, private or public, is that connected with the financing of the farmers. Most of these take up a new farm on cheap land largely because they do not have adequate capital to get a start elsewhere. Few have enough capital or credit to successfully handle even a small irrigated tract. Many would-be-farmers forget that farming is a capitalistic enterprise and that a certain amount of equipment is needed even by the tenant farmer. The owner must invest a large amount of money directly or indirectly in securing a shelter for his family and for his animals and in procuring the tools, seed, and other essentials.

The federal government does not lend money directly to these pioneers nor has the state done so except in a few instances. Most of the money or credit needed must be had from relatives, friends, or from local banks. The interest charge in these new communities is high, rarely if ever less than 8 per cent, more often 10 per cent or even 12, when commissions are added. This makes a load which it is almost impossible for the pioneer to carry unless he has some money of his own or is prepared to endure privations or even hardships.

It is true that the government indirectly furnishes some credit in that it has in effect loaned a considerable amount of money to the land owner, with no interest; that is to say, it has invested say $60 per acre in his eighty-acre farm or $4,800, without interest. The possession of this farm on which he may have paid nothing enables the owner to borrow considerable amounts of money, but on this he must pay a heavy rate of interest.

On top of this heavy interest charge are the large taxes which have been incurred in every new community for roads, school houses, bridges, county buildings, and all the improvements equaling or exceeding those of old communities in the east. The pioneers are trying to do in ten years what their forefathers did in a hundred and are correspondingly loaded with debt

such as can be paid only by exceptional crop conditions.

Landlordism—The ultimate object of the Reclamation Act, being the production of small self-producing farm homes, it is obvious that its success must be measured by the number of these contented homes rather than by great works, no matter how economically or effectively these have been built. The most important item then in any review of twenty years of reclamation is that relating to the number and proportion of successful homemakers.

Taking all of the farm units which have been irrigated or furnished with water by the use of the reclamation fund, it appears (Fig. 1) that 73 per cent may be classed as successful; that is, the family of the owner apparently has been supported by the products from the soil, which without irrigation (effected by the government works) would have been practically valueless.

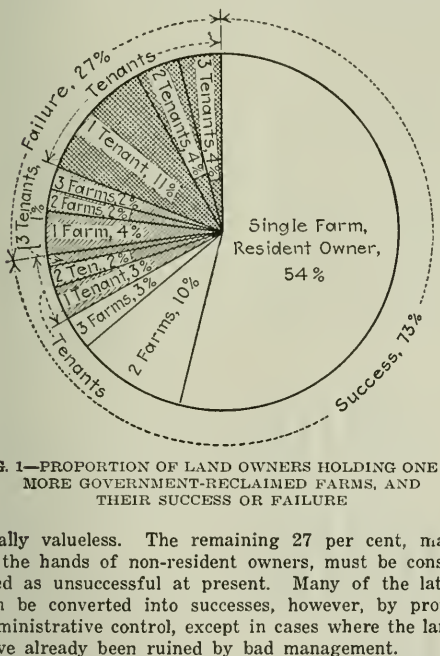

FIG. 1—PROPORTION OF LAND OWNERS HOLDING ONE OR MORE GOVERNMENT-RECLAIMED FARMS, AND THEIR SUCCESS OR FAILURE

The remaining 27 per cent, many in the hands of non-resident owners, must be considered as unsuccessful at present. Many of the latter can be converted into successes, however, by proper administrative control, except in cases where the lands have already been ruined by bad management.

Under existing conditions, it is somewhat remarkable that so many have succeeded on the land, but there has been a vast amount of unnecessary hardship, suffering and loss, because as previously stated there has been no way to prevent the unqualified homestead entryman or woman or purchaser of these lands from deceiving themselves or being deceived regarding the difficulty of pioneering.

The accompanying diagram (Fig. 1) illustrates the proportion of successful and unsuccessful landowners on the reclamation projects. The greater number of these, 54 per cent, include persons who have observed the spirit of the reclamation act, who have confined their efforts to a single farm unit and have lived upon this and cultivated it.

A considerable number of the land owners have not been satisfied with a single farm, which in the opinion of the Secretary of the Interior was adequate for the support of a family, but have acquired two farms, or sometimes three or more, the intent of the law being evaded by holding these in the name of the wife, child, or other relative.

These owners of two farms, who are rated as successful, comprise 10 per cent of the total, and those holding three or more farms, which they are cultivating themselves, comprise three per cent.

Of the unsuccessful landowners, the greater part, 11 per cent of all farms, are the people who are not living on their single farm, but are renting it. Other unsuccessful owners have two, three, or more farms, the rent from which, however, is not adequate to pay the interest, taxes, and other dues, and yield an income adequate for their support.

The reasons for the spread of landlordism are by no means simple, most of them arising from the easy terms of repayment and consequent inflation of land prices. Other causes lie in the fact that many of the people who have acquired lands under reclamation projects have found the inconvenience of country life too severe. They desire to live in town on account of the schools or of the conditions of employment of one or another member of the family. They find that the "lure of the white lights" is too much for the younger members or the earnings in industry are greater than those from the farm. It is perfectly proper that they should move to town but the point is made that the government has practically loaned the money, invested in reclamation, to the land owner for the purpose of enabling him to secure a home on the land; if he does not wish to live in this home, then in fairness he should permit some other owner to have possession rather than hold the land out of use or as a source of income through rents derived from a tenant or from the labor of a hired man.

Conditions Affecting Success of Reclamation

Degrees of Productivity—One of the alarming conditions on the reclamation projects has been the tendency toward decrease of productivity commonly known as the "wearing out" of the soil. When the reclamation act was passed, it was known that wherever irrigation was being practiced on any considerable scale, there was a tendency to swamp some of the lower land, also for the earthy salts, known as "alkali," to develop on or near the surface, ruining the cultivated field. In a well irrigated country, as for example, near Salt Lake City, Utah, it was estimated that from 15 to 20 per cent of the land, productive in the earlier years of irrigation would ultimately thus be injured. It was assumed, however, that on government projects, with the greater skill used in the works and in their operation, and better economy of water, these land losses would be greatly reduced.

The investigations by Carl Scofield, which were described in a previous article, are casting a light on this somewhat obscure subject of soil deterioration. Its effects are all too plainly visible in decreased productivity, as illustrated by the accompanying figure (Fig. 3) which shows the reduced yields of alfalfa hay, seed, and cotton. Here is a case where economy of water has been carried to an excess. Apparently, a far larger amount must be put upon the land to wash out the alkali which is accumulating. Similar conditions have been noted in Salt River Valley where lands which have been producing heavily in cotton were said to be "worn out." As a matter of fact, analysis showed

FIG. 2—FINANCING—PERCENTAGE OF TENANTS 1913 TO 1922 ON U. S. RECLAMATION PROJECTS

that the application of two acre-feet of water per acre, as has been the custom, tended to leave the salts in the soil. To wash it out and restore conditions of tilth would require at least two acre-feet additional with a corresponding doubling of the cost of the water.

Transportation and Marketing—When the lands on the government reclamation projects were first irrigated, there was usually a considerable demand in the immediate neighborhood for the alfalfa and other crops which were then produced. This was because contractors were still working in the vicinity and many persons were erecting buildings in the new towns and utilizing considerable numbers of men and of animals. The amounts received for the crops produced was notably large, being determined by the price in the outside markets, plus the cost of freight. In a few years, however, the conditions were completely changed.

With the development of larger areas of irrigated lands there were produced greater quantities of food and forage than could be disposed of locally, especially after the contractors and builders had left the vicinity. Then the prices suddenly dropped to those in outside markets, minus the cost of freight to these outside markets.

Every acre of the irrigated land has been or should be put into alfalfa or some other clover at one time or another in order to aid in the development of nitrifying organisms in the soil. To picture the desirable condition it is as though a crop of alfalfa was spread down and then rolled up as the fields after a few years are plowed and put into cultivated crops. Many of the land owners, however, having once put their land into alfalfa, prefer to let this crop remain and are unable or unwilling to practice the systematic crop rotation necessary to maintain or increase the soil fertility. They must find a market for the alfalfa hay in the immediate vicinity or else ship it to distant points. The local market is quickly glutted and there has resulted the economically unstable condition where hay is being shipped off the project and butter and pork shipped in. It is or should be obvious that no group of farmers can be permanently prosperous where this condition exists.

The experts in marketing of the U. S. Department of Agriculture have studied the situation and have given excellent advice, all which may be summed up in the recommendation that the heavy products such as hay and grain be manufactured on the farm or in the immediate vicinity into the more condensed form such as beef, pork, mutton, poultry, eggs and butter fat, retaining the fertility on the farms and shipping out only these condensed products—in other words, following the mottoes of "Feed the family from the farm and feed it first"; also "Feed all you raise and raise all you feed." Like other simple and obvious rules, this is not always easily followed, the advice has not been particularly palatable to men who have been accustomed to the one crop method. The location of the reclamation projects, however, remote as they are from large marketing centers, requires for ultimate continuous prosperity that some such method be adopted.

Have Settlers Had Adequate Help?—The question is frequently asked as to whether the government, state and national, has done all that it can or should to facilitate the creation of homes on the reclaimed lands. Many people assert that too much has been done and that communities as a whole would now be far better off if less of what might be called "paternalism" had been displayed. On the other hand, there is a steadily increasing demand that more and more aid be given, not merely in the way of sound agricultural and economic advice by county agents and experts of the state and national Department of Agriculture, but by going further, particularly in the way of credit facilities.

There is no doubt that the pioneer farmer must be afforded certain credit facilities. At the same time experience has shown that unfortunate conditions have arisen from the obtaining of too easy credit, notably during the time of inflated prices following the world war. As a result of these, many of the land owners on reclamation projects invested in other lands, in oil stock or in equipment such as automobiles which they really did not need. In short, taking the projects as a whole, there has been perhaps not too much credit but frequently an unwise use of the credit which was available. This is to be expected because many of the settlers upon the reclaimed lands were people who, through lack of thrift or "bad luck," have been induced to leave their former homes and who, with characteristic optimism, plunged into new enterprises to the full extent to which they could secure credit.

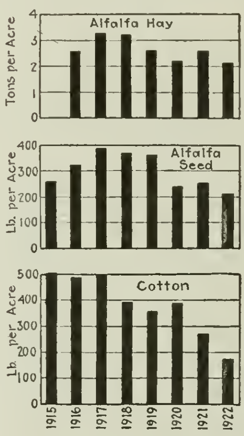

FIG. 3—PRODUCTION PER ACRE PER YEAR ON YUMA PROJECT

Showing the effect of accumulation of alkaline salts in the soil in reducing the yield per acre.

No help has been given directly by federal agencies in this matter of financing or credit other than that above described which arose indirectly out of the fact that the land owner was able to obtain possession of a tract on which the government had expended several thousand dollars and on which he was not paying any interest. This gave him certain opportunities for bor-

rowing other sums, on what is sometimes considered a second mortgage at high rates of interest.

In the matter of aid and advice, however, the national government, in co-operation with state authorities, has been liberal, responding to every inquiry and sending out printed matter not only in the form of pamphlets but also in a series of short statements used by the local press. Special appropriations have been made for investigations and for experimental farms on government projects. In round numbers, over a million dollars has thus been expended producing results of great value such, for example, as those which led to the planting of the long staple Egyptian cotton in the Salt River Valley, from which millions of dollars in profits have been received.

This work of experimentation and demonstration is necessarily slow; it requires great patience and persistence because the building up of better methods of agriculture or the spread of correct information regarding crop rotation and marketing necessitates man-to-man contact continued through months or years. The same is true of dairying, which has been notably successful on several of the projects, for example, on the Newlands in Nevada. This success is due to the quiet persistence of one or two men who have slowly overcome prejudice and various obstacles of human origin, finally getting the farmers to realize the true value of a good system of dairying.

The problem everywhere is to induce the farmer on the newly irrigated land to forget much of his former experience and to adopt the methods which agricultural experts and experienced farmers in the vicinity have found to be most successful. The inertia is great, and where a man has been accustomed to raising wheat only or alfalfa only and has an equipment for this purpose, finishing his entire work for the year in a relatively few weeks, he is unwilling to go into dairying, for instance, which requires daily attention throughout the entire year.

From what has been given in the preceding paragraphs, it must not be inferred that reclamation as a whole has not been a success. Rather, the contrary. Human interest is attracted, not by the rather prosaic statements of the successful enterprise, due to patient plodding and thrift, but by the unusual or extraordinary conditions of failure and the reasons for these. It is easier to draw a lesson from such failures than it is from the daily routine of a uniformly successful process.

The real measure of success as regards the reclamation work is measured, as before stated, by the predominance in numbers of prosperous and contented homes. The more convenient measuring stick is, however, that of the dollars which have come back from the investment made. While it is true that as yet not much more than 10 per cent of the original investment in the reclamation works has been returned to the federal treasury for use over again, yet this is not an indication of the breakdown of the theory but rather of the attitude of Congress in extending the time of payment. This was done under the belief that even if the money was not repaid at an early date the benefits through the development of homes and communities more than repaid the losses in interest on the investment.

Summing up the whole situation, it may be said, as in the beginning, that the law has been a success. It can be made a greater success in the future if the law makers and the executive officers will be able to apply the lessons taught and will have clearly in mind the object to be attained, namely, the creation of rural homes. Incidentally, it should be emphasized that when the reclamation act was passed, it was assumed that the greatest possible development of homes would be on the vacant public lands of the west. The studies made by the Reclamation Service in other parts of the United States, however, and published in 1919 (Development of Unused Lands, 66th Congress, 1st Session, House of Representatives, Document No. 262. Oct. 10, 1919. 184 pages) show that under present conditions the largest and best development of homes can probably be made on the unused lands of the South and East. The cost is far less than in the West because of the inflated land prices which have resulted in the West from over-exploitation of irrigable lands. The hope, therefore, of many public men is that the reclamation policy may be made truly national as contrasted with its present local or sectional character, and that under a revised law, based upon the experience of the past twenty years, larger and even more effective activities may be conducted throughout the United States wherever suitable unused lands exist as rapidly as needed for the creation of the small self-supporting farm homes, the backbone of our national and business institutions.

[*Further articles in the series will deal with past experiences and problems of reclamation and with future development. In next week's article George F. Kreutzer will discuss land settlement problems*—EDITOR.]

Reorganizing Austrian Railways

A LAW has recently been passed providing for the reorganization of the Austrian State Railways, in order to place them on a satisfactory economic basis, and for the creation of a corporation in Vienna for the purpose of conducting the operations of the federal railroads. This corporation must administer the entire property of the railways and act as a trustee for the government. The government is to furnish a capital of 200 milliard crowns, and is to cover any deficits.

An executive committee of five members will be held responsible to a commission of fourteen directors for actual operations. Eleven members of this commission are to be business men or experts in handling transportation problems, and are to be appointed by the railway government for a term of three years. Three members are to be chosen by the railway employees. The executive committee to be appointed by the commission and may be recalled by consent or order of the government. The chairman of the committee will have the title of general manager; each other member that of manager.

In addition to managing operations the executive committee must pass on all reorganization questions, formulate operating policies and plans, appoint and manage the personnel, and submit a financial balance sheet monthly and annually. It may raise short term interior loans of low denominations. The commission of directors is charged with general supervision and with safeguarding the public interests.

The government reserves the right to give or withhold approval of tariff changes and large or long-term loans and will supervise social and safety measures and regulate construction and maintenance.

Birdseye Party Completes Survey of Grand Canyon

U. S. Geological Survey Men Successfully Map Last Stretch of Treacherous Colorado—Dam Sites Investigated—Barely Escape Flood Waters—Thrilling Events Recounted

THE LAST stretch of the canyon of the Colorado that had not been surveyed in detail for accurate mapping, has at last been traversed by a party in charge of Col. C. H. Birdseye, chief topographic engineer of the U. S. Geological Survey, in a trip ended last month through 300 miles of the roughest waters and most treacherous section of the Colorado. The trip began at Lees Ferry, Ariz., and ended at Needles, Calif., and took approximately three months to complete. The chief purpose of the trip was to make an accurate survey of the canyon and to locate sites at which dams could be built to utilize the wasting waters for flood prevention, power development and irrigation. The trip was made in four principal boats, supplemented by a canoe, which however was later lost. These boats carried not only supplies and surveying and geologic instruments, but, except where portages were made, the members of the parties themselves.

The party consisted of well-seasoned experienced men, comprising, besides Col. Birdseye, E. C. LaRue, who has made a study of utilizing the Colorado River waters; R. C. Moore, state geologist of Kansas; R. W. Burchard, topographic engineer of the Survey, who had already surveyed the lower stretches of the river; Emery C. Kolb, of Grand Canyon, who with his brother made a boat trip from Green River, Wyo., through the Grand Canyon to the Gulf of California in 1911; Lewis R. Freeman, of Pasadena, Calif., explorer, writer and boatman; Leigh Lint, of Weiser, Idaho, and H. E. Blake, Jr., of Monticello, Utah. These two latter are young men of two years' experience in boating the rapids of the Colorado. Frank B. Dodge, of Honolulu, was another member of the party, being a skilful boatman, expert swimmer, and general utility man capable of filling any position from instrument man to cook. Frank Word, of Los Angeles, was the cook. About 90 miles below Lees Ferry, the party was joined by Herman Stabler, hydraulic engineer of the Geological Survey, and at Supai Creek by Felix Koms, who replaced Frank Word as cook. Following is an abstract of Col. Birdseye's report of the trip:

The party left Flagstaff, Ariz., July 18 for Lees Ferry, 140 miles away. One boat and all provisions and instruments for the trip were carried on two motor trucks. This 140-mile stretch of road included some perilous going over what is called the "dugway," a narrow road blasted out of the cliff, which at places rises about 300 ft. above the river. The job of steering a heavy truck laden with an 18-ft. boat around the perilous turns in this road lent considerable interest to the beginning of the trip. The other boats used were the property of the California Edison Co., and had been in use in 1921 in Cataract Canyon, above Lees Ferry. The party spent the rest of July making new topographic surveys around Lees Ferry and getting ready for the boat trip.

River Trip Begins—Leaving Lees Ferry Aug. 1 the party camped the first night 7½ miles below that place, where the radio set was tried out and in spite of adverse prophesies that a radio would be unable to get anything in the depths of the canyon, the Los Angeles broadcasting station was picked up. The canyon at that point is narrow and nearly 1,000 ft. deep. The next morning Badger Creek rapids were run. These rapids have a fall of 13 ft. in about 100 yd. and to the party just then beginning its trip, they looked wild, but later experiences with rough water made them appear slight upon recollection. Camp the second night was made about 11 miles below Lees Ferry, where the party learned by radio of President Harding's death about three-quarters of an hour after it occurred.

On Aug. 3 the party portaged boats and equipment past Soap Creek rapids, carrying and skidding the upper part of the rapids, but successfully running the lower rapids. These rapids have never been safely run by any party. It was man-killing work to portage the heavy wooden boats here. Perhaps we might have got through safely without portage, as we ran worse rapids later, but it did not seem wise to take the chance so early in the trip.

The first rapids which all the members of the party ran were encountered on Aug. 4—rapids which the party called "Sheer-Wall Rapids," due to the fact that there was no foothold for portage. Rapids were run with the boat stern first and with all occupants wearing life jackets of cork, with kapok collars. Members of the party lay face down in the boats, clinging hard to the life lines stretched across the deck. The waves seemed mountainous and to some of us our first ride of this kind was a genuine thriller, but we afterward became so used to riding rough water that we vied with one another to make the plunge with a lighted pipe or cigarette without losing the light.

On Aug. 5 the boat passed a boulder measuring 40 x 80 ft., rising 30 ft. above the water. This boulder, standing almost in the middle of the river, has been mentioned by nearly all who have written accounts of canyon trips. Seven rapids were run on Aug. 6. On the evening of that day, the party camped near some good springs on the right banks of the river, a place which was called Spring Cave rapids. In an attempt to "line" the canvas canoe around Spring Cave rapids, it was lost, the only mishap of the kind during the trip.

Dam Site Surveyed—After several other rapids had been run, on Aug. 8 the boat passed Vasey's Paradise, 31 miles below Lees Ferry. The party filled canteens from a large stream of clear cold water gushing from the cliff about 70 ft. above the river. Surveys of a possible dam site were made at this point, and camp was pitched on the limestone ledges at the head of another rapids where radio messages were received from Los Angeles broadcasting station.

On Aug. 9 about 41 miles below Lees Ferry, the party passed by some fine arches in the limestone wall of the so-called Marble Canyon. Here the walls, which rise about 2,000 ft. above the river, have been sculptured into remarkable forms by erosion and by the fall of great masses of rock. Advantage was taken of a severe rainstorm for all members of the party to get the first real bath they had had since leaving Lees Ferry.

On Aug. 10 the party remained idle as a tribute to the memory of the dead President.

Aug. 11 the boatmen ran the little fleet through Boulder rapids, below which quieter water was found, and in this stretch 46 miles below Lees Ferry the party passed three large caves, which they called the Triple Alcoves. On Aug. 12 Nankoweap Creek was reached and more clear water for drinking purposes was found. As the Colorado is decidedly muddy and carries 10 per cent of sand and other suspended matter, clear water for drinking was a luxury. In camp that night at the mouth of Kwagunt Creek, daily news items and baseball scores, as well as concerts, broadcasted from Los Angeles were picked up on the radio. The party ran Kwagunt rapids the next day, reaching the mouth of the Little Colorado River, which was in flood and poured into the main stream a great volume of yellow water, dirtier than that of the Colorado.

Marble Canyon Left—The mouth of the Little Colorado marks the end of what is called Marble Canyon and the

beginning of what is called the Grand Canyon, but the whole stretch of the river through the plateau from a point a few miles below Lees Ferry downstream might well be called the Grand Canyon. The distinction had been made, so the party began to reckon its progress down the canyon in miles from the mouth of the Little Colorado. That night the river rose 3 ft. and the party had to arouse itself and hustle to pull up the boats. By mid-August the party was thus working its way downstream through rapids after rapids, each day bringing its touch of adventure or experience. The engineers had become accustomed to rough water and wanted to ride the boats through the most threatening cataracts, and the better judgment of the boatmen had to be expressed forcibly to induce them to climb around on the rocky and narrow shore. At some places, however, portage was impossible, so the whole party had to shoot through on the boats together and take chances alike.

At the foot of Hance trail a pack train was expected, but as the party was more than a week ahead of its schedule, the train of course was not there, so three of the party climbed the canyon to its south rim at Grand View 5,000 ft. above and 15 miles away, reaching the rim at midnight and spending the night with a forest ranger, who drove them next day to El Tovar. The following day all returned to the canyon with a pack train bringing supplies and mail.

Re-equipped, the party passed Hance rapids, which is one of the worst on the river, having a fall of 28 ft. in a few hundred yards and being full of rocks over which the river surges in great waves. However, all boats made the trip safely, though all took water. Not far below Hance rapids, the party entered the upper Granite Gorge, a point where difficulty was experienced in securing a foothold for instrument and rod stations. However, the survey line was carried through without a break. The walls here are only about 125 ft. apart at the water's edge, and at some places the surveyors had to cling periously to small projections just above the swirling water.

Sockdologer Rapids Run—The dreaded Sockdologer rapids, 17 miles below the Little Colorado, were reached Aug. 21. The height of the fall here has been exaggerated greatly, amounting to only 19 ft., but most of it occurs in the first hundred yards. Waves measured 20 ft. from trough to crest. All members of the party had to take to the boats. The next morning the boats plunged into Grapevine rapids, which have a fall of 17 ft. in a few hundred yards and are full of rocks. At this place, as at most places in the Upper Granite Gorge, it is impossible to climb around the rapids, so that the whole party shot through in boats. Between all these perilous plunges down dangerous cataracts, the surveyors carried along their work. A continuous line was run through the canyon and detailed surveys were made of possible dam sites at several places.

At the mouth of Bright Angel creek, the party passed under the Geological Survey's gaging cable and the suspension bridge, a frail looking structure, affording the only good crossing to the north rim of the canyon in the whole stretch of the river through the plateau. At this point most of the members of the party climbed out of the canyon to return on Aug. 28 to find a Fox News operator prepared to take moving pictures of the party running the rapids. The operator rode in one of the boats with his camera and took a number of pictures of the party, both in camp and in the boats as they plunged through the rapids. The boats shot through rapids in quick succession at Pipe Creek, Horn Creek, Salt Creek and Monument Creek. The latter, shown on the Geological Survey's map as Granite Falls, has a drop of 17 ft. and is piled with great rocks that throw the water into high waves: Here the boats shipped considerable water.

Party Receives Visitors—On the evening of Aug. 29 the party camped at the mouth of Hermit Creek, where a good flow of drinking water was found. Here it was joined by Col. W. W. Crosby, superintendent of Grand Canyon National Park, and a large party that had been made up to see the boats run Hermit Creek rapids. So many visitors caused the cook to threaten to leave, so arrangements were made to replace him. Hermit Creek rapids proved to be extremely rough, the boats tossing about like corks on the huge waves, many of which broke over the boats. The fall here is about 15 ft. During the night of Aug. 30 a terrific thunderstorm wet the whole party in spite of rubber sleeping bags and other means of protection. As the rain bordered on a cloudburst, the next morning was devoted mainly to getting things dry.

U. S. GEOLOGICAL SURVEY PARTY WHO HAVE COMPLETED PRELIMINARY MAPPING IN GRAND CANYON
Left to Right—Leigh Lint, H. E. Blake, Jr., Frank Word, Col. C. H. Birdseye, R. C. Moore, R. W. Burchardt, E. C. La Rue, Lewis R. Freeman and Emery C. Kolb.

Crystal Creek rapids were next run, and on Sept. 2 the party reached Bass trail, where the pack train had brought a large stock of supplies, which were loaded into the boats taxing their capacity, yet consisting of no more than was necessary to carry the party to Diamond Creek, more than 100 miles below. The boats ran Bass Canyon rapids, passing under the upper Bass Ferry cable, upon which a man in a car can propel himself across the river with a windlass. The cable is about 50 ft. above the water and 300 ft. long. The lower Bass cable crossing is a few miles below, carries a smaller car, and appears to be not so secure. At this point detailed surveys were made for a promising dam site. Several miles below the lower cable crossing, the party encountered Royal Arch Creek, whose canyon contains a clear, cold stream and beautiful falls, pools, and fern dells. No account of any boat trip down the canyon contained any mention of this spot, but a Geological Survey party had evidently camped there, the remains of a camp fire being found and on the rocks nearby were carved Geologic Survey inscriptions dated May, 1905, and June, 1907.

Two Dangerous Rapids Encountered—After shooting these rapids, the most threatening having a fall of 15 ft., the party, after a day's run of 9 miles, camped on Sept. 6 at Specter Chasm. About a mile and a half below this place, the boats took an 8-ft. rapids, in which the party seemed to be in greater danger than at any other point. The channel was shaped like an "S," and the swift current tends to drive a boat against a large mass of rock lying halfway down the rapids. Two of the boats missed the rocks narrowly, one of them coming so close to it that Burchard touched it with his hand. One boat actually struck the rock, but so lightly that no damage was done.

On the morning of Sept. 8 the party reached a cataract that no preceding party had yet run. It had a fall of 15 ft. in a few hundred yards, and is full of rocks and bad holes. The first boat through grazed the rock and lost an oar, but the oar was recovered and the boat pulled through. After getting through, however, its operator signaled the others to take the midchannel. The next boat struck near the lower end of the rapids a rock on which it seemed to hang for a moment. On pulling out of the rapids, it was found they both had a bad smash in the stern, and that the stern hatch was leaking. This mishap consumed an hour in repairs with cotton waste, white lead, canvas, and copper sheeting. The other boats had no mishaps.

At the mouth of Tapeats Creek, which was reached on the afternoon of Sept. 8, the party found a cold stream of clear water and decided to spend the next day, which was Sunday, in camp. LaRue discovered that this creek had the greatest flow of any theretofore encountered, except the Little Colorado, its flow measuring 96 sec.-ft. About two miles up the creek the party found that half the flow came from a series of cascades from the west, and on tracing this side stream farther up found it gushed from a large cavity in the cliff. In the trip up the creek several Indian ruins and some arrow heads were found.

The next day the boats plunged through Tapeats Creek rapids and along rapids nearly a mile farther down, below which Deer Creek comes in from the right through a cleft in the wall of the canyon in a waterfall about 75 ft. high. A mile farther downstream some old Indian ruins were passed.

The party reached Fishtail Canyon at noon Sept. 10 and saw the eclipse of the sun, which there was 75 per cent total. The canyon looked particularly gloomy and desolate in the dim light.

Below Kanab Creek, the party found shelter from a long and violent thunderstorm in a cave at the head of a dangerous rapid. Here, after the storm, Kolb ran the rapids first and was drawn into a swirl in a big hole, where his boat turned upside down and he disappeared. Dodge at once plunged into the torrent and swam to the boat, catching it at the foot of the rapids. It had come up on the side of the river away from the party, and for several minutes it looked as if Kolb were gone, but Dodge found him under the cockpit, almost unharmed, though he did cough up some water.

Party Again Provisioned—Nearly at mid-September the party reached the mouth of Havasu Creek, 95 miles below the Little Colorado, and about 155 miles below Lees Ferry. Here Roger Birdseye and Charles Fisk, the provisioners of the party, were waiting with nineteen Supai Indians as packers, bringing supplies to last until the boats reached Diamond Creek, nearly 70 miles below. The Indians would not pack more than 40 lb. each and were so afraid of being overloaded that every man's pack was weighed at the Indian agency. Many amusing incidents were reported, such as the exchange of a package of oatmeal for a can of beans, in order to reduce the weight of the pack by a quarter of a pound. Although the reservation is less than 10 miles from the river, none of the Indians had ever made the trip down the narrow, steep gorge. Below Havasu Creek the boats were run through rapids safely and the journey was enlivened by thunderstorms and small adventures.

Camp was made on Sept. 18 on a small sandbar below the falls. At half past six in the evening the river began to rise and at 8 o'clock the boats, which were moored in a small cove, were pounding so badly it became necessary to find a safer place for them. Kolb and Lint therefore pushed off downstream in one of the boats in the darkness, with lantern and flashlight, and in about an hour returned overland to report that a small sand beach with a low shelving shore of limestone, up which the boats might be pulled, lay not far below, and that they had left the boat there.

Flood Threatens Disaster—No one expected a rise of more than 5 or 6 ft., but the river had already risen 3 ft. and the boats could not be held longer. There was space at this place for pulling one boat well above the water, so the cook boat was dragged up the side of the cliff by means of block and tackle. Kolb, Freeman, Lint, and Blake ran the other two boats downstream to the place selected, though not without difficulty. Freeman climbed back along the shore, but the other three remained for a sleepless night, for the water rose rapidly, and they were kept busy pulling one boat or another out of the water to a higher place on the bank.

At 11 o'clock the cook boat was afloat and had to be pulled up higher, though the job was not easy, for the waves lashed the rocks so vigorously that secure footing could not be found below the boat. Felix, the cook, went to bed 10 ft. above the water but was flooded out at midnight, and the others had to rescue his bed and clothes. During the night the beds with the cook's outfit had to be moved three times. I went to bed at 2:30 a.m. on a flat rock 20 ft. above low water but two hours later was awakened by the spray lashing the rock. At daylight all hands went downstream to see the other three boats and found them pounding in the waves but all safe.

At 8 o'clock on the morning of Sept. 19 the river had risen 16 ft. and it continued to rise all day, reaching a peak of 21 ft. about 6 p.m. The party spent most of the next day rather enjoyably in washing themselves and their clothing in the warm springs at this place, for the night had been chilly. Exercise was found in pursuit of a large rattlesnake, which was killed.

In the flood the rapids, which had been a short, almost sheer fall of 10 ft. at the crest, became a long sweeping "V" of swift water, and the waves below the crest for a quarter of a mile were running 20 ft. high and throwing spray that much higher. Immense quantities of driftwood, including many large logs, were carried downstream, and some of them were thrown completely out of the water. Measured in volume the rise was estimated to be 100,000 sec-ft. Evidently the rainstorms that had drenched the party from Sept. 13 to Sept. 16 were accompanied by worse storms farther up the canyon.

The river subsided slowly during the two following days, and on Sept. 22, with the river about 7 ft. above the old low water stage, the party resumed its journey.

Party Reports by Telegram — On Oct. 2 after running many small rapids, the party reached Diamond Creek, 164 miles below the Little Colorado, and 225 miles below the starting point. The party was reprovisioned and from that point telegrams were sent to Washington and elsewhere, reporting the safe arrival of the party and putting at rest rumors that the party might have suffered disaster because of the finding of a strange boat below. Here also the boats were overhauled, reports prepared, equipment examined, and radio outfit repaired and set up. Among the things received by radio was the announcement that the party itself had arrived safely at Diamond Creek.

The voyage was resumed Oct. 7, the boats plunging into Diamond Creek rapids. During that day Burchard fell on the rocks, fracturing a rib, but insisted on continuing his survey. With the exception of the first day's work below Lees Ferry he had made the entire survey and wanted to carry the line down to connect with his old work, just above the mouth of the Grand Canyon. He is therefore responsible for the entire survey through Marble, Boulder, Grand, and Black Canyons, from a point 7 miles below Lees Ferry to the Bull's Head reservoir site, about 40 miles above Needles. Though his rib was painful, bandages made it possible for him to continue the work.

Boat Thrown Into Air—Separation rapids were the next dangerous ones met. At the mouth of a deep canyon that comes in from the right, they fall nearly 20 ft., looking dangerous, and sheer walls leave no chance to pass around them. It is here that three members of the first Powell expedition are supposed to have left the canyon in discouragement, being soon afterwards killed by Indians. Kolb, Blake, and Lint ran their boats safely, but the deck loads made the boats top-heavy, causing them to dance about in the torrent like corks. Freeman ran last, with LaRue and Moore clinging to the hatches. The huge waves tossed the boat into the air, and when it came down, bottom side up, they were thrown out between the boat and the rocks, LaRue narrowly escaping being crushed. Freeman had dived clear of the boat and had come up a few yards from it, where he caught a rope. Blake and Dodge pushed out in their boat to render assistance. Dodge grasped the painter and helped to haul LaRue aboard, Freeman and Moore holding hard to the upturned boat, which was towed to quieter water and righted. All lost such loose articles as hats, pipes, and glasses, and Freeman lost both oars, which, however, were afterward recovered.

The accident afforded a good test of the serviceability of the watertight boxes, one of which, containing cameras, was strapped in the open cockpit of the overturned boat. After a half hour's submersion the cameras and films were found bone-dry. In camp that night, the radio set gave messages from Los Angeles, Salt Lake City, and for the first time from Colorado Springs.

Mattowitteki rapids, which lie below Mattowitteki Canyon, were next run. The fall here is 17 ft. in about a hundred yards, and the channel is dotted with rocks. One of Powell's boats broke loose while it was being lined around, and one man was thrown out but rescued. These rapids—the last bad fall on the river—are considered the worst in the canyon except Lava Falls. The boats were lined through by using long lines held by men at several points along the cliff. The job of handling these 900-lb. boats and portaging equipment was not easy.

On Oct 13 Burchard brought his line to the monument marking the end of his work in 1920, at Last Chance rapids, 252 miles below Lees Ferry, and checked his elevations, finding only a slight error. On Oct. 15 the voyage downstream was resumed, and the party reached Needles, 450 miles from Lees Ferry, on Oct. 19.

To the able leadership of Colonel Birdseye is attributed a large measure of the success of the trip. The persistence of "the indefatigable Burchard" was a matter of comment among his companions as was the skill and good judgment of Emery Kolb in piloting the boats through the rushing waters of the canyon.

Siltation of Austin and Lake Worth Reservoirs in Texas

By John B. Hawley
Consulting Engineer, Fort Worth, Texas

Remarks before Texas Section, Am. Soc. C. E., Oct. 5, 1923.

DEAN T. U. TAYLOR'S excellent paper on the silting up of the Austin reservoir in *Engineering News-Record* for Sept. 6, p. 380, while accurately setting forth the facts, is quite likely to be too greatly generalized by the casual reader, even to the extent of concluding that reservoir construction in Texas is a futile undertaking.

The situation at the Austin dam is quite unusual, especially in respect of the great drainage area, 37,000 sq.mi., for an original impounding capacity of 16,800,000,000 gal., or 51,000 acre-ft. Dean Taylor shows that 84 per cent of the capacity of Lake Austin was filled with silt from 1913 to 1922 (reducing a capacity of 33,745 acre-ft. to 5,456 acre-ft.). This makes Lake Austin look quite like a mere "sand-trap" for the 37,000-sq.mi. drainage area.

Now Lake Worth, on the West Fork of the Trinity River, six miles west of Fort Worth, has been in service slightly more than nine years, 1914 to 1923. Its drainage area is about 1,600 sq.mi., the areal geology of which is quite similar to that of the Colorado River above Austin. The gross capacity of Lake Worth, at spillway level, is, or was, about 14,000,000,000 gal. or 42,000 acre-ft.

In the Austin case 37,000 sq.mi. fed 33,000-acre-ft. capacity, or 1.12 sq.mi. for each acre-foot. In the Fort Worth case 1,600 sq.mi. fed 42,000-acre-ft. capacity, or 0.038 sq.mi. for each acre-foot. Axially, Lake Worth is about twelve miles long and has an average width of a half mile.

Some months ago, when the water level of Lake Worth was 4 ft. below the spillway, John F. Norris, Simon W. Freese and the writer carefully examined the shores of Lake Worth, digging through the reddish silt into the original black loam. The line of contact was clearly defined. Near the dam we found an average of ¾ in. of silt; 3½ mi. above the dam, 1½ in. of silt; and 7 mi. above the dam 3½ in. of silt. The last observation was made about ¼ mi. above the "Nine Mile Bridge," just below the "narrows" between the "upper" and "lower" lakes. Sometime later the writer made some examinations near the upper end of "upper lake," and found 2 to 3 ft. of silt at the low-water mark.

Lake Worth Siltation—The data are inadequate to estimate siltation for the nine years, as the depths of the lake will show much greater silt deposit than the shallows, but the contrast between them and Dean Taylor's figures for Lake Austin is striking. However, if Lake Austin, with approximately the same capacity as Lake Worth, was 84 per cent filled by silt from 37,000 sq.mi. of drainage area in nine years, then perhaps Lake Worth, with but 4⅓ per cent of that drainage area, might go 207 years before accumulating silt to 84 per cent of its original capacity. Again, assuming that the 4,200-acre water surface area of Lake Worth has been silted an average of 1 ft. during the nine years (and this assumption is deemed excessive) the silt volume would be but 10 per cent of the original capacity, as against 84 per cent in the case of Lake Austin.

The State Board of Water Engineers and the Engineers of Water Resources (for Texas) of the United States Geological Survey recently decided to make soundings on traverse lines to be established on Lake Worth, and to continue observations on its siltation through a long period of years. Data secured by these observations will be eagerly awaited by the profession.

The many impounding and storage reservoirs on Texas streams, and streams in every other state, many of them in useful service for decades, should be ample evidence to engineers, and to communities contemplating the conservation of surface waters, that the siltation troubles experienced at Lake Austin are substantially unique, being probably the most unusual in the history of engineering.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

An Engineer on City Charters

THE BEST CITY CHARTER—By Robert J. Harding, M. Am. Soc. C. E. With an introduction by G orge Chandler Whipple, Professor of Sanitary Engineering, Harvard University. San Antonio, Texas: The San Antonio Water Co. Paper; 6x9 in.; pp. 89.

As engineer and administrative officer for cities in the North and as chief engineer, manager and vice-president of a water company in the Southwest, Mr. Harding has had both experience in city administration and much contact with city governments. In addition he has collected and studied city charters of different types. The result of all this, plus much thought on the subject, is this essay on The Best City Charter.

Briefly, the author believes that a city charter should take the doctrine of representative government as its basic principle and the Constitution of the United States as its model. While seeing some advantages in the commission and commission manager as contrasted with earlier types of city charters, Mr. Harding is against both of the newer forms. These he considers unrepresentative and, as regards their common accompaniments—the initiative, referendum and recall—ultra democratic. But, strong as he is for representative government, he proposes to deprive the voters of the power to choose one-third of the city council by having the choice made by the mayor—from citizens especially qualified for the purpose who would at the same time raise the level of a body of ward representatives. So far as we know, such a limitation of representative government has never before been proposed.

Impressed with the fact that the commission plan is an abandonment of the separation-of-function-and-power idea of the American Constitution but largely if not wholly ignoring the development, a few decades back, of the federal type of charter, as at Brooklyn and Cleveland, and in the first model charter of the National Municipal League, Mr. Harding proposes a decidedly mixed type of charter with (1) a mayor of limited executive power; (2) a council with practically none but legislative functions; (3) numerous administrative boards on the theory that by this means the interest and knowledge of representative citizens will be put at the disposal of the city; (4) department executives and employees, apparently chosen in part by their immediate heads and in part by civil service commissions, but not as regards men to fill technical positions. Except for the health commission, these administrative boards seem to be limited in power to (1) the choice of an executive head of the department; (2) carrying out policies established by the city council and expending money provided by the budget; (3) recommending measures to the council for approval.

An engineering board would appoint a city engineer, initiate street widening and extension projects and have some control over utilities that use the streets, but there would be a board of public works to initiate public improvements and to construct and operate various public works, under the "direction of a man," chosen by the board, "preferably a municipal engineer with wide construction experience." In cities of less than 50,000 these two boards might be combined. The health board would have charge of plumbing and of city scavenging. There would be no curb on its expenditures so long as they were for public health.

The mayor is held to be the chief executive but from Mr. Harding's outline he seems to be that only in so far as appointment of board members is concerned. The mayor is also the "prime mover" as to policies while the council acts "as a buffer between the initiative [initiator?] and the people." Mr. Harding differentiates between the administrative and the executive functions of city officials, and Professor Whipple, in his introduction, enlarges considerably upon Mr. Harding's few lines on this subject. Both have in mind (1) legislation; (2) administration, to work out the details of legislative policies; and (3) execution of those policies as thus detailed, but Mr. Harding's scheme does not follow this division in a clean-cut way.

Rightly or wrongly the essay gives the impression that the author has largely ignored much if not most of what others have written on democratic institutions, representative government and city charters. Other proposals to improve city government, especially by the commission and commission-manager plans, adopted in the last twenty years by some six hundred cities and given up as yet by very few, the author characterizes as innovations, prompted by a desire to change. Notwithstanding the foregoing criticisms Mr. Harding's essay is well worth reading, especially by engineers, but those not already familiar with the two-hundred commission-managers charters now in use and with the theory and practice of charter making will do well to refer to Crane's "Digest of City Charters," and to read one or more of the many recent books on government—federal, state and municipal—and also Mill on "Representative Government."

The Engineer Who Makes a Speech

REVIEWED BY P. B. MCDONALD
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PLATFORM SPEAKING—By G. Rowland Collins, of New York University. New York: Harper and Bros. Cloth; pp. 341; $2.25.

For the engineer who has to make a speech here is a useful book of instructions designed especially for professional and business men. All varieties of formal talks, from the sales argument to the after-dinner speech, are discussed in a practical and helpful manner. The technicalities of voice and action are minimized, and stress is laid upon preparation rather than upon presentation in the old-fashioned elocutionary style. Analyses of purpose, subject matter, and audience are particularly well treated. While avoiding the old elocutionary etiquette, the author has not gone to the other extreme and descended to "pep" phrases and inspirational lingo. The methods of effective persuasion and argumentation are made plain.

From Serbian Cattle Herder to Scientist

FROM IMMIGRANT TO INVENTOR—By Michael Pupin, Professor of Electro-Mechanics, Columbia University. New York: Charles Scribner's Sons. Cloth; 6x9 in.; pp. 396, 25 halftones. $4.

Seldom does an autobiography have such breadth and height of interest as does Prof. Pupin's story of how a boy cattle herder in Serbia became an American scientist of world-wide fame. Many other foreign-born youths of humble origin have seized the opportunities presented after their arrival in America, but few have combined such great achievements in physics and engineering with devotion to such high democratic and humanistic ideals and put the whole on record in engaging and inspiring form.

What influences opened Pupin's mind as a youth and brought him to America, his hardships and experiences as a "greenhorn," his entrance to American citizenship and his achievement of a college degree at Columbia; his later studies at the Universities of Cambridge and Berlin, and his professorial and research work at Columbia University, and many things besides, are charmingly told in the first ten chapters of this autobiography. The concluding chapters, on The Rise of Idealism in American Science and on The National Research Council are brimful of suggestion and inspiration. Both of these chapters contain an eloquent plea for scientific research both "pure" and practical. Tributes are paid to the American Society of Civil Engineers and the other three "founder" engineering societies; to the National Academy of Arts and Sciences and to the National Research Council, growing as these two did from the Civil War and the great war of recent years; and particularly to Andrew Carnegie and Ambrose Swasey for their generosity and perspicuity in establishing respectively the United Engineering Library and Engineering Foundation. Other contributors to the promotion of science, both by their own research work and by their benefactions, are not overlooked, nor does the author fail to mention progress in other scientific fields than his own, mentioning in particular progress in biological science in the past twenty-five years.

As an illustration of Prof. Pupin's keen reflections upon many phases of human life and progress, mention may be made of a contrast which he draws in a few sentences between the great industrial work accomplished by Carnegie and by Swasey: The former "achieved great things in mass production," while the latter specialized in the production of "fine machine tools and astronomical instruments of precision."

All through the book notable instances are given of how things seemingly little at the time have a profound influence upon the development of knowledge and character in those who make the best of every opportunity for the advancement of themselves and of the world. It was the chance finding, the immediate purchase and the eager study of a second-hand book from a Paris bookstall that laid the basis for the development many years later of the Pupin inductance coil which has played such a part in the development of telephony during the last two decades. This book was La Grange's "great treatise, 'Mechanique Analytique,' first published under the auspices of the French Academy in 1778." Throughout his book Prof. Pupin refers again and again to his early experiences in the transmission of sound through the earth when he and other herdsmen signaled back and forth by that means.

Prof. Pupin's autobiography is a crowning addition to several most interesting books in this field of literature, that have been reviewed in these columns during the past few years. Like the others, this one can be recommended for reading by any engineer and particularly by students of engineering or of science, or for that matter by any of the youth of the land who are in the formative stages of their career. Many of the persons who within the next few weeks will be racking their brains to think of a suitable holiday present could safely obtain this volume for that purpose, but they should either get the book long enough to read it themselves before giving it away or else purchase two copies.

Addition to Turner on Elasticity

Reviewed by George Paaswell
Specialist in Mathematical Engineering Problems, New York City

ELASTICITY AND STRENGTH OF MATERIALS USED IN ENGINEERING CONSTRUCTION: Section III, Theory of Torsion in Shafting and Double Bending of Plates—By C. A. P. Turner, Consulting Engineer, M. Am. Soc. M. E., M. A. S. T. M., M. Am. Soc. C. E. Minneapolis, Minn.: Published by the Author. Cloth; 6x9 in.; pp. 122; 132 line cuts. $5.

Section III of the series of texts on elasticity purports to cover the theory of torsion and of double bending. The latter treatment is that given in the book issued jointly by Mr. Turner and the late Prof. Eddy, reviewed in these columns, Feb. 15, 1923, p. 312. But little need be added or retracted from that criticism.

Mr. Turner deserves much admiration for his sincere (and obviously costly) endeavor to bring to the attention of the average designer the more exact treatment of structures by the method of the mathematical theory of elasticity, but one notes with deep regret how unsuccessful a mere qualitative description of stress is. As the reviewer has pointed out previously, no proper description can be given without the aid of mathematics. The reader will not accept fundamental explanations upon the mere say so of the author.

The qualitative description of torsion is ably presented, if one overlooks the annoying intrusions of the author's special terminology, such as rotative and twisting shears. There are three fundamental strains in elastic theory—lengthening, shortening, and shear—and three fundamental stresses—tension, compression and shearing stress. The student can recognize these anywhere. Why confuse him by a special type of name?

St. Venant presented in complete form the exact theory of torsion, analyzing not only the circle, but all types of shapes, and gave an empiric formula that covered almost all cross-sections. Only the circle maintains the plane section during torsion and the old torsion formula is exact for this section alone. The author notes a bulge in the circular section; is that consistent with the demonstration that the circular section is not distorted?

In discussing plate action the author again makes the twisting shear the mysterious force maintaining plate action. This twist is merely a flexural action and the reader need expect no new data on plate action.

A minute's discussion may explain the difficulty in analyzing plate action by the exact theory of elasticity. Upon the simple assumption that Hooke's Law is valid, and upon the continuity of the body, differential equations are built up to be satisfied by the boundary and surface conditions of the deformed body. For the plate,

the data are too complex to lead to any solution of the plate, unless certain approximations are made. A solution can then be found for the circular, elliptical and rectangular plate resting on its periphery, and Michell has extended the solution by means of a theorem in inversion to a plate carrying an isolated load. The flat plate on four columns has not yet received any mathematical solution. Approximations may be found by dividing the surface into convex and concave dishes and applying the formulas for circular plates, properly modified to allow for the terminal bending stresses. This gives a very rough approximation, but it may be a limiting stress condition. The author might well have described some action as above and given the reader a comprehensible idea of plate action; he chose rather to found his analysis on twisting action, to the reader's confusion.

To sum up, while the text may illuminate, in a qualitative sense, torsional and double bending effects, the treatment as a whole can hardly be considered an addition to our knowledge of elastic action in plates.

British Presentation of Sewer Hydraulics

Reviewed by John H. Gregory
Consulting Engineer; Professor of Civil and Sanitary Engineering, Johns Hopkins University, Baltimore, Md.

HYDRAULICS APPLIED TO SEWER DESIGN—By G. S. Coleman, D.Sc. Eng. (London), Assoc. M. Inst. C. E., Associate Member of the Institution of Municipal and County Engineers, Senior Lecturer in Municipal and Sanitary Engineering in the Municipal College of Technology, Manchester, England, and Assistant Lecturer in the same subjects in the Victoria University of Manchester. London: Crosby Lockwood and Son. New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. 150; 70 line cuts. $4.

In his preface the author says, "The following pages are founded on notes of lectures delivered to third-year students sitting for the B.Sc. Tech. degree in Municipal and Sanitary Engineering in the Victoria University of Manchester, and also on notes collected by the author from his own practice as a municipal engineer for the past twenty-five years." In its present form the book is by no means a textbook for students in sanitary engineering, nor is it a brief treatise for the practicing engineer. Apparently it is an attempt on the part of the author to put in printed form the main essentials of hydraulics, applied to sewer design, as they appear to him.

From the standpoint of American practice the book is of little value, and as for considering the subject of hydraulics, some phases are not even mentioned, as velocity head, loss of head at entrance, and discharge through orifices. With some of the author's statements the reviewer ventures the opinion that engineers may not agree. For example, in discussing discharge formulas for channels the author says, "It is usual to allow a limiting average velocity of 3 ft. per second in vitrified sewer pipes and from 2 to 1 ft. per second in large sewers, the smaller value applying to the largest sizes. Sewers should never be put under pressure unless constructed of metal pipes." Engineers interested in the rational method of estimating storm water runoff will, however, find a brief but interesting discussion of this subject, especially as regards the time of concentration along a main sewer of the runoff from contributing areas.

The book is well printed and bound, but the illustrations are not well executed. An index is included. The sum of $4 net is far too high for the material presented.

Chief of Engineers of the Army

THE OFFICE OF THE CHIEF OF ENGINEERS OF THE ARMY: Its Non-Military History, Activities, and Organization—By W. Stull Holt. [Institute for Government Research. Service Monographs of the U. S. Government, No. 27.] Baltimore, Md.: Johns Hopkins Press. Cloth; 6x9 in.; pp. 166. $1.

No branch of the government has a more honorable history than the Corps of Engineers. Certainly every civil engineer, whether in military or civilian life, should be acquainted with that history. This book, issued as one of the series of the service monographs of the United States Government, is an excellent unprejudiced statement of the Corps' duties and performances. Appendixes give summaries of the laws under which the Corps of Engineers functions, financial summaries, statistics of floating equipment and a bibliography.

Publications Received

The Report and Recommendations on a Physical Plan for a Unified Transportation System for Chicago, abstracted in our issue of July 19, 1923, p. 104, may now be obtained from the Bureau of Statistics and Municipal Reference Library, City Hall, Chicago, Ill.; $2.25 postpaid.

Power Test Codes, a Test Code for Hydraulic Power Plants and Their Equipment, has been published by the American Society of Mechanical Engineers but distribution has been held up pending a decision as to whether a revised edition, to include certain changes, will be substituted for the present edition. (American Society of Mechanical Engineers, 29 West 39th St., New York. 70c. to members; 80c. to others; 25 or more copies, 65c.)

Boilers used exclusively for low-pressure steam heating, hot water heating, and hot water supply are covered in Section IV of the American Society of Mechanical Engineers Boiler Code, 1923 edition. This part of the code has been entirely rewritten since the 1918 edition and as now presented it includes rules governing the construction and operation of steel and cast-iron boilers. (New York; 80c. per copy, 70c. to members; 25 or more copies, 65c. each.)

Those Who Frequently Use mathematical tables and formulas in practical work, including the geometer and physicist, will find "Synopsis of Applicable Mathematics: with Tables," by L. Silberstein, Ph.D., a convenient volume. The Tables are logarithms of numbers and of the trigonometric functions, and special tables, such as elliptic integrals and the Bessel function. The formulas are the applicable formulas of algebra, geometry, trigonometry and calculus. Non-euclidian geometry is taken up and special attention is given to vector geometry, the quarternion, and tensor calculus. (First published September, 1922, as "Bell's Mathematical Tables;" Reissued April, 1923, as "Synopsis of Mathematical Tables." Printed in Great Britain by Neill & Co., Ltd., Edinburgh. New York: D. Van Nostrand Co.; $4.50.)

In the Routine of Dry Governmental Reports a decidedly unusual degree of interest attaches to a pamphlet just issued by the U. S. Department of Agriculture, under the title "Timber: Mine or Crop?" It is a comprehensive review of the lumbering situation and forest stock of the country, supported by a surprising mass of data on growth, cut, consumption and waste. As a short and easily digestible historical review of the development of American forest exploitation, and of the tremendous changes that have come upon different lumbering states in the course of this exploitation, the engineering reader will find it of particular value. The progress of the center of lumbering from New England to the Lake states, then to the South and now to the West, is outlined; the ruin that has descended upon many sections, such as parts of Pennsylvania and Michigan, through non-conservative exploitation of forest resources, is illustrated; finally, proof is given

that unless wasteful exploitation is stopped and at the same time forest growth is multiplied several times by the adoption of sounder cultural methods, the country will be without a sufficient wood supply in the not far distant future. Not least interesting in all this material are various sidelights on subordinate phases of the general problem such as the menacing part played by the retail lumber dealer in profiteering in our wood resources and the unfortunate influence of decreased water transportation of lumber. There can be little doubt of the importance of the recommendations of the report, whose alternative, the text concludes, "is idle forest lands and timber bankruptcy."

THOSE INTERESTED IN SHORE PROTECTION will find the latest Report of the New Jersey Board of Commerce and Navigation on The Erosion and Protection of the New Jersey Beaches of considerable interest. The report itself is brief, consisting of an outline of the methods followed by the engineering advisory board and its recommendations, but the appendixes are very full. They include an historical account of the changes in the New Jersey shore line, the general principles of coast protection, illustrations and descriptions of beach protective devices, a discussion of action of winds, currents and littoral drift, practice in beach protection in other places, and an outline of the New Jersey laws concerning riparian lands as affected by erosion. The report also contains a set of large scale maps of the New Jersey coast showing the changes in the above line during the past century.

WATER SUPPLY PAPER 494, an Outline of Ground-Water Hydrology, with Definitions, prepared by Oscar E. Meinzer, has been issued. (One copy free, U. S. Geological Survey, Washington, D. C.)

THE LATE WAR delayed completion of the Report on the Study of Fifteen Representative Sewage Treatment Plants, by H. H. Wagenhals, E. J. Therriault and H. B. Hommon, recently issued as Bulletin 132 of the U. S. Public Service. (Washington; paper; pp. 257; one copy free on application, as above; additional copies at 50c. from Superintendent Public Documents.) The plants studied are located at Alliance and Canton, Ohio; Atlanta, Ga.; Fitchburg, Mass.; Lexington, Ky.; Columbus, Ohio; Rochester, N. Y.; Baltimore, Md.; Reading, Pa.; Houston, San Marcos and Sherman, Texas. One-story and Imhoff septic tanks, contact beds, trickling filters and Riensch-Wurl screens in various combinations and (in Texas) activated-sludge process were studied. The plants are described and the results of analyses, made by the investigators for this report, are given. The report is so unique and valuable that every engineer engaged in sewage-works design or operation should obtain a copy.

THE ENGINEERING EXTENSION SERVICE of Purdue University, Lafayette, Ind., has issued a bulletin on Electric House Pumping Systems, by Professors G. C. Blalock and D. D. Ewing.

A.S.T.M. TENTATIVE STANDARDS, 1923, covering 170 subjects, is now available. (American Society for Testing Materials, 1315 Spruce St., Philadelphia; 859 pp.; $7 in paper or $8 in cloth.)

THE AUTOMOBILE, improved highways, the wanderlust and the desire to "camp out" make opportune a Florida State Board of Health Bulletin on Tourist Camps, their Sanitary Control and Operation, by George W. Simmons, Jr., chief sanitary engineer (Jacksonville). Revised camp rules are included.

Foreign Papers and Reports

THE EXCELLENT WORK of the Newcomen Society (H. W. Dickinson, secretary, The Science Museum, South Kensington, London, S.W. 7) "for the Study of the History of Engineering and Technology" is continued in Transactions, Vol. II, 1921-22. Among the papers included are: The Early History of Mechanical Handling Devices, by G. F. Zimmern; Greek and Roman Engineering Instruments, by R. C. S. Walters; and Mechanics and Engineering from the Time of Aristotle to that of Archimedes. Other papers deal with early railway and locomotive matters, steam navigation, etc. A short analytical biography of the History of Engineering and Applied Science, 1900-1920, is included. A number of interesting old cuts are reproduced. Membership in the society is open to all interested anywhere.

SEWAGE RESEARCH STUDIES at Moscow, 1903-22, are the subject of a 32-p. pamphlet printed in Russian, but with a résumé in French, by S. Stroganoff, chief of the sewage laboratory of the city of Moscow.

New Books and Revised Editions

DESIGN OF CONCRETE STRUCTURES—By Leonard C. Urquhart, Assistant Professor in charge of Structural Engineering, Cornell University; and Charles E. O'Rourke, Assistant Professor of Structural Engineering, Cornell University. New York: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. 452; 166 line cuts. $4.

THE DESIGN OF DIAGRAMS FOR ENGINEERING FORMULAS AND THE THEORY OF NOMOGRAPHY—By Laurence I. Hewes, B. Sc., Ph.D., M. Am. Soc. C. E., Deputy Chief Engineer, U. S. Bureau of Public Roads; and Herbert L. Seward, Ph.B., M.E., M. Am. Soc. M. E., Associate Professor of Mechanical Engineering, Sheffield Scientific School, Yale University. New York: McGraw-Hill Book Co., Inc. Cloth; 9x12 in.; pp. 111; 83 line cuts. $5.

EISENBRÜCKENBAU—Dritter Band. Die Hauptträgersystemz Nebst Ihrer Berechnung Bauliche Einzelheiten Der Balken-Bogen- Und Hängebogenbrücken Bauliche Einzelheiten Der Hängerbrücken Herstellung Der Eisenbrücken in Der Werkstatt Und Auf Der Baustelle. Von George Christophe Mehrtens, Geh. Hofrat und Professor der Ingenieur Wissenschaften an den Technischen Hochschule in Dresden. Leipzig: Wilhelm Engelmann. Paper; 7x10 in.; pp. 435; halftones and line cuts.

"HUTTE": TASCHENBUCH FÜR EISENHÜTTENLEUTE—Herausgegeben vom Akademischen Verein Hütte, E. V. Berlin. [Dritte Durchgesehene Auflage.] Berlin: Wilhelm Ernst & Sohn. Cloth; 5x7 in.; pp. 963; 511 line cuts.

HYDRO-ELECTRIC POWER STATIONS—By David B. Rushmore and Eric A. Lof. [Second Edition.] New York: John Wiley & Sons, Inc. Cloth; 6x9 in.; pp. 830; 437 halftones and line cuts. $7.50.

INDUSTRIAL OIL ENGINEERING—By John R. Battle, M.E., C.E., Assoc. M. A. S. M. E., M. Engineers' Club of Philadelphia. [Second Revised Edition.] Philadelphia: J. B. Lippincott Co. Cloth; 6x8 in.; pp. 1141; 400 halftones and line cuts, 9 charts, 9 colored plates. $10.

POPULAR FALLACIES EXPLAINED AND CORRECTED (with copious references to authorities)—By A. E. S. Ackermann, M. Assoc. Consulting Engineers, Assoc. M. Inst. C. E. [Third Edition.] London: The Old Westminster Press. Cloth; 6x8 in.; pp. 984.

PRACTICAL CONTROL OF ELECTRICAL ENERGY—By Alfred George Collis, A. M. I. E. E., M. Am. I. E. E. [Oxford Technical Publications.] London: Henry Frowde and Hodder & Stoughton; New York: Oxford University Press. Cloth, 6x9 in.; pp. 160; 142 halftones and line cuts. $3.50.

Intended to give "descriptive technical data of the design of electrical apparatus and machinery, as applied to everyday practice," and to explain and solve "alternating and direct current problems intelligently without the introduction of complications and formulas."

THE PREVENTION OF VIBRATION AND NOISE—By Alec B. Eason, M. A. (Cantab.), Assoc. M. Inst. C. E., A.M.I.E.E. [Oxford Technical Publications.] London: Henry Frowde and Hodder & Stoughton; New York; Oxford University Press. Cloth; 6x9 in.; pp. 163; 65 halftones and line cuts. $5.

STRENGTH OF MATERIALS: Prepared in the Extension Division of the University of Wisconsin—By Walter E. Wines, Assistant Professor of Mechanical Engineering, University of Wisconsin. [Engineering Education Series.] New York: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; 103 halftones and line cuts. $2.25.

A TREATISE ON ENGINE BALANCE USING EXPONENTIALS—By P. Cormac, Fellow of the College of Science for Ireland, Demonstrator in Mechanical Engineering at the College of Science, Dublin, Lecturer in Heat Engines and Motor Car Engineering at the City of Dublin Municipal Technical Institute. New York: E. P. Dutton & Co. Cloth; 6x9 in.; pp. 151; 55 line cuts. $8.

THE WELDING ENCYCLOPEDIA: A Practical Reference Book on Autogenous Welding—Compiled and Edited by L. B. Mackenzie and H. S. Card of the Editorial Staff of The Welding Engineer. [Third Edition.] Chicago: The Welding Engineer Publishing Co. Flexible; 6x9 in.; pp. 360; many halftones and line cuts, some colored plates. $5.

This (the third) edition of a book first published in 1921 contains a new chapter on training oxy-acetylene and electric arc welders, and additional matter on welding tanks and pipes.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Responsibility for Timber Treating Inspection

Sir—Within two years, we have had two failures on the part of inspection bureaus to detect failure on the part of plant management to live up to the specifications on creosoted timbers. In one case the quality of timber was involved; in the other, exact lengths. This concerned the same contractor, but different treating companies and different inspection bureaus.

Our contract provides that progress inspection does not relieve the contractor of responsibility for defects discovered at a later time. The extra expense incurred by the contractor was not relatively large but there was also delay and annoyance. The treating company in each case claimed that when we sent an inspector the responsibility rested with the inspector while the inspection bureaus each stated that the current rates for such inspection are so low that it would be suicidal to guarantee such details of inspection as were involved, or to make good any losses incurred by the contractor.

A recent conference in this office with the three interests involved in the last case seemed to bring out the fact that there should be either less responsibility placed on the inspection bureau and therefore more on the treating plant management, or else more on the inspection bureau with the plant management and contractor relieved from all subsequent responsibility.

The question of equity seems somewhat involved. When the county employs an inspection bureau whose representative passes on the material and treatment at the plant, and it later develops that there has been a failure to comply with the plans and specifications, should the county, acting through an inspection bureau as its agent, be responsible to the contractor, thus waiving the clause in the contract touching on progress inspection?

No doubt this question has arisen in other instances, and I should be glad to have an expression from others in regard to the equities involved.

V. R. Covell,
County Engineer,
Allegheny County.

Pittsburgh, Pa.
Oct. 24, 1923.

Making Contract Bids More Certain

Sir—The article "Overlooked Items in Estimating Road Work" in *Engineering News-Record* Sept. 6, 1923, p. 391, holds a great deal that is applicable to construction contracts in general. The item set forth in the first paragraph of the subtitle, "General Factors," and more definitely estimated as 15 per cent as the minimum that should be added to cover risks embraced in the so-called "Unilateral Contract" usually submitted by the owner, is a puzzling item for most construction contractors.

Contractors frequently submit alternate bids for doing work of construction through the use of substituted materials or equivalent procedure. Why not submit alternate forms of agreement to the owner? The contractor is in a position to form his agreement so as to reduce these hazards: (1) Acts of God; (2) delays and suspensions of work by owners; (3) unusual increase or decrease in contract quantities; (4) absence of means for legal redress for inequities or arbitrary decisions, and (5) the unilateral form of contract, under which one is generally compelled to bid and by which the contractor may be penalized for one or all of the above contingencies.

Items 1 and 4 are frequently but little understood by either contracting party as to the legal decisions affecting these terms when used in the uniform contract.

Items 2 and 3 are frequently the cause of disputes for which the clause in the contract provides a committee or referee. The unilateral form of contract is in a sense a misnomer, as it presumes the doing of an act in reliance upon the promise of another. This term, "unilateral," is a technical term distinguishing a contract of this nature from a so-called bilateral contract, where the promises and performances are said to be mutual.

Now, a word in closing as to the term "penalties," which is very misleading. Where the owner and contractor agree upon certain sums to be paid on breach of the contract (by either) it may be recovered if intended as liquidated damages for non-performance, but the weight of decisions by American courts shows that penalties will not be enforced and recovery is limited to the loss actually sustained.

In view of the conflicting laws of the various states, it is impossible to reconcile the use of the uniform contract in its present form without reference to the state decisions where the construction contract is to be performed. A saving of 10 per cent is worth while by either owner or contractor if this can be done through the substitution of an alternate form of agreement which will allow "bids to be more definite" and assure completion of construction without actual or threatened litigation.

Horace H. Sears,
Consulting Engineer and Attorney at Law.

New York City, Oct. 6, 1923.

"Sand-Hogs" or "Sand-Braves"

Sir—Occasionally there is in the daily press an expression or phrase that may be without a worthy origin and therefore a subject for comment. Engineering affairs are involved.

In deep foundations and caissons in the present state of the art employees are frequently obliged to work where health and life are in constant peril. Why are such laborers so often called "sand-hogs"? Apparently the words are a misfit. If not rude or harsh as some might argue, since no repugnance is felt by employer or scribe, still the last word implies a condition and sundry activities that have been fostered by man through irregular feeding and want of care. In nature the pig is an exceptionally neat creature, no more intent upon food than many other mammals, and it is far from being without wit or good sense. Besides in sterling ancestry the pig can claim distant kinship with the mighty mammoth of the past and the elephant of today as we have all known since a London meeting of the Royal Society about the year 1876 when it was declared that,

"A very tall pig with a very long nose
Sends out a proboscis quite down to his toes
And thence by the name of elephant goes
Which nobody can deny."

The papers say that many of the workers come from the West Indies. Kinship there has not been free from man's influence. Perhaps an early forbear was in "the fifty-foot boat" that astonished Columbus off the Honduras coast. It required stamina to endure the civilization of the white race for four hundred years whether the sufferers were of American or African descent. And today the man who passes the physician's test and works under an air pressure of 40 lb. in a temperature of 130 deg. F. must possess some qualities of value to the human race and might well be envied by groups of men who spend much time looking for a soft place and never get below the surface of things.

Courage that results in convenience to the public passes unnoticed while admiration for an inferior sort exhibited in the prize-ring is limitless. In caisson work as in many other kinds of employment there is opportunity for different degrees of intelligence and for quick action. Was not the workman who was driven through the roof of a tunnel and 30 ft. of water by an air bubble rushing to stop a leak?

If *Engineering News-Record* were to suggest that "sand-braves," harking back if you please to tribal times, would be a just replacement there is little doubt but that the press would quickly follow its lead.

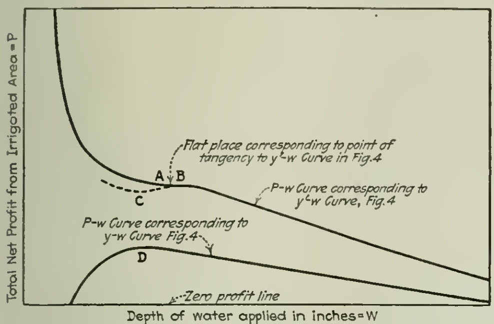
H. F. Dunham,
Civil Engineer.

New York City,
Nov. 1, 1923.

More on Duty of Water Tests

Sir—The very interesting paper on "The Economical Use of Irrigation Water Based on Tests," which appeared in *Engineering News-Record*, Oct. 4, 1923, contains a slight error under the discussion of the authors' Case 2. The error does not fundamentally affect the purpose of the paper but it is believed that it should be pointed out on account of its mathematical significance.

Near the bottom of the first column, page 550, in discussing the situation which arises when $\frac{b}{a}$ is less than the value of the y-w curve for zero water application, the following statement is made, "Should there be a point of inflection on the curve, which is very improbable, a tangent



P-w CURVES COMPUTED FROM Y'-W AND Y-W CURVES FIG. 4

may be drawn through P_2 to the curve as shown on the y'-w curve in Fig. 4, thus showing that a solution would then be possible."

The last clause of this statement is incorrect, as should be readily apparent from the fact that the "tangent" referred to crosses the y'-w curve. A horizontal tangent to a curve does not necessarily indicate a maximum point on the curve. It may designate either a minimum or a maximum, or neither.

The situation in the present case may be illustrated by constructing a profit-water (P-w) curve, as in the accompanying diagram. The point of tangency to the y'-w curve in Fig. 4 corresponds to the flat place shown in the P-w curve at A.

It happens that the point chosen for P_2 in Fig. 4 is such that a tangent can be drawn through the point of inflection on the y'-w curve. If a slightly higher location had been chosen for P_2, then a tangent might have been drawn to either the convexed upward part or the convexed downward part of the y'-w curve, in which case the P-w curve would have been of the general form shown dotted in the diagram, the two tangents designating the *temporary* maximum and minimum points B and C respectively.

In the paragraph immediately preceding the sentence quoted above the authors state that when $\frac{b}{a}$ is less than y "it means that a profit may be obtained from dry-farming, which is contrary to the conditions considered in this case." This statement closes the matter and the discussion should have been carried no further.

It is believed that it would be much safer in all cases to find the peak of the profit-water curve by actually constructing that curve rather than by the indirect y-w curve method illustrated. This applies especially to complicated areas where many kinds of crops are to be grown.

It is mathematically demonstrated in the paper that the point of tangency shown on the y-w curve in Fig. 4 corresponds to a maximum point on the P-w curve, but this same fact is illustrated more clearly by the summit in the profit curve at C, in the accompanying diagram. The P-w curve also presents a picture of the actual profits, which the y-w curve-tangent method does not do. A maximum profit point located by the latter method for Case 2 or 3 without a proper understanding of the system may prove upon investigation to be a "minimum loss" point.

Denver, Colo., Oct. 11, 1923.

JULIAN HINDS,
Engineer, Bureau of Reclamation.

Composition Core-Walls Suggested by Apishapa Dam Failure

Sir—The failure of the Apishapa Dam in Colorado, described in *Engineering News-Record*, Sept. 13, 1923, p. 418, illustrates anew the hazards involved in the construction of earth-fill dams which have no special provision for preventing excessive percolation or flow of water through the dam. Sprinkling and rolling of the fill material may not always be sufficient to provide a reliable structure, and the factor of safety of such a dam may be lamentably low.

The logical way of obtaining a satisfactory structure is the application of what one engineer has called "the great hydraulic principle": Construct one impervious surface, and build the rest of the structure to support that surface. Accordingly, clay puddles, masonry and concrete core-walls, etc., have been successfully used for many earth dams. In a discussion of a paper on the design of earth dams (Proc. Am. Soc. C. E., Sept., 1923, p. 1616) the writer described a somewhat novel type of impervious diaphragm, or composition core-wall, which is in full accordance with the "hydraulic principle" and at the same time costs but little. This composition core-wall is made of two slabs of reinforced gunite with a layer of asphalt between, and it extends at a slope of about 1½ to 1 from the impervious foundation material to the crest of the dam. While it is desirable to place selected fine material against the diaphragm on the upstream side, the main portion of the fill may consist of ungraded material, and much less care than usual need be given in placing and rolling this material, inasmuch as the composition diaphragm is so flexible that it may be expected to adjust itself elastically to almost any settlement that may occur in an earth dam. Such composition core-walls should be built on an incline inasmuch as the material overlying the diaphragm will then always keep the asphaltum under compression. Furthermore, no forms are needed and the diaphragm may be conveniently built up without interfering with the work on the main fill. The upstream face of the dam should be protected against wave action by gravel, riprap, or a slab of reinforced gunite, preferably provided with weep-holes.

Inasmuch as the composition core-wall is buried in the body of the dam it is well protected against damage from temperature or other external influences, and it may be expected to last indefinitely. As regards impermeability of this type of core-wall, it is well known that gunite is remarkably watertight, and the layer of asphalt between the gunite slabs will give additional assurance against leakage. It is of importance, however, to secure a safe contact between more or less impervious foundation material and the core-wall both along the base of the dam and on the side abutments.

The water rising in the reservoir will first come in contact with the selected fine material overlying the diaphragm so that saturated clayey material, and not the water directly, will press against the diaphragm. This is obviously a great advantage as compared with a concrete slab on the upstream face of the dam, sometimes used.

For comparatively low embankments the composition core-wall may be made of two 1-in. slabs of gunite and one layer of asphalt. For higher structures two or more 2-in. slabs with a corresponding number of asphalt layers may be used. It is estimated that in average cases the cost of such composition core-walls will amount to about 40 to 50c. per square foot. The saving in placing the fill material, the reduced seepage losses through the dam, the protection against burrowing animals, and the greatly increased factor of safety of the dam should more than compensate for the cost of such a composition core-wall, and failures like those of the Apishapa Dam would be very unlikely to occur.

Los Angeles, Calif., Oct. 20.

FRED A. NOETZLI,
Structural and Hydraulic Engineer.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

A Dinner in Honor of Charles M. Schwab will be given Nov. 20 by the Engineers' Club of Philadelphia to which Mr. Schwab was elected an honorary member last June.

Contract for a Portion of the Baldwin water filtration plant, at Cleveland, Ohio, including filter and administration buildings and seven gate-house structures, has been awarded to the Strange-Walsh Construction Co., of Cleveland, at $2,885,500.

According to Recent Press Dispatches, the Pennsylvania R.R. plans to electrify a portion of its system over the Allegheny Mountains. The power for this electrification is to be developed at steam generating plants located at the coal mines. It is probable that the portion of the system referred to is the four-track main line between Johnstown and Altoona.

The Third Annual Ohio Conference on water purification with the Ohio Department of Health will be held at Columbus, Ohio, Nov. 21 to 24. Besides numerous papers and topical discussions visits will be made by automobile to see the water purification and softening plants at Newark, now nearing completion, and at Delaware, in service for a year.

Missouri Road Construction Progress is announced by the state highway department as follows: 2,032 miles of the 7,640-mile state highway system completed to Oct. 13 at an estimated cost of $25,284,000, of which 1,018 miles are graded earth, cost $7,096,000: 717 miles gravel, $6,384,000; 48.06 macadam and asphalt, $978,000; and 249 miles concrete and brick, $9,034,000. Bridge work and culverts have cost $1,792,000.

The Survey of the Power Resources of the valley of the Tennessee River, which is being conducted by the Corps of Engineers, will not have reached a point where reports on the Finch and Power Rivers will be ready for at least a year. This means that the Federal Power Commission will not be able to pass upon the application of the Knoxville Power & Light Co., the Tennessee Electric Power Co., and the Tennessee Hydro-electric Co., before that time.

The Secretary of War Has Requested an additional appropriation of $2,000,000 to cover the installation of four more units of electrical equipment at Muscle Shoals. The plan had been to install at first four 30,000-kw. generators. The structures are being built with the idea of accommodating eighteen units ultimately. The decision to install eight units at the start is thought to indicate confidence on the part of Secretary Weeks that a market will be found for a portion of the secondary as well as the primary power.

Railroad Construction Program to Be Continued in 1924

The enormous construction program of the railroads of this country which was started in 1923 will be continued in 1924, according to an announcement of the American Railway Association. The total expenditures for this year will amount to $1,059,440,000 and the unexpended balance appropriated for new work which will be carried over into 1924 amounts to $243,804,000, which, with the $429,273,000 spent in 1922, makes a grand total of $1,732,517,000 spent in capital improvements since the railroads started their reconstruction and extension work in 1922.

Canal Bureau Investigation Ends

Judge Joseph A. Kellogg, appointed by Governor Smith to conduct an investigation into the canal bureau of the state department of public works under the Moreland act, has ended his investigation and is engaged in the preparation of a final report which will be submitted to the Governor soon after Nov. 20.

Royal K. Fuller, deputy superintendent of public works, in charge of the bureau of canals and waterways, is said to be in favor of the abolition of the office of division engineer and the undertaking of all dredging operations by contract. Mr. Fuller favors bringing the entire barge canal system to a mean depth of 12 ft. and undertaking dredging in the spring to bring this about.

Observers of the situation look for a general shakeup in the personnel of the barge canal force at an early date.

How Bureau of Reclamation Is Reorganized

Detail announcement of the changes in the Bureau of Reclamation briefly announced last week (p. 777) sets forth the complete separation of engineering and project operation, the latter including settlement of the projects. The field commissioner of the bureau is to be in charge of operation, including water service, collection, settlement and development problems. Project managers will report to the field commissioner on these matters and to the chief engineer on engineering matters. The engineering department is restricted to the investigation of proposed projects, the designing of irrigation works, and their construction. Both the field commissioner and the chief engineer are to be subordinate to the commissioner of reclamation. Minor departmental changes in the Washington office are also ordered, which, the announcement of the Interior Department says, "make a net saving of $10,000 a year on salaries alone." The reorganization of the field service is to become effective Jan. 1.

Many Bond Issues Voted Upon November 6

Pennsylvania Roads Get $50,000,000—Virginia Rejects $50,000,000 Issue—Other Projects

Bond issues for public improvements and constitutional amendments proposed to facilitate public works construction were not surprisingly extensive as recorded by voters throughout the country at the general elections held Nov. 6. Decided antipathy to raising the debt limit or to increasing bonded indebtedness was apparent in some sections of the country, while in others large issues were authorized or municipalities were empowered to extend debt limits in order to provide for increased sewerage, water-works and general municipal facilities, or provide for street and road work and public buildings and bridges.

The State of Pennsylvania authorized, by an amendment to the state constitution, an increase of $50,000,000 in the amount the state assembly is empowered to appropriate for road-building purposes. The money will be available only after the assembly provides for the issuance of bonds, and they are sold. As the next session of the assembly does not convene until January, 1925, the $50,000,000 will not become available until the construction season of that year. The amendment was approved by a vote of about four to one.

The only other large state highway issue voted upon, one of $50,000,000 proposed for the completion of Virginia's primary highway system, was overwhelmingly repudiated by the voters of that state.

Philadelphia Loan Approved

Voters of Philadelphia approved the municipal loan of $67,250,000, to be provided in 50-year bonds, the money to become available after the city council has passed enabling acts for each specific appropriation. The largest items in this loan are: Delaware River bridge, $5,623,000; sewage-disposal plants, $9,000,000; water supply, $6,000,000; sewers, $3,300,000; high-speed subway, $15,000,000; surface car subway, $10,000,000; damages for street openings, $5,077,000; and port development and art museum, $2,000,000 each. Although most of this money will not be available until March, 1924, construction of the Delaware River bridge can be carried forward on the basis of funds authorized as soon as enabling acts can be provided by the city council.

Philadelphia also authorized a municipal loan of $3,750,000 of 15-year bonds for road improvement in the city, police signal equipment, improvement of the county institution for the feeble-minded and the construction of a surface car line. Road improvement will take about $2,400,000 of the total, and the money will be available about March 1, 1924.

Voters of Chicago authorized the city to levy an additional 25c. per $100 of assessed property value for school construction and the acquisition of school sites; (2) to issue bonds in the sum of $2,650,000 for constructing the proposed La Salle St. bridge; and (3) to issue $2,000,000 in bonds for establishing, enlarging and improving parks and boulevards under control of the West Chicago Park Commissioners. The tax for school purposes, it is believed, will raise in the neighborhood of $4,250,000 yearly.

Baltimore was authorized to issue $10,000,000 in stock of the municipal corporation for water-works improvements. Work will consist largely in extending mains into new territory, and in the purchase of private plants within the city limits. It is planned to use $2,000,000 of the money each of the next five years, and sale of the first issue is expected to take place within 90 days. Baltimore was also authorized to provide $1,000,000 for new police department buildings.

CINCINNATI REPUDIATES ISSUES

Cincinnati was one city wherein bond issues for public improvement were overwhelmingly defeated. The five issues proposed, but against which at least five to three votes were returned, were: widening and extending Fifth St., $1,850,000; city's share of bonds for Eighth St. viaduct, $850,000; sewer extensions, $650,000; park system, $1,750,000; and Canal Boulevard, $3,300,000. Hamilton County, Ohio, also defeated $2,500,000 proposed public library bonds.

It is also interesting to note that the voters of Cincinnati rejected a proposed city ordinance to limit the speed of motor-driven vehicles by the installation of automatic governors. It was proposed to install and seal speed-regulating devices to hold vehicles to a 25-mile maximum.

A bond issue of $5,000,000 for a sewage disposal plant and necessary relief, storm water and interceptor sewers was passed by the city of Grand Rapids, Mich. Sewer construction to the amount of about $800,000 will be undertaken in 1924. The disposal plant will probably not be started until 1925.

Two amendments to the city charter of Detroit provide money for public improvements. The first raises the city's bonding limit from 6 to 9 per cent, and provides for the issuance of bonds as follows: water-works, 2 per cent of all real and personal property in the city; electric light and power, 1 per cent; other public utilities, 2 per cent; all other lawful purposes, 4 per cent; the total not to exceed 9 per cent. This bonding limit amendment, which required a 60 per cent favorable vote, received 62 per cent.

What is considered more important was the Detroit charter amendment which paves the way for rapid transit by allowing the city to bond up to 4 per cent of its assessed valuation for such purposes. This proposition also required a 60 per cent favorable vote, but received one of 67 per cent. The city is given authority to proceed with plans for the construction of a rapid-transit system. On the basis of the present valuation of the city's property $80,000,000 may be so issued. The amendment also provided for a subway board of three members each to receive a salary of not less than $10,000 yearly.

Another important construction project which was considered Nov. 6 was a proposition set before the voters of Toledo, Ohio, whereby $3,000,000 in bonds was to be used for grade elimination work. Though the measure received a large majority of favorable votes it was lost through failure to receive a two-thirds vote. However, it is probable that inasmuch as the electorate returned a majority in favor of grade elimination the work will be done through other means.

Several bond issues for road and bridge construction and others for building schools, were reported. In Oregon bridges are provided as follows: Sellwood bridge (near Portland), $350,000; Albany bridge, $294,976; and Harrisburg bridge, $203,592. All will span the Willamette River, the latter two at the the towns named.

Voters of Somerset County, Pa., approved a $2,000,000 road bond issue.

Other bond issues voted favorably on were: Charlottesville, West Va., $500,000 for water-works; McKeesport, Pa., $233,000 and Jamestown, N. Y., $280,000 for water-works; Massillon, Ohio, $300,000 for sewers; Warren, Ohio, $926,000 for schools; Youngstown, Ohio, $1,000,000 for schools; and Buffalo, $1,000,000 for a natural science museum.

Will Buy Distribution System of Montclair Water Co.

On Nov. 6 the town of Montclair, N. J., voted to buy the distribution system and other local property of the Montclair Water Co., or if that cannot be done then to build a distribution system. The vote to purchase was 3,860 to 1,852, and the vote to build a new distribution system, if need be, stood 1,467 to 4,483. The corresponding majorities were 1,852 and 3,016.

Prior to the election it was announced that the Montclair Water Co. had offered to sell all its property within Montclair, used for local supply purposes, for $1,700,000, retaining its share in the Little Falls pumping and filter plant and the other property owned jointly by the East Jersey Water Co. and associated companies. It was also announced that Montclair had applied to the North Jersey District Water Supply Commission for a right to 3 m.g.d. in the Wanaque supply being developed by the commission under a contract with Newark, and that the Newark authorities had agreed to exchange this water right for the same quantity of Pequannock water, and that pending the completion of the Wanaque works, some three years hence, Newark would sell Pequannock water to Montclair at $90 per m.g. The expectation is that the purchase of the distribution system will be consummated at an early day and that immediately thereafter a connection will be made with the Newark-Pequannock conduit.

By means of these contracts and changes Montclair will effect a change from the filtered Passaic River to which there has been increasingly strong local objection during the past few years. A feature of the campaign against this supply was the B. Welchii incident, treated at length in these columns.

Scores Injured as Two Temporary Grandstands Collapse

Fifty-eight spectators at a football game between West Virginia and Washington and Lee were injured, though none fatally, in the collapse of a temporary grandstand Nov. 10 in Charleston, W. Va. A score or more were hurt when a like accident occurred at Lewisburg, Pa., during the Lehigh-Bucknell game.

The accident at Charleston occurred when the spectators arose during an exciting moment when the home team was scoring at the far end of the field. The spectators had been seated about an hour. Most of the injuries received consisted in broken legs and sprains. These temporary stands were 200 ft. long and 12 ft. high at the rear and contained seating arrangement for approximately a thousand. Inspection of the stands by a local engineer indicated cross-bracing on the rear of the stands was lacking. No official investigation has been started.

No details on the description of the Lewisburg stand are available at present.

U. S. Senate Committee Views Chicago Projects

Sewage disposal and waterway projects of Chicago and Illinois are being studied by a committee of the U. S. Senate, largely in regard to the city's desire to increase its diversion of water from Lake Michigan to 10,000 cu.ft. per second for the purpose of diluting the sewage flow in the drainage canal. A secondary matter is the establishment of a 9-ft. navigable channel from Lake Michigan to the Mississippi. The drainage canal is 24 ft. deep and the state has started a 9-ft. connection to the Illinois River at La Salle, but the improvement of that river to the Mississippi must be done by the federal government.

At one of the meetings it was stated that the Sanitary District of Chicago has spent $125,000,000 on sewage disposal works and plans an expenditure of $97,000,000 within the next twenty-two years to provide for the increasing population. The city's entire program of sewage treatment and disposal is based on the claim that the city has a right to divert a flow of 10,000 cu.ft. per second from Lake Michigan.

French Firm Gets Contract for Port of Athens Work

The contract for the Piraeus Harbor works has been awarded to a French syndicate. The contract involves the expenditure of 200,000,000 drachmas, based on a rate of exchange of 400 to the pound sterling, any difference above or below this to be adjusted in bi-monthly settlements.

The conditions accepted are: 17 per cent compensation of the value of machinery and installations erected for the purpose of the works; 14 per cent for overhead expenses; and 10 per cent profit. Work is to begin this month and is to extend over a period of not more than 8 years. The tender accepted follows generally the specifications drawn by the port committee. There was only one other offer received, from a French-Dutch-Greek group. No American or British offer was received.

Omaha Water Emergency Is Investigated

Report Made on Inquiry Into Cause of Breakdown of Sedimentation Process Last August

Special Correspondence

An unfortunate combination of circumstances apparently was to blame for the emergency by which the water mains of Omaha were filled with mud during the week of Aug. 21. An open investigation was held, starting Oct. 23, by the directors of the Metropolitan Utilities District to ascertain what happened and why. (See *Engineering News-Record*, Aug. 30, p. 364.) Reports were made by C. D. Robison, engineer in charge of operations; R. B. Howell, general manager; F. P. Larmon, chief engineer in charge of construction; George T. Prince, consulting engineer and formerly chief engineer; and A. B. Hunt, superintendent of the Florence station and for forty-three years an employee of the water-works.

Mr. Robison's conclusions as to the cause of the breakdown of the sedimentation process through the series of seven reservoirs on which Omaha had depended to get a reasonably clear water, are as follows: (1) Failure to complete the installation of pumps authorized in June, 1922, before the maximum demand in 1923; (2) failure of the operating department to recognize the emergency in time and to use to the utmost the pumping capacity available to wash and fill the basins; (3) a river water of unusually high turbidity (20,000 p.p.m. was reported) at peak demand; (4) an open mud valve which increased the low-service pumpage by more than 2 m.g.d. and made less water available for basin washing and refilling; (5) a broken valve in a bypass around Basin 2 made it impossible to clean this basin until the demand was reduced or the influent from Basin 3 to the new filter plant was completed.

Principal Reason Given

Mr. Prince stated that the prime reason for the breakdown of the basin service was the lack of regularity in washing the settling basins. In his opinion the operating department did not fully realize the seriousness of the situation and allowed their fear of the possible breakdown of the machinery to deter them from maintaining the required pumpage into the basins and the proper washing of them. The river water carried about five times as much turbidity as in corresponding months of previous years. Connecting the filter plant with the existing system interfered with the normal operation only seven days and Mr. Larmon stated that there was ample time (nearly two weeks) after the last interference and before the emergency, for the reservoirs to be cleaned.

Mr. Larmon concluded that the fundamental cause of the breakdown of the sedimentation system was the lack of sufficient pumping equipment to permit washing the basins often enough to cope with the large amount of silt carried by the river.

Mr. Hunt also stated that the principal cause of the breakdown was the delay in ordering new pumps, breakdowns in the old ones for the past two or three years seriously interfering with basin washing, but he cited eight local contributing causes culminating when the river started to cut into a mud bank just above the intake.

The report of the investigating committee found that there was excess pumping capacity not used; that against the orders of the chief engineer a basin with unstable walls was filled and the wall collapsed losing 10 to 15 m.g.d. of water and putting the basin out of service 18 days; that the chemists' requests for basin cleaning were ignored; and, that a mud valve was opened wasting 12 m.g.d. (no one knows by whom). The committee was of the opinion that better operating records should be kept so that those in charge would be advised at all times as to turbidity, necessity of washing and of construction under way but that operation should always be the first consideration.

San Francisco to Have Vehicular Tube Under Market Street

Contract has been awarded by the California State Harbor Commission for a vehicular subway under the Market Street car loops at the Ferry. The tube has been planned to provide a means by which traffic moving along the waterfront can cross the heavy Market Street traffic without delay. The cost of the tube is to be apportioned as follows: Harbor Commission, five-eighths; City of San Francisco, one-quarter; Municipal Ry., one-eighth. Until the franchise of the Market Street Ry. expires, that company will pay 6 per cent interest on one-eighth of the cost.

The tunnel proper will be 330 ft. long, with a 330-ft. approach on a 4 per cent grade at either end. The clear width will be 23 ft. and the height 13 ft. Construction is to begin at once and is to be completed in about ten months. The contract went to the Tibbitts Pacific Co. for $237,700, and the total cost of the tube including cement, sump pumps, etc., is estimated at about $330,000.

N. Y. Building Congress Prepares Interesting Program

A program of luncheon meetings for members and friends of the New York Building Congress has been announced. The first will be held Nov. 21, the subject to be winter construction, and special reference will be paid to advantages of winter construction to public departments, real estate interests, property owners, architects, builders, workmen, and material dealers. The January meeting will be addressed by Charles L. Eidlitz, commissioner of the Electrical Contractors Association, on "What the Law Writes into Your Building Contract." Other meetings have been arranged as follows:

February, simplified practice, with special reference to how simplification can be applied to the advantage of the building industry; March, the building congress movement, and what it has done for all elements of the building industry; April, an illustrated lecture on the Japanese disaster; May, an international review of the contribution of organized labor to the building industry; and June, three centuries of American architecture, also an illustrated lecture.

Walsh Resigns as Head of N. Y. Canals Bureau

Greene Appoints Royal K. Fuller, Former Highway Commission Secretary, to Succeed Him

Edward S. Walsh, Commissioner of Canals and Waterways of the New York State Department of Public Works, twice superintendent of public works under Democratic administration, resigned Nov. 9, the resignation becoming effective Nov. 12. When the law combining the state departments of highways and public works and public buildings became effective, Mr. Walsh was temporary head of the combined departments which bore the title of State Superintendent of Public Works. Commissioner Greene was named by Governor Smith as State Superintendent of Public Works which relegated Mr. Walsh as head of the Bureau of Canals and Waterways.

Upon assuming his new office Colonel Greene instituted an investigation of the public works department, beginning with the canal bureau of which Mr. Walsh was the head.

In a statement to the press concerning his resignation, Mr. Walsh said: "In presenting my resignation as Commissioner of Canals and Waterways to the Superintendent of Public Works, I do so with the full knowledge and belief that I am acting in the best interests of the proposed plan of consolidation of the public works department having to do only with the canal system of this state.

"Not in sympathy with the consolidation act that subordinates the old Department of Public Works to a mere bureau known as the Bureau of Canals, feeling that when that section relating to the maintenance and operation of the canal system of the state was written into the constitution it was not contemplated nor intended that at any time in the future the canals would occupy a secondary place in the consolidation or concentration of state activities, I am confident that the step I am now taking is the proper one."

Colonel Greene has announced the appointment of Royal K. Fuller of Albany, as Commissioner of Canals and Waterways, to succeed Mr. Walsh, resigned.

Mr. Fuller, who was formerly a New York newspaper man, entered the state service in 1913 as secretary of the State Highway Commission. He served as secretary of the Highway Commission in 1913 and 1914 and was reappointed by Colonel Greene in 1919.

Since 1921 Mr. Fuller has been with the firm of Fuller & O'Brien in Albany. This firm has been engaged in the insurance and surety bond business, specializing on highway contract work.

Parkway Tunnel in Philadelphia Under Contract

The Commissioners of Fairmount Park in Philadelphia, on Oct. 31, awarded a contract to Andrew O'Neill, Philadelphia, for construction of three sections of the surface car tunnel under the Parkway. The contract price is $166,000. The work includes construction of the portion of the tunnel directly beneath the Parkway roadway, and will permit of completion of the roadway at this point.

Rail Bridge and Building Men Meet

Prominent subjects at the annual convention of the American Railway Bridge and Building Association, held at Seattle, Wash., in October, included the advantages and disadvantages of concrete tanks, a comparison of culvert materials, renewals of ballasted-deck timber trestles and the methods of installing culverts under traffic.

In a paper on "Concrete Tanks for Railway Water Service," C. R. Knowles, engineer of water service, Illinois Central R.R., stated that watertight concrete can be made but that there is need for uniform or standard designs of tanks to reduce the cost, as at present the first cost does not compare favorably with other materials. Both concrete pipe and cast-iron pipe for culverts were approved in a committee report, the selection being governed largely by local conditions. There is said to be a tendency towards the use of concrete pipe on account of lower cost of installation. That ballasted-deck timber trestles under repair are usually found in worse condition than indicated by the inspector's report, was stated in a committee report which also described different methods of carrying out renewals of ballasted decks. Another report presented various methods of installing and renewing culverts and pipe lines in railway fills under traffic by means of tunneling and trenching and by jacketing or jetting pipes horizontally through the solid fill.

A uniform painting program covering the entire year and enabling a permanent force to be maintained is practicable and economical, according to a committee report, and the arrangement of such a program was presented in a paper by T. R. Wyles, vice president of the Detroit Graphite Co. Detailed lists of tool equipment for bridge and building gangs and water service gangs were presented by another committee, together with notes of special equipment for the latter gangs. Other reports dealt with water facilities at stock yards and the heating of small passenger stations. The organization and management of railway bridge and building forces was the subject of a paper by George W. Rear, bridge engineer, Southern Pacific Ry.

Addresses on general railway matters included "Railways as Investments," by G. T. Reid, vice president of the Northern Pacific Ry., and "Relations of Railway Employees to the Public" by M. Nicholson, general manager of the Chicago, Milwaukee & St. Paul Ry. The new president is J. S. Robinson, division engineer, Chicago & Northwestern Ry.; C. A. Lichty, Chicago & Northwestern Ry., Chicago, was reelected secretary.

St. Louis' Legal Right to Build Auditorium Upheld

A taxpayer's injunction suit to prevent the City of St. Louis from issuing $5,000,000 of bonds for a municipal auditorium has been dismissed by a circuit court judge on demurrer by the city attorney. The judge holds that general powers of the city under its charter are broad enough to enable it to issue the bonds. He also states that courts of appeal have been almost unanimous in upholding the rights of cities to build municipal auditoriums.

Another Chicago Subway Plan

Of the many projects for subways in Chicago the latest is a simple one to relieve the extreme congestion of street traffic in the business district by removing from the surface the cars that come in from the west, southwest and northwest sections of the city. Since some of these car lines already use the tunnels under the Chicago River at Van Buren St., Washington St. and La Salle St., it is proposed to connect the first two tunnels by a U-shaped subway having its loop under Grant Park, at the lake front, and having a branch to the La Salle St. tunnel. This plan, suggested by R. F. Kelker, consulting engineer, could be extended later.

Pontoon Bridge Not Suitable

Washington Correspondence

Exceptions have been taken by the Secretary of War and the Chief of Engineers to published statements indicating that they allowed red tape to interfere with the relief of the situation caused by the burning of the North-End Bridge at Springfield, Mass. (See *Engineering News-Record*, Oct. 4, 1923, p. 540.) Their side of the matter is that Springfield interests did not want pontoon bridges after they were acquainted with the fact that the transportation cost on the nearest pontoons available would amount to $53,000. They also had lost sight of the fact that a pontoon bridge is a one-way structure, and that two bridges would have been necessary. On being acquainted with these facts, the local interests decided that relief in that term was not desirable.

Agricultural Engineers Hold Chicago Meeting

Sectional meetings were the main feature of the annual convention of the American Society of Agricultural Engineers, held at Chicago on Nov. 8 to 10, the three general sessions being short and for the presentation of addresses. The farm structures section had papers on the structural design, ventilating and heating of farm buildings; also "Fire Resistive Construction for Timber Buildings," by T. F. Laist, National Lumber Manufacturers Association, and "Sewage Disposal Projects," by H. B. Walker, professor of agricultural engineering at Kansas State Agricultural College.

Tile drainage, soil erosion and land clearing were the principal subjects discussed by the reclamation section, the papers including "Drainage Investigations," by L. L. Hidinger of the Morgan Engineering Co., and "American Irrigation Since 1900," by Samuel Fortier, U. S. Department of Agriculture. Features of education in agricultural engineering constituted the program of the college section. Other groups of papers were considered by the farm power and machinery section and the rural electrification section.

Officers for 1924 are as follows: President, S. H. McCrory chief of division of agricultural engineering, U. S. Department of Agriculture; vice-presidents, L. J. Fletcher and E. R. Jones, professors of agricultural engineering at the University of California and University of Wisconsin, respectively; secretary and treasurer, Raymond Olney, Mount Clemens, Mich.

Random Lines

Leaky Valves?

For Sale: Silica Sand Plant and Quarry. Immediate sale necessitated by ill health of Prime Mover—From *Engineering News-Record* advertising pages.

* * *

A Bolshevik Distinction

Lenin's argument was that Revolutionists must no longer be mere enthusiasts, idealists, and dilettantes; they must become professionals, "revolutionary engineers." . . . He wrote: "I trust that our champions will accept this technical word 'engineers' for when I speak of inadequate preparation I reproach myself. . . . The Revolutionists must not be degraded into the amateur." — From an article in *Die Neue Rundschau*, translated in *The Living Age*, entitled "Lenin, Revolutionary Engineer."

This should be a refreshing distinction to those controversalists who are not yet persuaded that engineering is a profession.

* * *

No Life of Ease

Sir—In this column of Oct. 18, 1923, I find "motion picture engineers" listed with the "moving engineers" and other pseudo-professional men. This is so manifestly unjust that I cannot let it pass. During the past year we have built short railroads where there was no excuse for a road, on the side of a wild gorge, taken a locomotive in (in pieces), set it up, and wrecked it in the same gorge. How would the average practising engineer like to get and how would he meet the following request: "Wanted—a practical set showing the side of an ocean liner, from water to top of stack; foreground to be water, with wave action, and liner to sink in same, tilting as it sinks to match stock film of sinking liner." Another request was for plans for a method of producing in "practical" earth, a suddenly appearing crack.

The art director wants a "visible" chart giving him the horizontal and vertical angles of all the lenses in use in the studio, so he will know the space required for his sets in advance, and his camera distances. The property man brings in a photograph of an existing dam and power house, and wants drawings of same, so he can build a scale model of it. He also wants to know the best method of arranging the construction of the model, so it can be blown up, and release an apparently large body of water. Add to all this the rejuvenation of old bridges, so as to be "practical," and their immediate re-aging so they will fall, and you will see that some engineering knowledge and ingenuity is required.

Those of your readers who imagine that we spend our time with peroxide blondes, and he-dolls with shellacked hair, are sadly mistaken, as badly mistaken as the misguided flappers who think motion pictures mean a life of ease. The hours are long, the work is often at high pressure to save the time of a large and expensive cast, and the engineers see little of actual production, except when their presence is required for engineering effects.

"One of Them"

Highway Research Board Reviews Progress

Technical Committees Report—Activities Hampered by Lack of Funds

Engineering News-Record Staff Report

Co-ordination of highway research has made substantial progress in the last twelve months, as indicated by the reports of committees at the meeting of the Advisory Board on Highway Research of the National Research Council held in Washington, D. C., Nov. 8 and 9. About 60 research engineers and engineers interested in highway engineering and highway transport attended the three sessions and inspected the experimental work of the U. S. Bureau of Public Roads at Arlington, Va. Six committees on economic theory, structural design, road materials, finance, traffic and maintenance made formal reports and there were separate papers and sub-committee reports on rubber tires, mechanics of slabs, objectives of research, research by land grant colleges, research in North Carolina and motor vehicle performance.

The resignation of Prof. W. K. Hatt as director of the Board owing to his return to Purdue University was noted and the announcement made that E. R. Olbrich, construction engineer of the North Carolina Highway Commission, had been appointed technical assistant to the director. The appointment of a new director lies with the executive committee and will be made soon. Three bulletins have been published during the year. All work however has been hampered by lack of funds.

The by-laws of the Advisory Board provide for a committee on ways and means which has been appointed but has been inactive.

Funds Lacking

Shortly after the formation of the Advisory Board, Vice-Chairman Flinn planned to circularize a number of prospective contributors to the financial budget but the policy of the Board in respect to this matter was not settled. It appeared wise afterward to look to official sources such as state highway commissions and federal organizations for main support. While the Connecticut Highway Commission aided the Board with an appropriation for a period of two years, the desire of other commissions to take similar action was checked by legal barriers.

At the suggestion of the director contributions of money and equipment have been made by industries to research projects that were languishing and to which the Advisory Board was asked to give assistance. In such cases the funds are not handled by the Advisory Board. The only responsibility the director takes is in a matter of judgment as to the probable successful management of the research.

A field of work demanding direct expenditure of the funds of the Board is in holding conferences of research workers for the purpose of agreement on objectives of research and upon boundaries of fields of action. This fruitful service together with the expenses attending meetings of the research committees, can be extended if funds were available.

The present income is only sufficient to pay the salary and traveling expenses of the director, and publication.

Following the reports from committes and special papers a technical summary of which will appear in the next issue the delegates re-elected A. N. Johnson as chairman and A. D. Flinn as vice-chairman of the Board for the coming year.

Wickenden to Administer Fund for Educational Study

William E. Wickenden, assistant vice-president of the American Telephone & Telegraph Co., has been chosen director of the committee which is charged with administering the $108,000 fund provided by the Carnegie Corp. for a "discriminating study of the present status of engineering education." Award of the money to carry out research conceived by the Society for the Promotion of Engineering Education was noted in these columns last week.

Mr. Wickenden is a native of Toledo, Ohio, and a scientific graduate of Denison University, which institution he left in 1904. After a year's teaching in Rochester he was a graduate student in physics and electrical engineering from 1905 to 1907 at the University of Wisconsin, later becoming an instructor in the same institution. In 1909 he was appointed assistant professor of electrical engineering at the Massachusetts Institute of Technology, being made associate professor in 1914. He remained at that institution until 1918.

In 1917 he made a study of educational and personnel problems for the engineering department of the Western Electric Co., research which led to the creation of a personnel department, of which he became manager in 1918. During that year he also served as regional supervisor of personnel methods for the Students' Army Training Corps. In 1921 he was transferred to the headquarters staff of the American Telephone & Telegraph Co. as assistant vice-president in charge of the recruiting and development of supervisory and technical personnel for the group of companies which comprise the Bell system. This work included the promotion of relations with universities and colleges throughout the country and supervision of the recruiting and introduction to the telephone business of approximately 2,500 graduates of engineering colleges.

Mr. Wickenden has written considerably for the technical press, his writings relating principally to illuminating and power plant engineering and to personnel problems in industry. He is chairman of the education committee of the American Institute of Electrical Engineers and chairman of the committee on relations with engineering colleges of the American Management Association. He was recently chairman of the committee on business training of the Society for the Promotion of Engineering Education.

Mr. Wickenden's home is in Upper Montclair, N. J.

Railroads Make New Records; Plan Increased Efficiency

Peak Load Past—More Freight Handled Than in Any Previous Period—Program for Next Year

As a result of the ambitious plans made by the railroad companies last Spring to meet the demand for improvements in the transportation services, the greatest peak load season in their history has been passed successfully. The effort has resulted in setting up the following efficient records:

(1) They have put into service 14,636 new freight cars and 2,963 locomotives, a larger number than in any similar period in the last decade; (2) a larger number of cars and locomotives have been repaired and put in serviceable condition than in any equal period. The percentage of locomotives in disrepair on Oct. 1 was the lowest in the history of the railroads; (3) more freight business was handled between Jan. 1 and Oct. 20 than in any corresponding period in history. The number of cars loaded with revenue freight in that period was 40,545,920, representing an increase of 10 per cent over the total for 1920, the previous record; (4) the average mileage a day attained by all the freight cars throughout the country in the first nine months was 27.6, and in September reached 29.2. This compares with 22.5 miles for the first nine months of 1922; (5) a record-breaking business was handled without congestion, and with practically no embargoes or car shortages; (6) the amount of freight service rendered with each car was 511 tons carried one mile daily, which surpasses the mark of a year ago by 31 per cent; (7) from Jan. 1 to Oct. 1 23,268,635 tons of coal were dumped at Lake Erie ports for movement by boat to the Northwest; (8) a greater amount of railroad coal has been placed in stock-pile storage than was ever heretofore stored by the railroads.

Announce a New Program

In order to continue the work of the past year and to make further improvements the American Railway Association has announced the following program for next year:

(1) That there be a continuation of the intensive efforts of the railroads to reduce the percentage of locomotives and cars awaiting repair, and maintain it at the lowest possible minimum consistent with the volume of business offered and the revenues which the railroads are permitted to earn; (2) that there be increased supervision on the part of the railroads and greater co-operation with shippers to bring about better utilization of car capacity; (3) that there be continued the intensive effort to increase the average daily movement of freight per freight car and an endeavor to make new records of achievement in the prompt movement of traffic; (4) continued study and consideration of the possibility of the greater joint use of facilities; (5) that there be a continuation of the complete co-operation of the railroads in carrying out the directions of the car service division of the American Railway Association; (6) that active support be given by the railroads to all phases of the work of the regional shippers' advisory boards that have been organized by the public.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 10-11, 1924.

AMERICAN ROADBUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 14-18, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York, Jan. 16-18, 1924.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Chicago, Ill., Jan. 21-24, 1924.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich. Annual Meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

The California Section of the American Water Works Association held its fourth annual meeting at Fresno, Oct. 25-27, with an attendance of 150.

The Indiana Section of the American Society of Civil Engineers was recently organized, at Indianapolis. Presentation of the charter was made by John H. Dunlap, secretary of the American Society of Civil Engineers, who is making an organization tour of the Middle West and Pacific Coast states in the interest of the society. Mr. Dunlap gave an outline of the work of the national and state organizations. The meeting was attended by twenty members. Lawrence V. Sheridan is temporary chairman. Permanent officers will be elected at a later meeting.

Personal Notes

COL. THEODORE A. LEISEN, consulting engineer in charge of the construction of the 320-m.g.d. filtration plant at Detroit, Mich., has been made general manager of the Metropolitan Utilities District of Omaha, Neb., replacing R. B. Howell, who has resigned to take up his duties as United States Senator from Nebraska. Prior to his service in Detroit, Col. Leisen was chief engineer and superintendent of the water departments of Wilmington, Del., and Louisville, Ky., and consulting engineer of the water company of Frankfort, Ky. In 1919 he was commissioned Major, Q.M.C., and had charge of the construction work at Camp Custer, Mich., later becoming lieutenant-colonel of the Reserve Corps. He is a past-president of the American Water Works Association. In Omaha he will take up the problem of the city's water supply.

E. R. OLBRICH, construction engineer, North Carolina State Highway Commission, has resigned to become assistant director of the Advisory Highway Research Board of the National Research Council with headquarters at Washington, D. C.

WALTER G. KIRKPATRICK, consulting engineer, Birmingham, Ala., has accepted a professorship of engineering in the University of Mississippi, of which he is an alumnus. Mr. Kirkpatrick was formerly city engineer of Birmingham, Ala., and had served in the same capacity in Jackson and Monroe, Ala. He was for a time special engineer for the Alabama Power Co.

MAXWELL V. SAUER has resigned as hydraulic engineer of design of the Hydro-Electric Power Commission of Ontario, Canada, to become hydraulic engineer of Canadian Vickers, Ltd., at Toronto, and consulting engineer to Vickers, Ltd., of England. After graduation from the engineering department of the University of Toronto, Mr. Sauer was with the Ontario Power Co. at Niagara Falls, as assistant to the mechanical engineer, then for a year he was chief designer for the Niagara Falls Power Co., Niagara Falls, N. Y., returning to the Ontario Power Co. as mechanical engineer. From 1913 for five years, as engineer of design for the Greater Winnipeg Water District, he was engaged in the construction of the Shoal Lake aqueduct and appurtenant structures, including a 100-mile railroad.

ALLISON H. BAER, who has been field secretary of the Associated General Contractors for a year, recently resigned to become secretary-treasurer for the Hitchcock-Tinkler Construction Co., which has been awarded the Moffat tunnel construction job at Denver. The new field secretary of the A. G. C. is WILFRED J. COLSON, who has been secretary of the Builders' Exchange of Worcester, Mass.

IVAN E. HOUK has resigned as city engineer of Dayton, Ohio, and has accepted a position as engineer with the U. S. Bureau of Reclamation. Mr. Houk will be stationed perhaps permanently in the Denver office and expects to be engaged on research work and hydraulic problems. He has had extensive experience in hydraulic investigation. In October, 1911 he became associated with the Morgan Engineering Co. of Memphis, Tenn., serving two years on hydraulic measurements and studies and the design of reclamation works and drainage structures in the lower Mississippi Valley. In 1913 he was made assistant engineer on flood prevention surveys and studies, being located at Dayton, Ohio, and was in charge of stream-flow measurements, investigations and hydraulic studies. Prior to his becoming city engineer of Dayton he was assistant engineer on Miami Conservancy District work.

LESLIE H. ALLEN has become associated with Russell B. Williamson, architect, Milwaukee, Wis., as partner and business manager. Mr. Allen has for the past two years been in charge of the Concrete House Division of the Portland Cement Association, and prior to that was for two years with Fred T. Ley & Co., New York, and for eleven years with Aberthaw Construction Co.

RALPH BEEBEE, city harbor engineer of Oakland, Calif., has resigned to accept the position of chief engineer with the Berkeley Waterfront Co. which plans extensive wharf improvements along the South Berkeley bay shore. HARRY HESS, assistant city harbor engineer, has been appointed to fill the vacancy temporarily.

PROF. VLADIMIR KARAPETOFF of the School of Electrical Engineering, Cornell University, has been awarded a prize of four thousand francs by the Montefiore Foundation of the University of Liege, Belgium, for his kinematic computing devices for representing complicated electrical relationships. In his experiments Prof. Karapetoff had the assistance of funds supplied to Cornell University by August Heckscher.

GEORGE J. CALDER, former resident engineer on construction of the filtration plant at Sacramento, Calif., and now construction engineer for the new Carquinez highway bridge across the straits, between Solano and Contra Costa Counties, has opened consulting offices at 1010½ Eighth Street, Sacramento, Calif., with M. W. SAHLBERG, junior partner, in charge. Both are civil engineering graduates of the University of California.

Obituary

B. J. DALTON, who was chairman of the valuation committee of the Missouri-Kansas-Texas R.R. lines from 1916 to 1920, died at the Ka y Hospital, Parsons, Kan., Oct. 28, aged 58 years. Mr. Dalton was a native of Franklin, Ky., and a graduate of the University of Kansas engineering school. For a time he was chief engineer of the Kansas, Oklahoma Central & Southwestern Ry. which was later absorbed by the Santa Fe system for which he became a resident engineer. Later he was chief engineer of the Denver, Enid & Gulf Ry. Previously he had served for two years as city engineer of Lawrence, Kan., and in 1906 he became professor of railway engineering at the University of Kansas. Prior to 1916 he was assistant district engineer of the Bureau of Valuation of the Interstate Commerce Commission.

COL. HENRY S. HAINES, retired railroad civil engineer and for many years connected with and at one time vice-president of the Plant System of railroads in the South, died at Lenox, Mass., Nov. 2, aged 86 years. Colonel Haines was born in Nantucket, Mass., educated in Savannah, Ga., and served in the Civil War as chief of transportation engineers. He advised the government of India on its change of railroad gage and was chief consulting engineer for the City of Paris on the increase of its water supply. He was the author of several standard works on American railroad management. He was a past president of the American Society of Civil Engineers and the American Society of Mechanical Engineers and of the American Railway Guild.

CHARLES M. CUNLIFF, superintendent of construction for the division of parks and recreation, St. Louis, Mo., died in that city Nov. 2, at the age of 32 years. Mr. Cunliff served in the engineering department of the Zoological Board of Control of St. Louis for four years, building the cliff bear pits in Forest Park and the Zoo Lakes. He served at the officers' training camp at Salt Lake City during the War, having enlisted in the 32nd Regiment of Railway Engineers.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Fitting the Electric Motor to the Pump

A Practical Discussion on the Application of Electric Drive to a Fundamental Operation in Industrial Plants

By R. H. Rogers
Power and Mining Engineering Department,
General Electric Co., Schenectady, N. Y.

Pumping is a fundamental operation in all industrial plants which lends itself admirably to electric drive. The selection of pumps, motors and control for the most successful operation is not a simple problem and if not well studied the plant is penalized continuously through the following years. The fact that some of the major industries with well organized engineering departments are operating many pumps with characteristics entirely unfitted for the service would indicate that this branch of engineering needs some explaining, especially for those who have little time for an intensive study of these problems.

The clearest way to show all the elements that affect the overall efficiency of electric pumping units is to analyze the whole span from the electric meter to the work accomplished, not overlooking other items that make an installation successful. The items that directly affect the kilowatt-hours per million gallon-feet are discussed below:

(1) *Ratio of Dynamic to Static Head.*—The vertical tape measurement from level to level or the calculated head, if pumping against boiler pressure, is not the measure of the pump's work. Every foot of pipe, every valve,

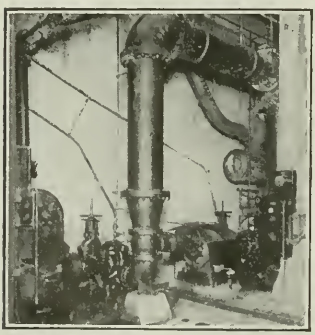


FIG. 1—LIBERAL SIZE OF PIPING REDUCES DYNAMIC HEAD

Sulphite stock centrifugal pumps (2,900 g.p.m., 66-ft. head) direct-connected to motors.

every elbow or other fitting adds to the theoretical to make the actual or dynamic head. For instance, considering only pipe diameter, a 5-in. three-stage centrifugal delivering 400 g.p.m. through 300 ft. of 5-in. pipe will cost $375 per year more to operate than if a 10-in. pipe were used. This differential would pay for the larger pipe in a year. Tables of heads to be added for sizes of pipes, valves and elbows at various velocities are available in pump catalogs and handbooks and they deserve close consideration.

In general, the piping should have much greater area than the pump openings, as high velocity is essential in the pump but detrimental in piping. From 6 to 8 ft. per second should not be exceeded; lesser velocities are desirable, for, once the system is installed,

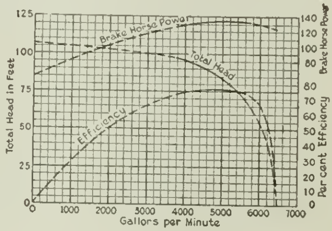


FIG. 2—TYPICAL CURVES FOR 12-IN. CENTRIFUGAL AT CONSTANT SPEED

the loss goes on for years. The suction pipe especially should be deeply immersed, should be as short as is consistent with good installation practice and the bends, if any, should be of long radius. An excess of dynamic head over static head means just that much more work for the motor forever after, and if it is 10 per cent or 50 per cent that excess will show up at the meter.

Fig. 1 shows pump installations with no suction lift as they are placed alongside a sulphite stock tank. The piping is very liberal in size so that the difference between dynamic and static head is slight.

(2) *Pump Characteristics.*—Head, gallons per minute, efficiency, revolutions per minute and horsepower plotted together show the character of a centrifugal pump. If the speed at the point of best efficiency is at or near an induction-motor speed—1730, 1150, 865, 690 or 575 r.p.m.—it will insure its operation at the most efficient point if direct-connected to a squirrel-cage induction motor. If the horsepower required at the most efficient point is near one of the standard squirrel-cage motor ratings—200, 150, 125, 100, 75, 60, 50, 40, 30, or 25 hp.—it will insure a high overall efficiency for the set. Fortunately induction motors have a very flat efficiency curve through the working range, such as 90 per cent at full load; 90.5 per cent at 75 per cent load and 90 per cent at 50 per cent load, so that this feature has little effect. However, the power factors of such motors require that they be operated at near full load to keep the current to a minimum. Power factor affects only the leads and generating system and not the meter, except as the rates may be adjusted to penalize low power factor in a plant. At loads as above, the power factor may be in the order of 89, 87 and 80 per cent.

A desirable characteristic in centrifugal pumps is that of having the load fall off each way from the best operating point. This prevents an overload coming on the motor by an accident or mishandling of valves which would subject it to maximum head (closed off) or minimum head (direct discharge).

Fig. 2 shows typical centrifugal pump curves for constant speed. The efficiency is high and fairly flat from 70 to 97 ft. head and from 4000 to 5600 g.p.m., hence the pump could be efficiently applied between these limits. The horsepower falls off both ways so that the motor cannot be overloaded.

(3) *Operating Off Rating.*—Pumps are rated naturally at their best operating point, and any deviation in speed, head or delivery will result in a higher cost per unit of duty. While some future conditions may have to be given consideration, operating at lower than rated head should be avoided, especially where a constant speed motor is used. Fig. 3 shows the variations in kilowatt-hours per million gallon-feet pumped by a 10-in. centrifugal direct-connected to the constant-speed motor which gives the highest overall efficiency at the pump rating. The gallon-feet pumped in a year at 135-ft. head for $9,100 (2c. per kw.-hour) would cost $17,000 if pumped at 45 ft. head with pumps of this class. This difference of $7,900 per year is not out of line with many pumping duty costs that may be found among the misapplied pumps in industrial plants.

(4) *Choice of Motor.*—For constant-speed service induction motors of the squirrel-cage type or synchronous

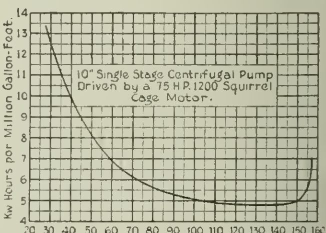


FIG. 3—KILOWATT-HOURS REQUIRED FOR PUMP DRIVEN AT CONSTANT SPEED

motors may be used. Synchronous motors improve the power factor for the plant, and this may be enough to justfy the valve manipulation incident to starting centrifugal pumps with such motors, together with the complication of bringing direct-current excitation to the motor. There is little difference in the efficiencies of the motors mentioned. For direct-current service the shunt-wound motor is not well adapted for centrifugal-pump drive as it is too sensitive to load and voltage changes. A compound-wound motor should be used with only a moderate series field, say 10 per cent; such motors have been standardized for centrifugal-pump service.

For adjustable-speed pump drives wound rotor motors, or the brush-shifting, commutator type of motors, may be used. The latter have much higher efficiencies at reduced speeds and this justifies their higher cost if operated at below normal speed frequently or for long periods. Fig. 4 shows the relative outlay in kw.-hours for an adjustable-speed pump using wound rotor and brush-shifting motors. The third curve shows the high cost of throttling to get reduced output. It will be noted that at 60 per cent of normal pump output the brush-shifting motor would operate 24 hours for \$10.72; the wound rotor motor for \$14.88; the squirrel-cage with throttled pump for \$25.20. The differences become greater upon reducing the output still more.

Vertical motors may often be used to great advantage by locating the pump at whatever depth may be necessary below the motor room floor. This reduces or eliminates the suction lift, with consequent benefit to the overall efficiency. Where grit is present in the water or the pump is inaccessible the entire weight of the revolving parts may be carried on a suspension thrust-bearing at the top of the vertical motor. This allows of easy inspection and maintenance. Vertical motors are available in synchronous, squirrel-cage, wound rotor, brush-shifting and direct-current construction.

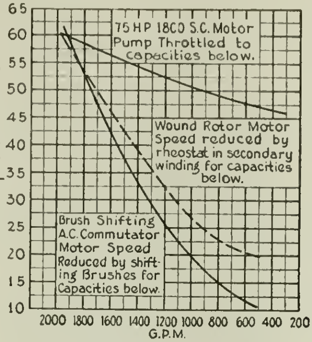


FIG. 4—RELATIVE OUTLAY FOR ADJUSTABLE-SPEED PUMP

Squirrel-cage motors can be used on centrifugal pumps up to 500 hp. provided the inrush of starting current is not objectionable. Wound-rotor motors start with much less line disturbance and are used for that reason even when intended for constant speed duty. Synchronous motors are not usually installed below 75 hp. and are, of course, for constant-speed duty only.

Reciprocating pumps, rotary pumps and screw pumps have heavy starting duty due to highbreakaway torque and full-load pumping duty from start. For these reasons squirrel-cage motors cannot be used if line disturbance is objectionable. Synchronous motors can be used, but the pump must be relieved of its load in starting so that the motor can pull into step. Wound-rotor motors for alterating current and compound-wound motors for direct current are best for pumps of this class, as they are possessed of strong starting characteristics. The brush-shifting commutator type of alternating current motor is equally good where adjustable speed operation is desired.

Pump Control.—Squirrel-cage motors are controlled by manual or automatic compensators to which may be attached disconnecting switches and ammeters. The automatic compensators may be actuated by a push button at some convenient point, by a float switch, by a thermostat or by a diaphragm pressure switch.

Wound-rotor motors for constant-speed duty may be controlled by an automatic panel actuated by push button or by float switch. The heavy starting duty on the reciprocating pumps determines the type of motors used.

Where adjustable speed is required or it is desired to control the starting by hand, a manual rheostat is provided in the secondary circuit while the line contact is made by a manual or magnetic switch. Synchronous motors are commonly controlled by a compensator and a field discharge switch.

Brush-shifting motors require only some form of line switch with overload protection and a mechanical means for shifting the brushes. This may be a hand-wheel, a shipper rod or a small pilot motor actuated by remote push buttons.

Compound-wound, direct-current motors for centrifugal pumps require a disconnecting switch and a hand starter. If adjustable speed is required a manual field regulating rheostat is added.

Direct-current motors may also be controlled by magnetic panels actuated by push button or float switch as in the case of the alternating-current motors. Fig. 6 shows compound-wound motors in a nitrate plant controlled by fused disconnecting switches and hand starters all neatly arranged.

Control apparatus in all cases should be fully enclosed and provided with overload and undervoltage protection. Where it is desired to have the motor restart by itself after an undervoltage shut down, undervoltage release should be specified. Undervoltage release must also be provided if the motor is to be started by a float switch or other auxiliary circuit closing device.

The presence of explosive gases or of especially corrosive acid fumes necessitates the submergence of contact-making parts in oil. Such control items are available for all classes of pump service. For a battery of motor-driven gasoline pumps in a certain refinery the switches are of the oil-immersed type, and as a squirrel-cage motor has no moving contacts there is no danger of starting a fire or explosion.

Pump Service.—In conclusion, it is to be noted that motor-driven pumps are successfully coping with exacting classes of service in industrial plants. Liquids, whether thick, light, volatile or acid, are all being handled under manual or automatic control with the greatest facility. The flexibility of electric drive allows the plant engineer to draw a straight line from level to level, put the pump in the line practically without bends, with the assurance that he can bring the power to the pump without any loss in efficiency or inconvenience to the plant.

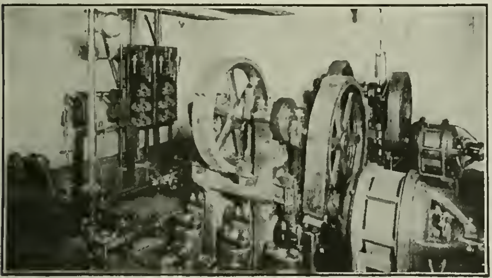


FIG. 5—RECIPROCATING PUMPS REQUIRE HIGH STARTING TORQUE OF WOUND ROTOR MOTORS

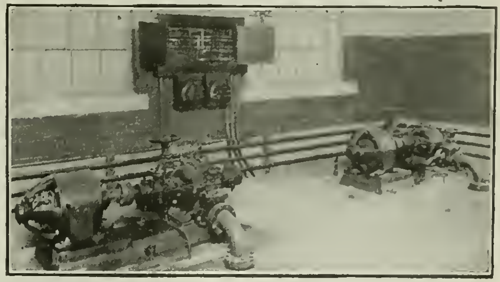


FIG. 6—COMPOUND WOUND MOTORS WITH DISCONNECTING SWITCHES AND HAND STARTERS

American Lumber Commission Sails to Study Japan's Needs

An American commission of lumber exporters sailed from San Francisco Nov. 10 on the Japanese steamship *Taiyo Maru* to study Japan's lumber requirements for reconstruction in the area devastated by the earthquake. The American commission will conduct its survey and negotiations on behalf of more than 100 large export lumber mills in the Pacific Coast region. The commission is composed of Major E. G. Griggs, of Tacoma, Wash., president of the Douglas Fir Exploitation and Export Co.; O. M. Clark, of Portland, Ore., lumber manufacturer, and Chester J. Hogue, of Seattle, manager of the West Coast Forest Products Bureau.

This group of lumber authorities will visit Tokyo, Yokohama and other Japanese cities and confer with Japanese commercial interests identified with plans to furnish emergency supplies of lumber in large volume, and with the least delay possible, to meet rebuilding needs. A special effort will be made by the commission to induce Japanese lumber buyers to accept shipments of American standard lumber sizes.

To Investigate "Dumping" of Foreign Cement

Foreign representatives of the Customs Special Agency Section of the Treasury Department have been instructed to investigate and report as soon as practicable the foreign market values back to April 1 of British, Norwegian, Swedish, Danish and German cement and to forward any other information available bearing on the question of "dumping."

This inquiry results from complaints by the Sun Portland Cement Co. and the Oregon Portland Cement Co. to the collector of customs at Portland, Ore., that cement was being imported from Norway and Sweden at prices below the home market price, thus coming into conflict with the anti-dumping act of 1921.

Tokyo Organizes Huge Building Company for Reconstruction

A huge building construction company is being organized in Tokyo for the purpose of undertaking the construction of commercial and industrial buildings on the unit basis, says a report received by the Far Eastern Division of the Department of Commerce from its representative at Tokyo. This company plans to specialize in four-story reinforced concrete buildings designed to withstand earthquake shocks. Such material as cannot be obtained locally or which cannot be supplied in standard specifications, it is announced, will be obtained abroad.

Funds for the promotion of this new company will, according to present plans, be obtained in large part from the Government at a low interest rate. At present the company is marking time awaiting the announcement of the plans of the Capital Restoration Board as to the areas set aside for industrial and business purposes.

It appears at present, says the Department of Commerce, that in addition to securing abroad a large part of the iron and steel and lumber that goes into the permanent reconstruction, considerable quantities of cement will have to be imported as well. Ordinarily Japan exports considerable cement but the enormous demand that is bound to come with the commencement of permanent building activities, coupled with the destruction of about 8 per cent of Japan's cement production, will be greater than the industry can meet.

The annual capacity of Japan's cement mills was, before the earthquake, in the neighborhood of 14,000,000 bbl. and plans are under way which will, within six months' time, bring this up to 17,000,000 bbl., notwithstanding the losses suffered by the earthquake. Until such time as this increased output is brought about it is expected that the domestic supply will be inadequate and that considerable cement will have to be imported. In anticipation of this need, the Government has placed cement on the free list effective until March 31, 1924.

Conservative bankers in Tokyo are advocating a program of reconstruction spread over a period of 20 years and financed in most part through the flotation of domestic loans. In order to keep the yen on an even keel, however, they favor the flotation of foreign loans sufficient to cover all purchases made abroad.

Business Notes

ORTON & STEINBRENNER Co., 608 So. Dearborn St., Chicago, manufacturer of locomotive cranes and buckets, has just completed a large addition to its works at Huntington, Ind., which will double the output of the company. All equipment for the addition to the plant, including a large number of modern machine tools, has been purchased and most of it is already in use.

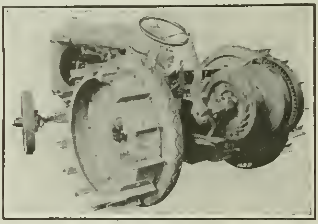
H. B. ACKLAND has been appointed manager of the New York office of the G. H. Williams Co., Erie, Pa., manufacturer of clamshell buckets. Mr. Ackland is a mechanical engineer and was formerly with Westinghouse, Church, Kerr & Co.

C. H. LOOMIS & SONS Co., equipment distributors, Newark, N. J., announces the occupation of a new warehouse at 304-306 Jelliff Ave., housing a line of contractor's plant which includes Rex concrete mixers, Domestic gasoline engines, pumps, hoists and air compressors, and American portable sawmill rigs.

Equipment and Materials

Hoist Attachment for Tractor

A hoist attachment that can be fitted to a Fordson tractor in 15 min. has been added to the line of construction equipment manufactured by the Clyde Iron Works, Duluth, Minn. It consists of a friction-driven drum 8 in.



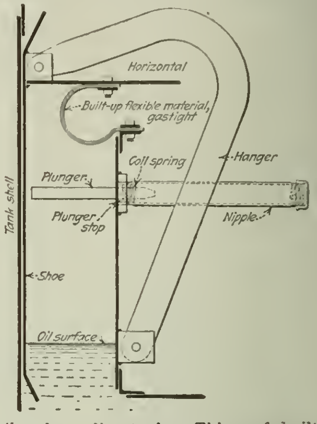
in diameter, 10 in. long between flanges and with 18 in. diameter flanges supported in a cast-steel frame. It is fastened to the tractor by eight of the rear axle housing bolts and two bolts through the outside holes of the drawbar cap. The frame is designed so that no drilling, tapping or machine work of any kind is required to attach it to the tractor and the hoist is mounted so as not to interfere with the tractor in any of its uses.

The drum is equipped with the Clyde standard wood cone frictions and thrust mechanism, bronze bushings with grease cup lubrication, a band-brake that is asbestos-lined and operated by a foot lever and also ratchet with pawl. All shaft bearings are babbitted and lubricated with grease cups, the drum shaft bearings being equipped with removable caps. Power is received through a roller chain from the pulley shaft, the pulley being replaced with a sprocket. A rod on the lever side of the drum gives the operator full control of the throttle.

The hoisting duty of the attachment is 3,900 lb. at 142 ft. per minute for the first layer of ½-in. cable and 2,320 lb. at 242 ft. per minute when the last or seventh layer is on the drum. The hoists are mounted on timber skids for shipment and weigh 600 lb. each, including the tool box.

Floating Roof for Gasoline Tanks

Fire tests were conducted Oct. 16 at the Chicago plant of the Chicago Bridge & Iron Works to prove the ability of the Wiggins floating welded-steel roof to protect the contents of



oil and gasoline tanks. This roof, built for experimental purposes, floated on the surface of gasoline contained in a steel tank 6 ft. high and 30 ft. in diameter. The tank contained about 3 ft. of water on top of which there was an average depth of gasoline of 2½ to 3 in. There is a gas-tight space (see drawing) between the vertical rim of the floating roof and the shoe which presses against the tank shell; this small air space is the only one between the surface of the liquid and the roof. Evaporation is prevented by a special form of seal shown in the accompanying drawing.

In the tests fire applied at numerous points and in different ways failed to start any permanent conflagration. The results, it is claimed, demonstrate not only the fire prevention features of the floating roof but also its value in eliminating evaporation losses.

Publications from the Construction Industry

Metal Lath—ASSOCIATED METAL LATH MANUFACTURERS, Chicago, has published in the form of a 16-p. pamphlet approved specifications for metal lath construction. The specifications cover the quality of material and methods of application of all types. For years manufacturers of metal lath have given out slightly conflicting recommendations on the use of their products. The present set of specifications aims to present, in so far as it is possible to do so, uniform recommendations. In addition to the text, there are a number of drawings showing the use of metal lath in a variety of building construction details, including partitions, ceilings, floors and cornices.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Steel Ingot Output Gains—Slight Drop in Pig Iron

The October steel ingot output showed a gain of nearly 7 per cent, compared with the month preceding, according to the American Iron and Steel Institute. There were 3,382,986 tons produced last month, in the steel mills of the country which turned out 84.15 per cent of the steel ingot output in 1922. The September total was 3,161,964 tons and that for October, 1922, 2,872,415 tons.

Production figures, for the first ten month of the current year, are compared with 1922 in the following table:

Months	Tons of Steel Ingots 1923	1922
January	3,644,629	1,593,482
Feb.	3,294,264	1,745,022
March	3,858,675	2,370,751
April	3,760,997	2,444,513
May	4,000,695	2,711,141
June	3,574,567	2,634,477
July	3,350,829	2,487,104
August	3,506,755	2,214,582
September	3,161,964	2,373,779
October	3,382,986	2,872,415
November	....	2,889,297
December	....	2,779,890
Total	35,536,361	29,116,453

The October pig-iron output, however, showed a slight drop from the month preceding. Over 3,149,000 tons were produced last month as against 3,125,009 during September. Compared with the May production peak, the October output dropped 18½ per cent, making it the lowest rate for any month in the current year.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 265 to 277, are the following:

Hotel, Durham, N. C., Citizens Hotel Co., $1,000,000.

School, New York, N. Y., Supt. Bd. of Educ., $1,500,000.

Hotel, Ashland, Ky., Buckingham Hotel Co., $1,000,000.

School, Brooklyn, N. Y., Supt. Bd. of Educ., $1,500,000.

Hotel, Paterson, N. J., Alexander Hamilton Hotel, $1,000,000.

Hotel, Duluth, Minn., W. Schroeder, $1,500,000.

High School, St. Louis, Mo., Bd. of Educ., $1,500,000.

Apartment, Philadelphia, Pa., C. E. Oelschlager, $1,500,000.

Hotel, Tacoma, Wash., Citizens Hotel Corp., $1,500,000.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 265 to 277, are the following:

Filter and Admin. Bldg., Cleveland, Ohio, to Stange-Walsh Constr. Co., $2,885,500.

Bank and Office, Cleveland, Ohio, to Fuller Constr. Co., New York City, $5,000,000.

School, Brooklyn, N. Y., Bd. of Educ., to G. Colon and Co., $1,030,000.

Hotel, Long Beach, Calif., to Hennessy Bros., Los Angeles, $1,250,000.

Public Bond Sales Active

The month of October shows greater activity in the bond market than the three preceding months. *The Commercial and Financial Chronicle* reports the total of state and municipal bonds placed at $81,940,676, the highest since June. September of this year placed $51,860,828 and October, 1922, $71,333,536.

The largest issue during October was the $21,000,000 block of Illinois bonds. West Virginia negotiated a sale of $2,000,000 4½s which is a part of a $5,000,000 offering. New York bankers took option on the remainder of the bonds.

Bonds offered but not sold for October totaled $31,000,000.

The total of all the various forms of loans placed in October for the past five years follows:

1919	$108,519,268
1920	170,791,051
1921	189,847,801
1922	163,258,214
1923	347,998,755

In the accompanying table of representative bonds, six were sold at par, four below par, and the remainder above. The yields ranged from 4.201 to 6 and the rate of interest from 4 to 6 per cent.

Next week—"Water-Works Installation in 1922 and 1923"

REPRESENTATIVE BOND SALES DURING OCTOBER

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Missouri	Roads	$5,000,000	4½	99 449	4.59	Nov. 1, 1923	1928—1932	First Nat. Bank of N. Y. and others
West Virginia	Highway	2,000,000	4½	100	4½	Sept. 29, 1923		National City Co., N. Y and others
County								
Dade, Fla.	Highway	335,000	5	98 18	5.15	Oct. 1, 1923	1925—1954	R. M. Grant & Co., New York City
Douglas, Minn.	Ditch	60,000	4¾	100	4¾	Oct. 1, 1923	1929—1943	Minn. Loan & Trust Co., Minneapolis
Geauga, O.	Refund	4,000	6	100.37	5 91	Oct. 1, 1923	1924—1931	Chagrin Banking Co., Chagrin Falls, O.
Hancock, Ind.	Roads	4,400	5	101.14	4.75	Sept. 15, 1923	1924—1933	Citizens Bank, Greenfield, Ind.
Henderson, N. C.	Refund	80,000	6	100	6	Sept. 15, 1923	1929—1944	Nat. Bk. of Commerce, New York City
Knox, Ind.	Drainage	9,247.87	6	100.56	5.89	Oct. 1, 1923	1925—1934	W. M. Alsop, Vincennes, Ind.
Luzerne, Pa.	Bridge	350,000	5	101.28	4.57	Nov. 1, 1923	1925—1928	Biddle & Henry, Philadelphia, Pa.
Penniscot, Mo.	Drainage	32,000	6	101.77	5.84	Oct. 1, 1923	Oct. 1, 1943	Liberty Central Trust Co., St. Louis, Mo.
Polk, Minn.	Ditch	80,500	5	101.40	4.93	Nov. 1, 1923	1932—1953	Northwestern Trust Co. and others, Minneapolis
Warren, Ind.	Road	17,850	5	100.96	4 80	Oct. 1, 1923	1924—1933	Warren Co. Bank, Williamsport, Ind.
Municipality								
Albermarle, N. C.	Water	90,000	6	104 55	5.64	Nov. 1, 1923	1926—1963	Keane, Higbie & Co., Detroit, Mich.
Arlington, Mass.	School	88,000	4½	101.929	4.22	Nov. 1, 1923	1924—1938	Merrill, Oldham & Co., Boston, Mass.
Brockton, Mass.	Water and street	110,000	4¾	100.048	4.24	Oct. 1, 1923	1924—1943	F. S. Moseley & Co., Boston, Mass.
Claremont, N. H.	Water	75,000	4	95 21	4 201	Nov. 1, 1923	1924—1943	Merrill, Oldham & Co., Boston, Mass.
Clyde, O.	Electric plant	17,000	6	103.77	5.40	Oct. 1, 1923	1925—1934	Detroit Trust Co., Detroit, Mich.
Concord, N. C.	Street improvement	88,000	5½	101.06	5.37	July 1, 1923	1923—1944	Seasongood & Mayer, Cincinnati, O.
Cuyahoga Falls, O.	Water and streets	76,769	6	161 11	5.73	Oct. 1, 1923	1924—1932	Seasongood & Mayer, Cincinnati, O.
Dallas, Tex.	Streets	1,250,000	4½	100	4½	May 1, 1923	1924—1963	Geo. H. Burr & Co. and others, N.Y. C.
Gastonia, N. C.	Water, streets, sewers	500,000	5¼	100 54	5.21	Aug. 1, 1923	1925—1964	Kissel, Kinnicut & Co., & Wm R Compton Co., New York City
Grandview Heights, O.	Water, street imp'vt.	27,900	5½	100 38	5.42	Oct. 30, 1923	1925—1934	Citizens Trust & Savings Bank, Columbus, O.
Lakewood, O.	Paving	201,676	5	100	5	Oct. 1, 1923	1925—1932	Wm. A. McHugh & Co., Cleveland, O. Highway Constr. Co., Elyria, O
Laramie, Wyo.	Sewer	112,000	5	100 20	4.99	Nov. 10, 1923	1933—1953	Albany Nat. Bank, Laramie, Wyo.
Madison, Wis.	Water	50,000	4½	97.85	4.67	Oct. 1, 1923	Oct. 1, 1943	Blyth-Witter & Co., Madison, Wis.
Mooresville, N. C.	Water	200,000	5¼	100	5¼	Oct 1, 1923	1924—1963	Amer. Trust Co., Charlotte, N. C.
Orville, O.	Water	60,000	5½	'01 56	5.17	Oct. 1, 1923	1924—1933	Sidney Spitzer & Co., Toledo, O.
Sanford, N. C.	Street, water, sewer	225,000	5½	100.10	5.48	Oct. 15, 1923	1924—1958	Wachovia Bk. & Trust Co., Raleigh, N. C.
Scarsdale, N. Y.	Fire house	50,000	4¾	103.17	4.47	May 1, 1923	1928—1952	Sherwood & Merrifield, New York City
Township								
Greensboro School, Twp., Ind.	School	30,000	5	100 005	4.999	....	....	J. F. Wild & Co., Indianapolis, Ind
Webster Twp., Rural School Dist., O.	School	$12,087 03	6	100 11	5 97	Oct. 1, 1923	1924—1931	Ryan Bowman & Co., Toledo, O.

Ten Largest 1923 Contracts Total $85,328,722

From contracts awarded published in *Engineering News-Record*, the ten largest to date are given in an accompanying table. Three of these are in New York City with a total of $23,226,086, while Chicago with three, totals $21,602,636. The remaining contracts are not located in commercial centers. It is also noteworthy that on the whole, contracts were awarded to contractors located in the centers where the construction was done. Also out of the nine classifications into which the types of construction are divided in Construction News, six of them are represented in this list. The largest was for a $20,000,000 power plant in New Jersey.

TEN LARGEST CONTRACTS—JAN. 1 TO NOV. 1, 1923

1923	Work	Location	Price	Successful Contractor
Feb. 1	Office.	New York City	$6,000,000	F. T. Ley & Co., New York City
Feb. 8	Office	Chicago	8,000,000	Starrett Bros., Chicago
Apr 5	R. R. & telegraph system	Montana	12,000,000	Peterson-Shirley & Gunther, Omaha, Nebraska
June 7	Subway	New York City	5,976,086	Patrick McGovern, New York City
June 28	Telephone Exchange.....	New York City	11,250,000	Marc Eidlitz & Son, Inc., New York City
July 12	Office	Chicago	8,000,000	Wells Bros. Constr. Co., Chicago
Aug. 16	Sewage works..........	Chicago	5,602,636	J. Griffiths & Sons Co., Chicago
Sept. 6	Dam.	Danville, Ky.	4,000,000	L. E. Meyer, Chicago
Sept. 13	Bridge	California...	4,500,000	Duncanson-Harrelson, San Francisco
Oct 18	Power plant.....	Kearny, N. J.	20,000,000	Pub. Service Prod. Corp., Newark, N. J.
Total			$85,328,722	

Weekly Construction Market

This limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Nov. 1; the next, on Dec. 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.00
Structural rivets, 100 lb............	4.40	4.75	4.90	3.75	4.25	5.30	5.00	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb.....	3.54	3.50	3.38	3.20	3.45	3.85	3.65	4.10	3.90
Steel pipe, black, 2½ to 6 in. lap, discount......................	44%	40%	43%	47%	53–5%	36%	33.2@42.2%	35%	47.43
Cast-iron pipe, 6 in. and over, ton....	63.60	54.75	61.00	57.20@60.20	60.50	69.00	61.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl............	2.55@2.65	2.60	2.05	2.20	2.50	2.84	2.61	2.90	2.25
Gravel, ¾ in., cu.yd................	1.75	1.85	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd........................	1.25	1.24	2.00	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd..........	1.75	2.00	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft..........................	61.00	39.00	54.75	57.50	44.75@45.75	48.00	41.00	29.50	70.00
Lime, finishing, hydrated, ton	18.20	25.00	23.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl..	3.00@3.25	1.60	1.85	1.50	1.50	2.70	2.10	2.80	9.50
Common brick, delivered, 1,000 ...	22.55@23.65	11.00	+11.60	11.00	16@18	12.00	15.00	15.00	16.50
Hollow building tile, 4x12x12, per block....................	Not used	.102	.110	.0724	.075	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block.....................	.1179	.102	.110	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal......	.98	.97	—1.05	1.14	.99	1.12	1.08	1.15	1.38
Common Labor:									
Common labor, union, hour.........	.75	.35	.....	.....	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour.....	....	.30	.30@.50	.82½	.50@.55	.35@.50	.50	.62½	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93⅜c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.28). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in., $119.

Changes Since Last Week

Recent price reductions in basic building materials have resulted partly from seasonal influences and partly from plentiful supplies. These concessions have resulted in an unusually large winter building program in all classes of construction. Federal Government projects especially, having been held up for some time, will enter the market at a time when competition for labor and materials is not so keen.

While the construction outlook is well-defined, the same cannot be said of business generally. The stock market has improved recently; money is fairly easy; freight loadings are unseasonably heavy; the recent steel dividend indicates an optimistic outlook in that industry, yet foreign exchange rates have dropped still further; curtailment has occurred in the pig-iron, textile and leather output and freight rate reductions on grain and coal remain unsettled. Shipments of locomotives from the principal manufacturing establishments to the various railroads, during the first ten months of the current year, increased 183 per cent over the same period in 1922.

The declines referred to have occurred mostly in concreting materials, lumber and clay products, and have not affected such items as steel, lime and labor costs. Linseed oil, however, has steadily declined carrying with it paint prices in general. Other raw materials entering into the manufacture of paint have not declined in proportion.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

Volume 91 — NEW YORK, NOVEMBER 22, 1923 — Number 21

Paying for the Coal Reserves

PART of the mounting cost of anthracite coal is made up of interest on the ever-increasing capitalized value of the coal lands held in reserve for future use, according to the latest report of the Coal Commission. This has got to stop sometime if the price of coal is to be kept within reasonable bounds. As the supply of coal is depleted the value of the remaining coal lands will increase and if the owners of these lands are to be allowed to keep on increasing the capitalized value of these lands the interest on this capitalized value which now makes up part of the cost of the coal being mined will increase correspondingly until the cost of coal becomes prohibitive. Just how such coal lands are to be valued is not an easy question to answer for to hold exactly to the original cost value would work an injustice to the coal companies who bought their lands years ago for little or nothing but who held them through the losses of pioneer days. Yet there is still greater injustice in the method of enhancing values such as was used when the stockholders of the Delaware, Lackawanna and Western R. R., when separating the railroad from the coal business, sold their coal properties, valued at $6,240,000, to themselves as stockholders in the Alden Coal Co. for $72,240,000. We can think of no better way to hasten nationalization than a few more such exhibitions of capitalizing monopoly property possession.

Valuing Monopolies

THIS whole matter of capitalizing the unearned increment due to monopoly control is in for serious consideration in the next generation. One does not need to have radical or "red" tendencies to see the difference between profiting in the rising value in land in a city or in a wheat growing country and the same kind of profiting in coal lands, or possibly as time goes on in oil lands and even water power. There is nothing that compels people for all time to do business near the corner of Broad and Wall St. in New York. When rents become prohibitive there the prospective lessee moves elsewhere where the leasing cost is low enough to enable him to operate at a profit. Coal, on the contrary, is a disappearing necessity and the undisputed possessor of as much of it as remained would in time have the rest of the country in his complete power. Obviously nothing like that is going to be permitted but the difficulty is going to lie in determining where monopoly ownership shall be permitted to stop. There is a sufficient analogy in the matter of water power to give all power people pause. Is it possible that some of the public resentment against private power interests is due to the fear that as water power becomes more and more a necessity the valuation of water rights will be correspondingly increased to a point where a fair return on such monopoly value becomes outrageous?

An Arbitration Court

ARBITRATION proceeds apace in the construction industry. The New York Building Congress has adapted an arbitration clause whose inclusion in all building contracts is advised and which has features not common in such contract provisions:

> All disputes arising in connection with this contract shall be submitted to and determined by arbitration, as provided in the arbitraton law of the state of New York, in a Tribunal of Justice to be known as the Court of Arbitration of the New York Building Congress. to be established and conducted by the New York Building Congress (Arbitration Committee), under the rules of procedure as set down by the Arbitration Society of America as of Sept. 1, 1923.

It will be observed that provision of the machinery for conducting arbitration cases is indicated This consists of the selection by the Building Congress of half a hundred men competent to act as arbitrators and the services of its Arbitration Committee to arrange place and time of meeting and establish rules and methods of procedure in conformity with the arbitration law of New York. In brief a Court of Arbitration is established. This is constructive action well in advance of most of similar contract arbitration plans.

Floods and Waterway Transportation

COLONEL ASHBURN'S report on the government's Mississippi River freight service, noted in the news pages, is an excellent defence of the waterway as a freight carrier but it contains, inadvertently perhaps, the best possible explanation of the continuing disability of the Mississippi to compete with its paralleling railways. During the spring and summer of 1922 the great river was in flood, so that for a month or more navigation was dangerous and freight landing on nearly overtopped levees impossible, while for a succeeding half year the channel, twisted and shifted by the record flow, was either unmarked or impassable. In consequence tonnage carried, which had been approaching a paying basis, fell so low that only an enormous surplus or the resources of the government could have saved any shipping line from bankruptcy. The director of the service rather intimates that this could have been avoided had proper engineering control of the channel been exercised and accepts the disaster of 1922 as something which could be avoided in the future. This is a doubtful attitude. The Mississippi will continue to have floods, so long as rain continues to fall in the valley, and those floods will continue to warp and wreck an already tortuous channel. No engineering control within the bounds of financial possibility can prevent it. Any operation of freight service on the river, therefore, must count on recurring periods of long disuse, or at best difficult use, with loss of profit during those periods, as well as the loss of favor which a discontinuous service entails. And this is a heavy impost for any commercial enterprise to carry.

Art and Craftsmanship

VERY recently someone remarked in a discussion of highway bridge specifications before the American Society of Civil Engineers how noteworthy it is that three separate "standards" for such specifications should be simultaneously under consideration. Not only the society but also the American Railway Engineering Association and the Association of State Highway Officials have drafted such standards, each intended to become established as the universal rule of good bridge building. For many years we have had specifications, expressing the preferred practice of this or that engineer, but present specifications are the direct antithesis of the old ones, since they represent not an expression of individual engineering judgment but its elimination in favor of unvarying uniform practice. The spirit of the past was to make bridge practice good by enlisting the best and freest engineering judgment; the new spirit is to prevent the exercise of such judgment and if feasible enforce uniformity for the sake of good bridges. The situation is indeed significant. Let the reader picture to himself an attempt to draw up standards for arch dams, or for sewage disposal tanks, or for harbors, anything that is recognized as a subject of true engineering activity. Such an attempt is an evident impossibility; any standard for even temporary use would be a statement of the problem only, not of the method or nature of its engineering solution. Were it possible to write standard rules for the engineering solution, it would mean that the subject in question had become so routinized as to be removed from the field of engineering and be relegated to the domain of craftsmanship. Thorough training in calculation may be required to lay out rivets under an algebraic rule of spacing, yet the process will still be craftsman routine. The deciding issue is whether scope is left for the exercise of judgment and ingenuity in meeting the demands of the service which the structure is to meet. If upon answering this question it is found that steel highway bridge construction has indeed passed out of the realm of the engineer into that of the artisan, then the engineering profession has reached the close of the book in one line of its great endeavor of making the teachings of science subservient to the needs of a practical art.

Highway Bridge Troubles

REFERENCE to the experience records of highway bridges for the past year or two brings out a point that bears somewhat on the question of design rules, discussed just above. Very few accidents have been reported which could be charged to bad proportioning or detailing of the steel construction. On the other hand, many accidents are found to have been caused by conditions unrelated to steel practice. Speaking in approximate terms, once a week a bridge has been reported wrecked by a colliding vehicle which struck the end posts, or pushed the structure off its seat, or tore out a web member. Once a month—again approximating—a failure resulted from a bridge being too narrow for safe passage of vehicles or being so located with respect to the approaches that entrance of vehicles was unduly difficult (and therefore in the long run hazardous). It would seem that in so far as it is the bridge engineer's business to build safe bridges, he has primary concern with matters that lie beyond rivet spacing or permissible width of cover plates. Sound principles of highway bridge construction undoubtedly include among other things certain principles of safe location, layout, and guarding. However, it is not customary to treat of these matters in bridge specifications, and they are not included in the three standards which are now being discussed. Perhaps such specifications are not meant to be guides to good bridge construction. If so, some misconceptions would be avoided by labeling them accordingly; every one should be permitted to know, as bridge engineers know, that not every bridge meeting the standard specifications is a good bridge, and that good bridges may be built which do not satisfy the specifications. If the limited character of the current standard specifications were clearly noted, it might have the result that good bridge construction in its broadest aspects would find a place in technical discussion.

Lessons from Paris Rufuse Disposal

WHEN the private company which disposes of the mixed garbage and other refuse of the city of Paris completes its improvements and extensions to its disposal plants, Paris will have what promises to be the most complete system of refuse collection and disposal of any large city in the world.

Under this plan, which is outlined at length elsewhere in this issue by the technical director or managing engineer for the disposal company, the mixed refuse is collected by hundreds of motor trucks, owned by private companies and driven by chaffeurs provided by the company but directed and loaded by the city. These trucks deliver the refuse to four disposal plants where, by means of sorting, screening and grinding, all the material of commercial value is reclaimed for utilization. The residue goes to furnaces which yield still further by-products—heat, which is converted into steam and thence into electric current, and clinker, which is made into brick. The city seems to exercise such a complete control of refuse collection as will enable it to insure good service, while the disposal contract seems on the one hand to guarantee a fair profit to the contractor and on the other to be well designed to give the city a share in any excess over fair profit.

All the data at hand indicate that the Paris plan is worthy of careful study by cities and by engineers concerned with garbage and refuse disposal, in whatever country located. By this we do not mean to advocate mixed as against separate collection and disposal of city wastes, nor sorting, screening, and incineration against any other method of final disposal, nor, least of all, do we mean to advocate private rather than public agencies for collection and disposal of municipal refuse. What we do urge is the same careful attention by other municipalities as seems to have been given by Paris to working out a system of refuse collection and disposal adapted to local conditions, which, if private agencies are employed, will protect them against undue risk, while at the same time giving the city some share in the profits, if any, from utilizing municipal wastes, all to the end that the net combined cost of refuse collection and disposal, which is bound to be considerable in any case, may be cut to the lowest figure compatible with good service.

Paris affords a notable example of the change in the incineration of mixed refuse that has been going on abroad of late—in part led by Paris. In that city and in a rapidly growing number of British towns, the entire collection of mixed refuse does not go to the

incinerator. Instead, all material of commercial value is salvaged; paper, etc., for sale, garbage and fine ash to go to land for its fertilizer value and for the physical improvement of the soil. In particular, it is to be noted that by eliminating ashes and as much as may be of other incombustible waste, the calorific value, pound for pound, of what goes to the furnaces is greatly increased, while the furnace output, for re-handling and final disposal, is not only much decreased, but what does remain is almost wholly a clinker—useful abroad, whether or not it would be in America, for making brick or concrete. It should be noted also that all this applies to mixed refuse only and not to furnaces for burning garbage alone or garbage mixed chiefly with paper, tin cans, bottles and the like, as is the case in so many American municipalities that have attempted incineration.

In conclusion, it is well to remember that although a considerable number of American cities have installed equipment to utilize the heat generated by burning city refuse, but rarely has any of the heat generated been used except at the disposal plant, if even there. Under existing conditions, there seems, if anything, less chance of heat utilization in this country than there has been in the past. This makes all the more interesting and important the results that may be achieved at Paris when the enlarged plant and new scheme are in complete operation. It is hoped that careful records will be kept and will be made available.

A "Business Administration"

BUSINESS principles are to govern the administration of federal reclamation henceforth, said the Secretary of the Interior as he discharged Arthur P. Davis. No more engineers, but business men instead, and the business type of management! Accounts have just come from the far West that detail the first item of this improved management, as carried out in this instance by the Secretary himself—the "business man" upon whom the country is compelled to depend at the moment for the guardianship of our national investment in reclamation projects.

Each of the score or more reclamation projects is a large-scale business undertaking, in which an investment of many millions of dollars must be cared for and an annual business of four or five million dollars administered. The machine by which such a business is handled is of necessity a carefully organized mechanism, as certain to be damaged by unskilled tinkering as a watch. Yet the Secretary has ordered the summary disruption of one of these operating mechanisms, on no better basis than the wanton and ignorant recommendations of an "inspector" qualified for the examination of reclamation projects by a long career as a political henchman. What is more, the Secretary in issuing this order went over the heads of the two officials who are in direct charge of the management of projects and answerable for their proper organization and sound management.

Somewhat more in detail. Since early summer the way has been prepared for improved reclamation management by visits of several sets of inspectors to the projects. The merit of certain of these inspectors consisted in their having no knowledge of reclamation but an intimate knowledge of politics. One of them, a hanger-on of New Mexico party politics and appointed to a position in the Interior Department by A. B. Fall of that state when he was secretary, more especially engaged the confidence of Secretary Work. The activities of this "inspector" while on his visit to the projects seem to have consisted largely in stirring up trouble among the farmers. It may as a matter of charity be assumed that the Secretary has not been advised of the proceedings of this inspector on the projects, but his procedure in blindly adopting the mischievous and destructive recommendations of the inspector can hardly be covered with the same mantle of charity.

Reports which we have obtained of the inspector's doings at the Newlands project, in Nevada, join in showing the following. He collected groups of malcontent farmers and townsmen in Fallon, the chief city of the project, invited complaints, and promised, on the part of the Secretary, any concessions that might be asked for. Specifically in response to some of the complaints he promised that various persons would be paid for canal rights-of-way, unconcerned about the fact that this subject had already been covered by agreements and deeds arranged for by the project organization. He further induced the malcontent water users to appoint a committee to draw up complaints, and led them to prepare silly resolutions condemning "the unjust and discriminatory freight rates paid by the settlers" and holding "the Reclamation Service with their vast influence criminally negligent in permitting this injustice." After engaging in a fight with the Reclamation Service's gate tender at Lake Tahoe (a local paper says, while the inspector was drunk) he reported that this man should be dismissed and that half a dozen other dismissals and shifts should be made in the operating staff of the project. Innocent of experience in project operation, he decided upon recommending the disruption of the project organization built up by the project manager, a man of exceptional ability and long experience in this difficult and responsible work.

Secretary Work's action on this report was to adopt the inspector's recommendations in bulk, over the heads of both the reclamation commissioner and the chief engineer. Under date of Aug. 28, Secretary Work, by letter, directed Commissioner D. W. Davis to have carried out at once the recommendations of the inspector as follows:

(1) To discharge the purchasing agent, his work to be performed by the chief clerk, "who should have the stenographer write his letters; or, when everybody else is busy, should type his own orders, etc."; (2) to use a neostyle in making up forms and papers, (a duplicating machine was already in use in the project office); (3) to discharge the office engineer, his work to be divided between the project manager and several of the field engineers; (4) to designate the chief clerk as acting project manager in the absence of the project manager; (5) to discharge the gate tender at Lake Tahoe, and endeavor to secure a local resident to perform his duties, "the position to be filled by a man whose comportment and behavior will avoid criticism of the department"; (6) to discharge the water master, and have the superintendent of irrigation perform his dutes; (7) to discharge the master mechanic, and have the engineer of drainage perform his duties.

Neglect and mishandling are sure to result from disrupted organization and the destruction of morale resulting from this type of "business" management. Whoever has the interests of the reclamation projects at heart will look with anxious hope to the assembling of a new Congress and to the possible awakening of the President to the activities of the spoiler who represents him at the head of the Interior Department.

City Forces Build Sewage Treatment Works

Remarkable Construction Plant Installed by Sewer Department of Worcester, Mass., for Force Account Construction of Imhoff Tanks and Trickling Filter

By Earl R. Perry
Superintendent of Construction, Worcester, Mass.

NOTABLE construction characterizes the new sewage treatment works at Worcester, Mass. One of the largest Imhoff-tank and trickling-filter installations of the world is being put through successfully by day labor. The operation is very nearly self-contained; all materials are produced on the job except cement, lumber and the metal elements of the structures. All major equipment, even the 32x40-in. jaw crusher, is electrically operated. Minor features are form erection practically without falsework, cement-gun fabrication of thin slope walls of sedimentation chambers and winter concreting of heavy walls.

Explanation of each of these outstanding features is more appropriately made elsewhere except in the case comprise primarily Imhoff tanks, dosing tanks, trickling filter and secondary tanks. This location, however, necessitated, as indicated on the map, the extension, for about a mile, of the 72-in. outfall sewer. About 1,500 ft. of this extension is inverted siphon across swamp; the maximum head is 26 ft. and there are blowoff valves for drainage. The new sewer will have a capacity of 66 m.g.d. To increase the fall through the treatment units the channel of the river below the works was diverted as indicated on the map.

The structures on the sewer line are a Venturi meter and a grit chamber. The grit chamber, having two compartments with coarse bar screens, is located just above the point where the sewage will enter the siphon.

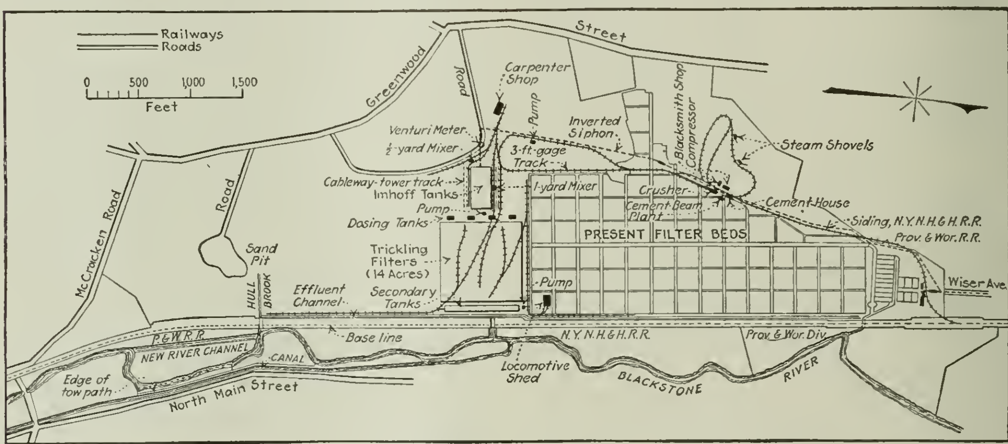


FIG. 1—CONSTRUCTION PLANT AND SERVICE RAILWAY LOCATION MAP

of force account work. This followed from the fact that the work was for Worcester. With the exception of buildings, the construction work of this city has always been done by its various departments. Therefore, when the treatment plant came to the point of construction the Sewer Department was instructed to undertake the work. With a portion of its personnel as a nucleus, a working organization of between 200 and 300 men was developed. Heading this organization are David M. Earle, city engineer; Ralph G. Lingley, superintendent, Sewer Department; and Earl R. Perry, superintendent of construction. Doing the work by day labor has been as rapid as and certainly no more expensive than contract construction. It is noted that only construction is considered in this article as follows: (1) structures, (2) plant, and (3) methods.

Structures—A map of the land owned by the city for sewage treatment purposes is shown by Fig. 1. Because its topography conformed fairly well to the requirements, the area just south of the present sewage filter beds was selected as the site of the new works which

It has sufficient cross-sectional area to reduce the velocity of the sewage from 3.8 ft. to 1 ft. a second. The two compartments will hold 100 cu.yd. of grit and will be cleaned by means of a clamshell bucket. As indicated by the map the 72x30-in. Venturi meter is located between the siphon and the Imhoff tanks.

In the Imhoff-tank unit there are two batteries of six tanks of the double type. The main influent and effluent channels separate the two sets of six tanks. One of the tanks is shown by Fig. 2, which indicates the general structure and the arrangement of the channels, which are all open and provided with gates for controlling and reversing the flow. The twelve tanks are designed to care for a daily flow of 28 m.g., or the sewage of an estimated population of 243,000 in 1934.

Each double tank, Fig. 2, is 61x90 ft. in plan and has a total depth of 33 ft. The tanks have a freeboard of 2 ft., a gas vent area of 21 per cent, and a detention period of 2½ hours. There are four sedimentation chambers in each tank with slopes 1⅓ to 1 and a total capacity of 240,300 gal. or 32,040 cu.ft. The sludge

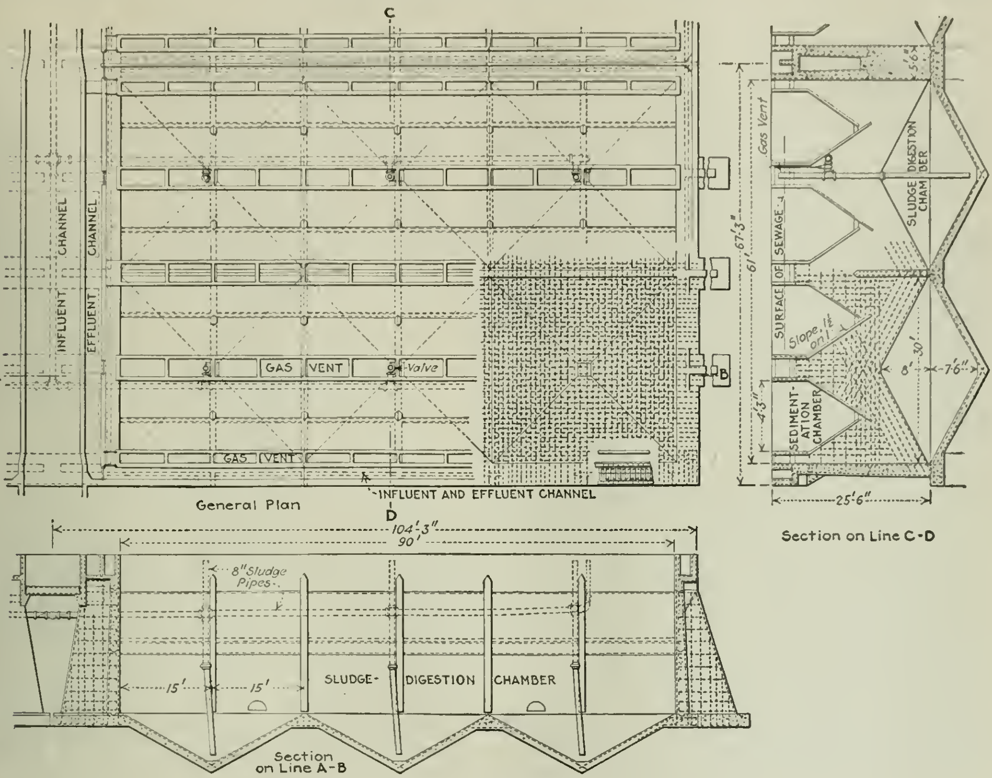


FIG. 2—DETAILS OF IMHOFF TANK—ONE OF TWELVE UNITS

chamber in each tank has a capacity of 70,200 cu.ft. and is provided with six hoppers from each of which sludge may be drawn through an 8-in. cast-iron pipe. The sludge will be dried on sand beds, a portion of the present sand filtration area being used for this purpose. Each hopper is an inverted pyramid 30 ft. square and has 1 on 2 slopes. Perforated water pipes will be placed on each slope for the agitation of the sludge.

The effluent from the Imhoff tanks flows into four pairs of dosing tanks discharged intermittently upon the trickling filter. The time of discharge will be three minutes. The trickling filter has an area of 14 acres and a depth of 10 ft. Distribution of the tank effluent is accomplished by 2,940 full nozzles and 60 half nozzles of the Worcester type. These nozzles discharge under a variable effective head of 7 ft. to 1 ft. and are spaced 15 ft. apart. There are seven inspection galleries in the filter, four of which have inverts acting as main collecting drains. Precast cement mortar beams set on sills form a grid floor having an air space of 43 per cent. A detail of this floor construction is shown by Fig. 3.

Four secondary tanks, each 60x120 ft. and 15 ft. deep, have a detention period of 1½ hours and a total capacity of 1,750,000 gal. These tanks will have hopper bottoms similar in design to those of the Imhoff tanks. An effluent channel 2,500 ft. long conveys the final effluent to the Blackstone River. A laboratory building will be erected at a point near the Venturi meter and be fully equipped to make regular analyses.

Plant—Decision to utilize local sand and stone required a large installation of plant. The map, Fig. 1, shows its arrangement. In addition to aggregate for the concrete tank work the construction of the trickling filter alone required 225,000 cu.yd. of crushed stone, ranging in size from 1½ in. to 3 in., and the manufacture of 2,000,000 cement mortar beams, 16 in. long, 4 in. wide and 1½ in. thick. These items presented the greatest problems and it was considered advisable to open a quarry, erect a crushing plant and

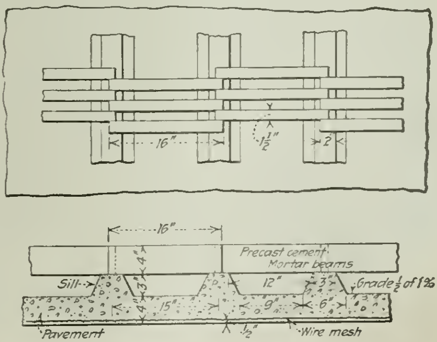


FIG. 3—DETAIL OF TRICKLING FILTER FLOOR

also a plant for the manufacture of precast cement mortar beams, and to open a sand pit. All this required much equipment.

The crushing plant consists of one 30x42-in. jaw crusher, used as a primary breaker, and two 13-in. jaw crushers used as secondaries, together with necessary elevators, scalping and sizing screens and bins. The stone less than 1⅛ in. is used as coarse aggregate.

A cement storehouse, capable of housing 25 cars of cement, was erected near the terminus of the standard-gage siding and near the crusher. All cement is unloaded from the cars by means of pallets and gravity conveyors. Boxes, containing two bags of cement, are filled by the storehouse men and lined up on gravity conveyors set in a horizontal position in readiness for the charging of batch cars. This method allows the batch trains to proceed without undue delay. An electrically-driven cement-bag cleaner was installed which reclaims 1 bag of cement from every 60 bags cleaned. All other materials such as lumber, steel and coal are transferred to the narrow-gage cars and transported directly to the work.

A two-stage compressor having a displacement of 599 cu.ft. per minute furnishes air for quarry drilling and for drill sharpening at a blacksmith shop equipped with a sharpener and an oil furnace. Ingersoll-Rand Jackhammers Type DDR are used for down holes, the Type DCR for block holing and the X-70 Leyner-Ingersoll Drifter for snake holes. The rock is loaded by two steam shovels into 4-cu.yd. dump cars from which it is dumped into the primary crusher.

A used brick press was purchased and remodeled to produce the cement beams required for the trickling filter floor. This machine turns out a very satisfactory product at the rate of 8 per minute. The press is fed by a continuous mortar mixer, the mixture used being 1:3. Very little water is used before the beam is pressed. The beams are caught on wooden pallets as they come from the machine and are sent to the curing chambers on gravity conveyors. Men stationed in the curing chambers remove the loaded pallets from the conveyor and stack them seven high. The product is very dense due to the great pressure exerted by the machine. The beams are cured for 48 hours under a temperature of 125 deg. F., and are frequently moistened by nozzles producing a very fine mist. An attempt was made to cast the beams by hand but the product proved much inferior and more expensive.

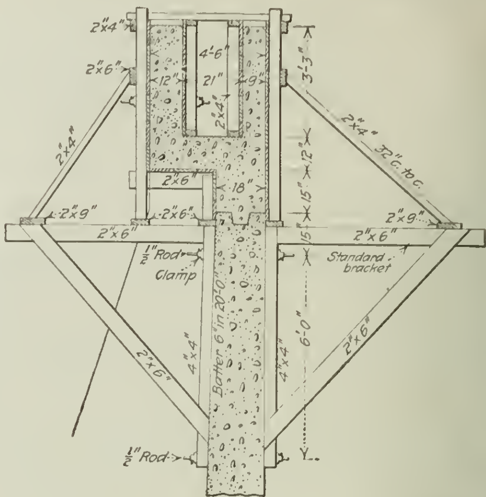


FIG. 5—BRACKETT SUPPORTS OUTSIDE CHANNEL FORMS

Practically all material is moved on 3-ft. gage track.

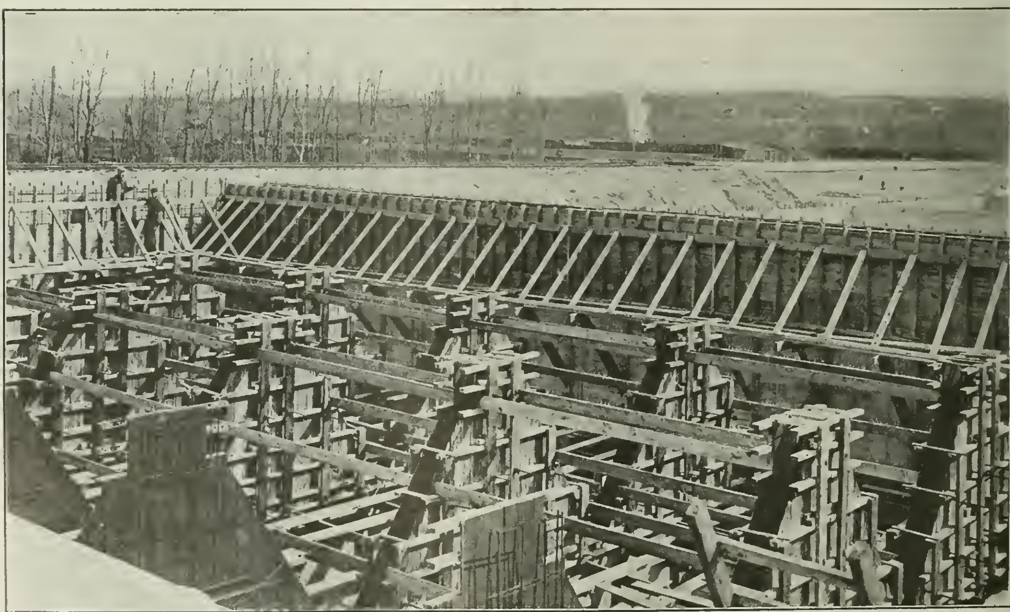


FIG. 4—TYPICAL FORMWORK WITH BRACKET SUPPORTS

Over three miles of track are used in the entire plant layout. Four 9-ton steam locomotives and seven 6-ton gasoline locomotives are in operation the greater part of the time. The maximum grade on track, which is in constant use, is 4 per cent. Three lines of track parallel the Imhoff tanks and come beneath the cableway span. One track on the south side of the tanks is used to transport material to the work at a high

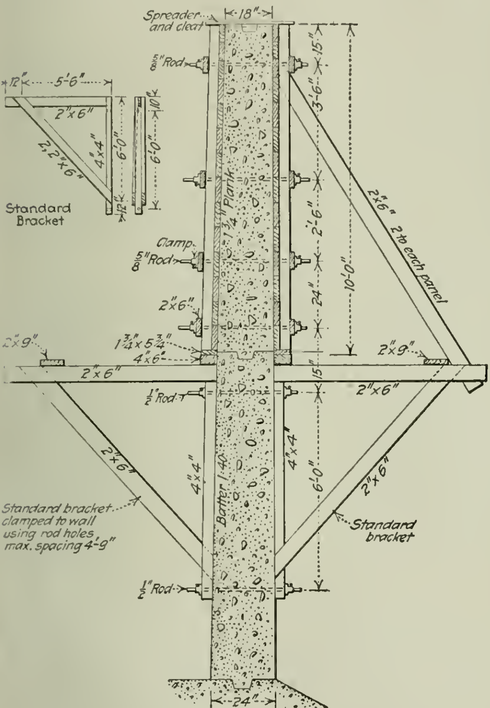


FIG. 6—BRACKETS FOR TOP LIFT OF WALL FORMS

level, while the track immediately north of the tanks serves a similar purpose at a low level. The latter track also handles the mixed concrete from the 28-S mixer. The third track is at the high level and is used by batch trains serving the mixer.

A carpenter shop with all necessary machinery was erected to the west of the Imhoff tanks at a point where there was ample space for piling lumber. Used lumber is returned to a saw installed near the tanks and is used where short lengths are required.

The principal piece of hoisting equipment on this work is a cableway, with movable towers, having a span of 374 ft. and a lifting capacity of 4 tons. This type of hoisting equipment was selected for the construction of the Imhoff tanks and has proved to be well adapted for this type of construction. It is easily and quickly moved by its own power. When removing forms and falsework which were to be moved ahead on the work they were piled on the front of the platform of the towers and moved ahead with them. It was an easy matter to keep the concrete fairly level in the forms. Much of the concrete was of such a stiff consistency that a chuting plant would have been useless.

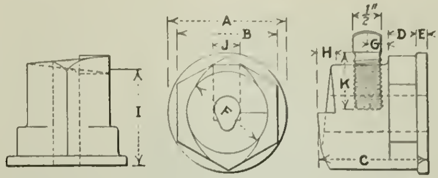


FIG. 7—CLAMP FOR TIE RODS FOR WALL FORMS

A 28-S mixer was used while concreting the heavy section work, the set-up of this mixer being so arranged that batch cars could be dumped into the batch hopper. Trains of six batch cars receive measured quantities of stone and cement at the crushing plant and cement storehouse and later take on measured quantities of sand from bins located near the mixer. Three trains are constantly serving this mixer. Sand of excellent quality is obtained on the property, the charts being loaded by Fresno scrapers through a trap in an overhead platform.

By a short extension of the New England Power Company's high-tension line and the installation of transformers, electric power was available and has been used for the crushing plant, compressor, cement beam plant, cableway, concrete mixer, carpenter shop and pumps. Seventeen motors with a total of 550 hp. are in use. This power is extremely satisfactory and reliable. Only one serious interruption of service has been experienced, this being due to an ice storm of unusual severity. The loss of the power was of no importance as it was impossible to proceed with the work for several days.

Construction—The difference required in elevation between the surface of the sewage in the Imhoff tanks and the surface of the final effluent is 25 ft. In order to obtain sufficient fall through the plant it was necessary to lower the level of the Blackstone River at Hull Brook. The river level was lowered 3 ft. by excavating a new channel as shown by Fig. 1. This excavation was made by two steam shovels, one passing the material to another located on the bank. In addition to the excavation of the new channel about 500 cu.yd. of ledge were removed which almost completely blocked the course of the river. During this work the river water was diverted to an old barge canal which formerly connected this city with tide water. The excavation for the effluent channel was then made, thereby lowering the water table at the site of the trickling filter about 4 ft.

Practically the entire site of the Imhoff tanks, dosing tanks, trickling filter and secondary tanks was a thickly wooded swamp having a gravel bottom overlaid with peat varying in depth from 2 ft. to 12 ft. Two steam shovels loading narrow-gage trains were used to re-

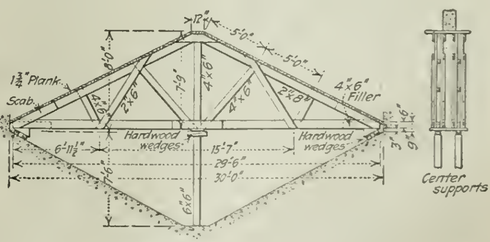


FIG. 8—FALSEWORK FOR TRANSVERSE WALL FORMS

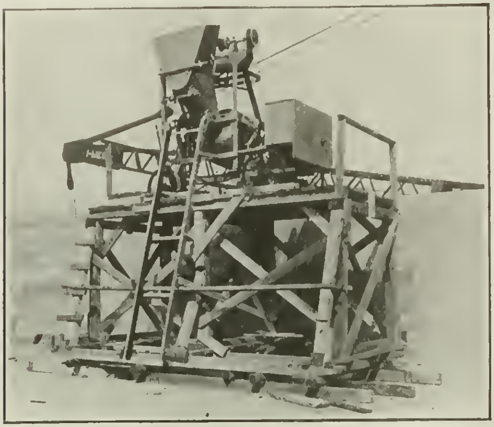


FIG. 9—OUTFIT FOR CONCRETING FILTER WALLS

move the peat. Good foundation material was several feet below the subgrade of the filter area. This was brought up to grade by backfilling with gravel which was allowed to settle and later rolled. The bottoms of the Imhoff tanks are about 7 ft. below ground-water level. A 5-in. electrically driven centrifugal pump has easily and economically taken care of the water. As soon as the excavations for the hopper bottoms were completed the subgrade was roughly plastered with 2 in. of concrete in order to preserve the shape of the excavation. The hopper bottoms were constructed by using stiff concrete well tamped and finished with 1 in. of cement mortar. At first forms were used but they proved expensive and difficult to place and the results were not always satisfactory.

Panel forms 7½x10 ft. in size, Fig. 4, were used extensively on the tank wall construction. These were of fairly heavy construction, 1⅝-in. planks being used instead of boards. Some of these panels have been set twenty times and are still in good condition. The walls of the tank were constructed in three lifts, the forms being supported and sway-braced by brackets attached to the preceding lift as shown in Figs. 5 and 6. Rods and clamps of ⅝-in. steel were used to tie the forms for concreting. These rods were pulled, the forms removed and brackets fastened to the wall by ½-in. rods and clamps. A new rod clamp, on which a patent has been granted, was developed on this work and has proved very satisfactory, Fig. 7. This clamp has a cam-shaped face by means of which it may be tightened against the form by temporarily using another clamp which is a duplicate of the first. This is accomplished by locking the cams on two of the clamps and tightening the setscrew on the outer clamp upon the rod. The clamp nearest the form is then rotated by applying a wrench on the hexagon forcing it against the forms. The setscrew on this clamp is then tightened and the outer clamp removed. The clamp is provided with an ellipse-shaped hole by which a wedging grip is secured on the rod without bending it. The forms and concrete for the transverse walls were supported by falsework as shown in Fig. 8. These frames were set on wedges and re-used. This wall was placed in two lifts, the second lift forms being supported by a staging clamped to the first lift of the wall. The panel forms for the vertical gas vent walls were supported by pieces clamped to the second lift of the transverse walls. This method of supporting forms saved considerable falsework which would have been difficult to erect owing to the sloping hopper bottoms and the fact that they were nearly always flooded.

A 1:2:4 concrete mixture has been used on nearly all the work. The concrete was mixed at a central mixing plant, discharged into controllable form buckets and run on a narrow-gage track to the cableway by which it was placed in the forms. While the cableway was handling a bucket of concrete the locomotive returned to the mixer with the empty bucket for another batch. This system worked out well as both operations required about the same time. Walls running at right angles to the cableway were concreted by moving the towers, the concrete being placed in several walls during one operation. In the case of thin walls the concrete was shoveled into the forms by hand, no attempt being made to place it directly into the forms by the bucket.

Concrete work on heavy wall sections was continued during the winter, the panel forms being boarded on the outside of the studding and the space packed with straw. The top of the wall was protected by tarpaulins under which live steam was exhausted for 48 hours. Concrete was not placed in forms on days when the temperature was below 15 deg. F. at 8 a.m. It was estimated that this cold weather work cost from 25 per cent to 30 per cent additional and was carried on in order to advance the construction as fast as possible and to retain a large part of the working force. No attempt was made to concrete walls of light section during cold weather.

The sedimentation slopes are constructed by means of the cement gun, the gunite being shot against a form. The slopes are 3 in. thick and well reinforced with triangular mesh and diagonal rods. The mixture used is 1:3, but owing to the rebound, which is largely sand, the material as actually placed is estimated to be approximately 1:2½. The sand and cement is passed through a ⅜-in. screen before being placed in the gun. A rough coat 2½ in. thick is shot first, followed by ½ in. of finish. The finish coat is troweled with plastering trowels. This work is done under canvas in order to protect it from too rapid drying and sudden showers

FIG. 10—CONCRETING SILLS, TRICKLING FILTER FLOOR

which might damage fresh work. The covers are left on for 5 days, during which time the slopes are frequently wet down. Experience indicates that this is essential to good work. The forms for this work were set on wedges in order to guard against possible damage to the work during the removal of the forms. In order to concrete about 3,000 ft. of wall which will enclose the trickling filter a mixer was placed upon a raised platform and provided with an extended skip track, Fig. 9. Platform and mixer are removed on rolls.

The 4-in. concrete floor and the sills of the trickling filter floor are concreted by means of buggies and one-bag mixers. A steel form for the sills, Fig. 10, which keeps its shape and is easily filled was designed on this work. Before dumping the crushed stone of the filter upon the beams it is necessary to carefully place about 6 in. of stone in order that the drains will not become clogged due to stone falling between the beams. When this work was done by hand-placing it was found that there was a tendency of the workmen to fit the stone together thereby destroying the air space of the floorings. In order that these stones might be dumped upon the beams from wheel-barrows and the drains be kept clear, sheet-iron pans 8 ft. long were placed in the drains to catch falling stones. These pans are moved ahead and cleared of stones as the work progresses. It is essential that the stone of the filter be kept as free as possible from dust and fine stone. Screens of 1½-in. mesh were placed on blocking 6 in. above the floor of the dump cars which transport the stone from the crusher bins to the bed. In this way a false bottom is formed which retains the dust and fine stone. After the stone has been dumped the cars are run off the filter and dumped to the other side which removes the dust and fine stone.

Will Not Abandon Severn Tunnel

The published statement that the Great Western Ry. of the United Kingdom is planning to abandon the tunnel under the Severn River is denied by an official of that railway. This engineering marvel of 1886, in the course of industrial progress has become a limiting factor in the most expeditious handling of the increasing traffic movement between England and South Wales. The plan to bridge the Severn from Beachley to Aust is simply to provide an auxiliary route. It is the intention to continue to utilize the tunnel to the maximum of its capacity for an indefinite period to come. With the coming of electrification at no distant day, the one objection to the use of a tunnel nearly five miles long will be overcome in the elimination of smoke. The cost of maintaining the tunnel has been remarkably low and it requires very little attention per day despite the fact that it has been in use more than 37 years. The detailed arrangement for the bridge probably will be announced in the near future. The structure will carry four lines of track and a broad roadway for vehicular traffic. It is expected that the government will be a heavy contributor to the cost of the bridge as there is almost as great need for additional highway facilities between England and South Wales as there is for an auxiliary railroad route. The railroad company is insisting on the construction of a bridge with sufficient clearance to make a draw-span unnecessary. This probably will mean that a clearance of 60 ft. at high tide will have to be provided. The cost of the structure is expected to be $25,000,000.

Height Limits for Chicago Buildings

AN INCREASE in the height limit of buildings in the "loop" or business district of Chicago is made practicable by a decision of the corporation counsel to the effect that the new zoning law is superior to the city's old building code. That code limited the total height to 400 ft., including a tower, and also limited the height of main structure to 260 ft. At present the only building which exceeds that limit is the Chicago Temple Building, which houses a Methodist church and is surmounted by a steeple tower or spire extending to a height of 556 ft. This construction was made possible by a special city ordinance, based on the ecclesiastical purpose and design, while the spire gives little obstruction to light or air. In designing the new Straus Building a 10-story rectangular tower was provided, rising above the 22-story main building and having its roof 475 ft. above the street level. Objection to this was made on the part of the city, but the objection is disposed of by the legal opinion noted above.

Under the zoning ordinance (reviewed in *Engineering News-Record*, May 31, 1923, p. 958) the height of main building in the loop district is fixed at 264 ft. No maximum height for a tower is specified, but there are certain restrictions. Under this ordinance the tower of a building having the dimensions of the Straus Building might extend to a total height of 565 ft. The limitations of tower design under the building code and the zoning ordinance are as follows:

Floor Area—Building Code: In no case shall the area of the tower exceed 3,600 square feet.

Zoning Ordinance: The area of the tower at its base shall not exceed 25 per cent of the area of the lot on which the building is erected.

Width—Building Code: The tower shall not exceed in width one-fourth of the street frontage of the building on which it is erected.

Zoning Ordinance: The face of the tower shall not exceed 50 per cent of the street frontage of the building.

Volume—Building Code: The area of the tower shall in no case exceed 15 per cent of the area of the building upon which it is erected.

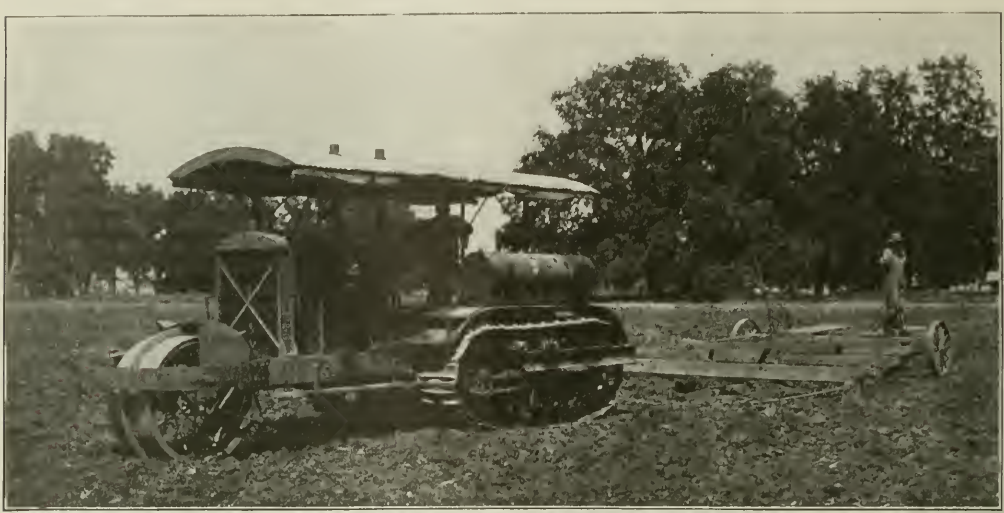
Zoning Ordinance: The volume of the tower is limited to one-sixth of the total volume of the building measured in cubic feet.

Height—Building Code: In no case shall the height of the tower exceed 400 ft. above the street level.

Zoning Ordinance: This ordinance makes no mention of any limitation of height. The height of a tower is governed by the provisions indicated above.

Cornices and Parapets—The old building code permitted a cornice projection of 5 ft. The new zoning ordinance provides that at the top of a building the cornice may not project more than 2 ft., but it allows the cornice to be increased beyond the 2 ft. to a maximum of 5 ft. on a sliding scale, depending upon the distance below the height limit that the cornice is placed on the building. This ordinance also places a limit of 8 ft. on the height of parapets. There was no such limit clearly stated in the building code, with the result that there are said to be parapets 30 ft. in height in Chicago.

Alley Set-Back—Another regulation provided by the zoning ordinance is the set-back along the alley frontage of buildings. In the downtown district no wall of a building may be erected nearer to the center line of an alley than a line beginning at a point in the middle of an alley and leaning toward the building line 1 ft. for each 10 ft. in height.



Tractor and Checker at Work on Durham State Land Settlement

Federal Land Reclamation: A National Problem

5. After Reclamation, Organized Land Settlement

By GEORGE C. KREUTZER

Superintendent, Durham State Land Settlement, and Executive Officer the State Land Settlement Board Durham, Calif.

The fifth of a Series of Articles on the History and Performance of the Great Government Adventure in Irrigation of the Arid Land of the West.

What Mr. Kreutzer sets forth in this article is based on more experience than that derived from the two California settlements. In 1909, after a period with the Reclamation Service, the author went to Australia with Elwood Mead and worked with him in land development for the state of Victoria. They established 32 settlements there. Careful observation of the conditions and problems of this work forms part of the background of the present article. Readers interested in the early history of the Durham settlement will find a useful account in ENGINEERING NEWS-RECORD *of Dec. 5, 1918, p. 1014, under the title "Developing Irrigated Land with Selected Settlers."*—EDITOR.

IF AN IRRIGATION project is to succeed, the payment for land irrigation works must come from the sale of the products raised on the farm. This means that the settler must make a success of his farming, and his success in turn is dependent on getting his farm into full production at the earliest possible time. The common belief that good soil and an adequate water supply are all that a settler needs to start farming is a fallacy. Much more is needed; the settler's problem has just begun when the engineers have finished the canals and put water on the high corner of the farm. But reclamation has been mostly engineering. Little or no attention has been given to the aid and direction of settlers, and no financing of the settlers has ever been done in this country.

The development of raw land to the point of satisfactory production is expensive. The erection of farm cottages and barns takes time and money. Yet the family must be housed and land must be graded and farm ditches built in order that irrigated crops may be grown. If there is only one pair of hands to do all the work, something must remain undone; the farm work usually suffers and a cropping season is lost. Moreover, grading land, building ditches, and erecting farm buildings are not farm work. Many farmers have neither the skill nor the inclination to do it well or effectively.

Some Neglected Matters—Careful selection of settlers, intelligent guidance, assistance with money for worthy projects, and the organization of co-operative marketing are some of the things that have been neglected. Community spirit and a desire to co-operate with one another must be encouraged to accomplish for the individual the things that he can not do for himself. Collective bargaining must be a part of the plan. Co-operative purchasing and co-operative marketing must be done when and where they are economically sound. When none of these things is done for the settler he may scratch out a living but he is rarely able to pay interest on the cost of his farm or reclamation charges, much less on the capital debt.

Small farms well tilled and efficiently equipped are the kind that pay. When raw land was cheap and taxes and irrigation charges were low it was not so important that the whole farm be immediately put under intensive cultivation. Returns from crops that could be pro-

duced with little work and capital were sufficient to meet fixed charges. But under present-day conditions, in order to colonize successfully settlers must have long-term credits and enjoy low rates of interest to purchase their farms and make needed permanent improvements and to provide live-stock and equipment. There is nothing new or experimental in supplying such credit. Holland, Denmark, Great Britain, Germany, Italy, France and Australia loan money to settlers at rates of interest from 2½ to 4 per cent and for periods of from 40 to 98 years. The loans are not subsidies, simply loans; but as such they form the vital feature in a workable plan. These countries realize that their social, economic and political salvation are dependent on a home-owning population. Denmark has been converted from a country of tenants to one of home owners in less than half a century—the result of a sound land settlement policy.

California Settlement Law—In this country no attention was given to organized land settlement until California passed its state land settlement act in 1917. It provided long terms on the purchase price of the land; loans for effecting improvements and for the purchase of live-stock and equipment; and service in farm engineering, animal husbandry, orcharding and other branches of agriculture. Aid and direction were to be fully utilized.

Two settlements have been established: one at Durham, comprising 6,400 acres, upon which 143 families are located; and the other at Delhi, of 9,000 acres, upon which 270 families are located and which finally will accommodate 360 families. The Durham settlement was established in 1918 and the one at Delhi two years later.

Developing Durham—The land for the Durham project was a portion of a large cattle ranch, with a skeleton irrigation system. Accurate soil and topographic surveys were made, followed by the subdivision survey. The farms were not the customary rectangular 20, 40 or 80-acre units but were of such size and shape as the character of the soil and topography indicated would be best adapted for farming and the kind of settlers who were likely to settle upon them. Proposed irrigation ditches and drainage courses were made boundaries of farm units. This minimized the construction of ditches and structures. The ease with which a rectangular farm may be worked means nothing if it is traversed by a diagonal ditch. The tract was divided into 109 farm units of 96 to 300 acres each, and 34 farm laborer's allotments of 2 acres. The price of the land was fixed according to soil type and topography, based on the productivity of the soil and the cost of bringing raw land to full production; it ranged from $48 to $245 per acre, which included a paid-up water right and full construction costs. As the survey stakes were put in for farm ditches the agricultural program proceeded rapidly. Farm laterals were built, land was graded and alfalfa sown. Areas that could not be made ready for alfalfa were sown to grain.

In June, 1918, the first 60 farms were thrown open for settlement; 900 acres of alfalfa were established and over 1,200 acres of wheat and barley were ready to cut by the end of June. All farms had not been planted, but those that were proved most popular with the applicants; they realized the benefits to be gained from buying a farm where harvesting would be the first agricultural operation. The planting work was charged to each unit at cost, and grain crops that cost an average of $9.50 per acre brought returns to the settlers as high as $40 per acre one month after settlement. The returns per farm varied from $326 to $2,015, with a full summer season ahead in which to grow crops.

What Was Asked of the Settler—The terms of sale were 5 per cent of the selling price as a deposit and the balance payable in 40 semi-annual amortized payments which included interest at 5 per cent per annum. Thus a $5,000 farm could be purchased for $250 down and forty half-yearly payments of $190 each. A 40 per cent deposit on permanent improvements was required, the balance being repayable similarly to the balance due on land.

The Board set the minimum capital a settler should have at $1,500—more would be better, of course. Livestock or equipment was considered as part capital. That capital was not the only asset a settler should have was fully recognized. He must possess agricultural experience, industry and good health, and generally be of such character as to make the highest use of the unusual opportunity offered. It is believed that no plan can be successful where citizenship alone is the only requirement; many failures must result from it. Agricultural experience is necessary to put energy and capital to their highest uses. Successful farming is closely coupled with hard work, careful living and a habit of husbanding resources seldom found in other occupations.

Advising the Settler—On each application for a farm, consideration was given to the kind of farming the applicant would follow and how he would develop the farm with his limited capital and the state's assistance; farms were granted to those most likely to utilize the opportunity offered. When possession was given conferences were held with those needing help and a program was agreed upon that would put the farm on a paying basis as early as possible.

The farmstead engineer, who was a trained architect and recognized rural building requirements, designed the settlers' houses, barns and other buildings to fit in with each settler's limited pocket-book. He got them the most for their dollars: structures of architectural merit, convenience and cheapness and at the same time adapted to additions without costly alterations. Conferences between the superintendent, the farmstead engineer, the settler and his wife often resulted in the abandonment of an expensive house plan and the substitution therefor of something cheaper but sufficient for their needs. Farmstead layouts were made showing the proper location of house, barn, garden, poultry runs, family orchard and corrals. This service prevented the settler from making costly mistakes and provided neat farm layouts. Natural advantages in topography and growing trees were made use of.

Each settler was furnished a contour plan of his farm upon which were located farm ditches, check banks and proposed structures. Since the contour interval was 6 in., most of the engineering service could be given from the plan, thus reducing field work to a minimum. This service does away with guess-work.

At least once each year the settler's assets and liabilities are summed up and his net worth determined. At the same time an operating statement is made estimating the next year's income and expenditure. This

is done primarily for the settler's information and secondly for the information of the administration—credit cannot be extended without such statement. To get data for the statement a thorough inspection of the farm must be made, and it is found that at such times the most helpful suggestions can be made for the betterment of the farmer's condition. His economic problems can only be solved when all of the facts are known.

The Settlement Act provides that up to $3,000 may be loaned to a settler upon the security of permanent improvements, live-stock or equipment. Much less is loaned to him if he can get through without the full amount. It should not be made too easy to get money, or difficulty will be experienced in getting it back. The farmer should be made to recognize his obligations and make an honest effort toward meeting his debts. This means a proper division of the farm income between the financing body and the farmers as the operators of the farms.

FIG. 1—A PLANNED FARMSTEAD AT DURHAM

Borrowings—Loans may be made on permanent improvements up to 60 per cent of their value and are repayable in 40 semi-annual payments including 5 per cent interest. Likewise, loans on live-stock and equipment are granted, when needed, up to 60 per cent of value, repayable in 36 monthly payments.

Nearly all of the settlers at Durham and Delhi have borrowed some money. Many would not have survived had provision not been made for this credit. It would have been the usual story of spending their own money and still the farm would not be on a paying basis. They would need a little more money and at best could get a short-time loan with no chance of meeting it at maturity: a few months or a year of this struggle and another abandoned farm would be left as a monument to an unsound land settlement policy.

Few people realize how costly it is to bring a farm into full production. An analysis of six of the best dairy farms at Durham shows that the cost of barns, fences, grading, alfalfa, ditches, hog houses, dairy equipment, domestic water system and other necessary improvements, not including the house, amounted to $119 per acre for a 30-acre unit. The cost of dairy cattle, hogs and other live-stock amounted to $85 per acre, and equipment and farm tools amounted to $20 per acre. This is more than $200 per acre and still the cost of the land and house must be added. The live-stock investment may seem high, but it takes good cattle to produce profit; scrubs won't do. However, the figures are not alarming when understood.

These farmers made a larger return on capital investment than do those not so well equipped. The investment was not all needed at once, and a considerable portion of it was made from income; but all six farmers had borrowed money from the state. It can therefore be readily seen that loans for improvements, live-stock and equipment speed up the development program and hasten the approach of the time when the farmer shall become self-supporting.

How One Loan Helped—A young couple settled at Durham and had $3,000 capital. They purchased 41 acres, of which 36 acres were in alfalfa. The cost of the grading, ditches and alfalfa was $1,640, on which they paid down $656. A comfortable cottage cost $1,500, upon which was loaned $900. The settler built his own barn at a cost of $600, and purchased a team, wagon, cow and heifer, harrow, plow, rake, mower and other tools costing $850. Initial deposit on land was $461.50. He had to have a well and hand pump and $140 worth of lumber for chicken house and other outbuildings. His expenditures to this time were more than his original capital and he would have been in debt had he not sold his first cutting of alfalfa. Soon a half yearly payment would be due the board. Before the second cutting of alfalfa was harvested an inspection of the property was made. The alfalfa was past the stage of making good cow hay. The family was called upon and the young wife said that her husband was driving a tractor in a neighboring county, while the alfalfa had been let to a neighbor on shares. The neighbor was busy cutting his own field, and counted on spare time to farm the neighbor's field, where he got only half the crop. After several questions were asked, the young wife admitted that they were "broke" and a tear coursed down her cheek as she related that they had never been entirely without funds before—Of course they hadn't! They wouldn't have had $3,000 in the bank when he was 35 and she 29 if they had not been saving and careful. A conference was arranged and the husband sent for. At the conference a program was agreed to which provided for the purchase of sufficient dairy cattle to utilize the feed. The cattle purchased could be added to their assets and give ample security. The following week they had 11 high-grade cows instead of two, and they were on the pay roll. Their first week's check from the Dairymen's Association amounted to $48.47. They had borrowed $1,110 to make the purchase of cattle, payable in 36 monthly payments of $33.30 each. One week's check would meet it and leave $15 to buy groceries. His loans at that time amounted to $2,994.

That live-stock note was paid on time and the farmer and his wife have progressed; their net worth increased from $3,000 in 1918 to $8,149 at the end of 1922. A loan at the right time rescued a somewhat hopeless situation and this family can now look forward to the future with confidence. And so nearly every settler's progress is a story.

Land For Laborers—There is no definite type of farm laborer in this country. Itinerant laborers drift from the grain belt to the fruit sections and finally congregate in the large centers during the winter and spend their scanty savings. Few are married, and if

they are it is a difficult struggle for parents and children. This is an unsatisfactory condition; the laborer should be a home owner and live under his own fig tree and vine. It rivets him down and gives him the same satisfaction and ideals possessed by the farm owner; he becomes interested in taxes, schools and community improvement. His children have the same self-respect and independence as the children from the farm homes, and these children are going to be the farmers of the future. Hence a place was made for the farm laborer at Durham and Delhi.

The laborer allotments are 2 acres in area and the same purchase terms are given as on the farms. Laborers were accepted as settlers on these allotments if they had the initial deposit. Except in two cases, they had an average capital of less than $200. When they could not pay the 40 per cent cash deposit on their cottage, but had skill in the use of tools, the materials were bought by the state and the labor furnished by the purchaser (generally labor on such buildings is equivalent to 40 per cent of the total cost).

At the end of 1922 these laborers had increased their assets from $6,000 to $39,000, or an average of more than $1,000 each. They are independent and owe nothing that is due; four have completely paid for land and improvements. No farm laborer has failed. The few who left did so because they were offered permanent work elsewhere that seemed attractive. One who came with $20 left three years later with $1,400 in his pocket. Another, a carpenter, who came with $150 at the age of 48 years, now has a five-room house, barn, vineyard and berry patch, cow, poultry and small tools, a Ford to take him to his work, and total assets valued at $2,700. In short, the farm laborers have worked hard because they could see daylight, because conditions had been made favorable for the economic and social growth of the laborer and his family.

Community Matters—At both Durham and Delhi the settlers were organized into a co-operative association to take care of their social and business needs. Through the association, purchasing was done in carload lots. Cement, posts, wire, seed, fertilizer, and many things that were needed for the development of their farms were bought and distributed at cost. No attempt was made to buy groceries or personal effects. The association acted as the clearing house for the community. Specialists from the University of California gave talks on tuberculosis in cattle and its control, management and care of poultry, pruning, deep tillage, and other timely subjects.

California is favored in having many agricultural commodity co-operative marketing associations—raisin growers, prune and apricot growers and a score more. These associations are state-wide. The Durham and Delhi settlers utilize them where their products can be marketed in that way. When products are produced in sufficient quantity and no association exists to market the product a small co-operative is organized if it is economically sound to do so

There was no co-operative association to handle the dairy products at Durham. It was discovered that a good whole milk and sweet cream market could be developed. At first a small hand separator was rented and the first week's sales amounted to only $40, but the business grew to $100,000 per year. The dairymen own a modern plant and produce milk and cream of high quality. The plant and equipment have been paid for by charging dairymen 5c. per pound of butter fat and 1½c. per gallon of milk. After the deductions were made the dairymen received more for their product than if they had sold their product independently.

The Result as a Whole—Thus two settlements were established where the settler worked with better tools, owned better live-stock and had mobilized for him all the skill and science of modern agriculture. Because many of the things mentioned have been lacking in land settlement heretofore, too many settlers and projects have failed.

The plan outlined and functioning in California is

FIG. 2—GETTING HIGH FARM PRODUCTIVITY THROUGH DAIRYING
Herd of Jim Braden at Delhi, Calif.

not a panacea, but it is a better way of doing it than any other way tried. People of industry, character and energy, together with reasonable capital, can and do succeed. While much is provided by the state, still the individual must do his part. He must avoid pitfalls in agriculture that ruin many.

I have no patience with men who complain that ten or a dozen dairy cows are slavery. They are not. They are an anchor to keep people from skylarking around the country when they ought to be at work. Any of us, if we expect to be of any use in our chosen line, must keep our noses to the grindstone. The study of successful people in any community proves this, hence it has been our aim at Durham to have our people engage in a kind of agriculture that is safe, in which the dairy cow plays a large part in the prosperity of individuals. insuring that the fertility of the land will be maintained, as well as bringing the farmer a ready income.

Dr. Mead, chairman of the State Land Settlement Board, said of the policy applied at Durham and Delhi: "It is a radical departure from the methods of the past. The day of the speculative land buyer is gone. The day for the creation of communities, organized for teamwork in business, in farming and in social advancement, must soon come. There has never been in the history of the world a greater opportunity to create a high rural civilization than can be achieved in the United States under a planned development by utilizing the knowledge, ability and experience of all its people."

[*The next article in the series will appear in the issue of Nov. 29.*—Editor.]

Composite Foundations for Large Temple Building

Concrete Piers for Column Groups—Concrete and Wood Piles Elsewhere—Underpinning for Original Footings

HEAVY FOUNDATIONS including a combination of concrete piers and concrete and wood piles, together with a concrete dome over a large basement area, are required for the Bahai temple now being built at Wilmette, Ill. An exceptional feature of the work is that after the pile footings had been built they were underpinned to give the required carrying capacity. A general description of the structure is necessary for an understanding of the foundation conditions.

The building will be a nine-sided structure about 150 ft. in outside diameter with a central space 72 ft. in diameter and 162 ft. high from the main floor to the top of a dome. This dome, with a rise of 49 ft., will be composed of steel ribs and framing and beneath it will be an ornamental ceiling dome of similar construction. Around the central space and forming the outer part of the building there will be nine rooms or compartments 40 ft. wide, one of which is assigned to stairways giving access to the galleries. At the base of the dome will be a drum or ring girder supported at nine points by groups of four columns. With the galleries and other interior structural work the foundation load at each of these points will be about 810 tons.

Nine concrete piers 6 ft. in diameter and carried down to rock at a depth of 120 ft. below the ground constitute the foundations for the central part of the building and the steel dome. At the top, each 6-ft. pier is flared out to form a rectangular cap or footing 11 x 9¾ ft., as shown in Fig. 1, to provide support for four steel columns, as noted above. It will be seen that owing to the shape of the building these columns are placed eccentrically on the footing. Steel reinforcing is used in the flaring column cap. Upon the cap is a grillage composed of nine I-beams in one direction and six in the other direction, the latter being grouped three under each pair of columns.

Spread footings would have been permissible for the lighter loads of the outer structure around the central

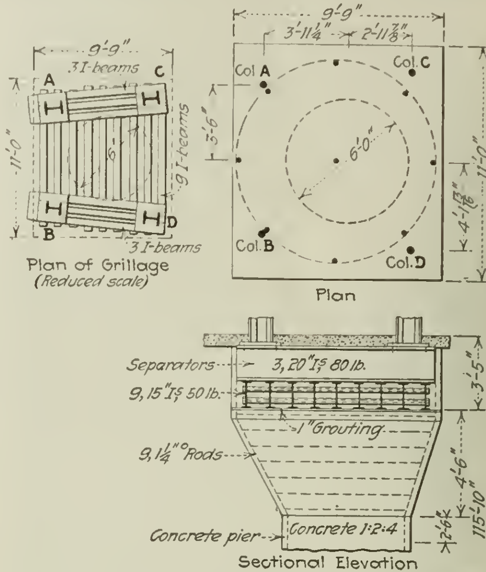


FIG. 1—FLARING HEAD OF FOUNDATION PIER CARRIES FOUR STEEL COLUMNS

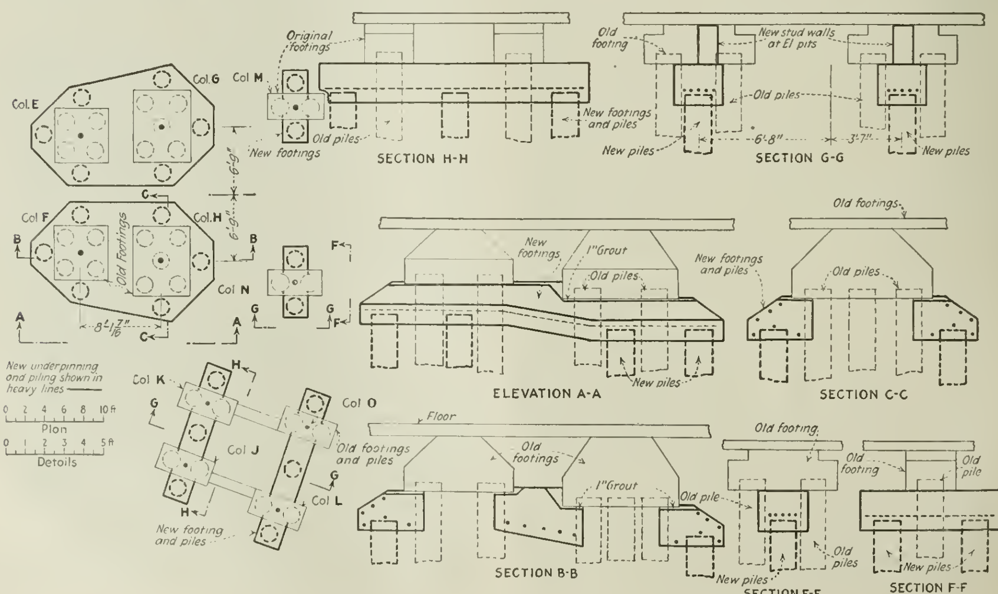


FIG. 2—COLUMN FOOTINGS REINFORCED BY UNDERPINNING

area. But to provide for greater security against settlement, in view of the fact that the central foundations are rigidly supported on rock, it was decided to use concrete piles 18 ft. long for this part of the work. It was recognized that in general it is not the best practice to combine two different types of foundation in one structure, but it is believed that in this case both types are so secure or stable that there will be no movement or settlement sufficient to cause cracks or distortion in the superstructure.

Construction difficulties were encountered with both types of foundation. Water was the great difficulty in these caps forming underpinning for the original footings, as shown in Fig. 2.

Piles of composite construction were used for this reinforcement of the outer foundations. In the first place, timber piles 35 ft. long were driven to such depth that the tops were approximately 20 ft. below the ground line. Then a concrete shaft 16 in. in diameter was poured in place on top of each wood pile and extended up to the underside of the concrete footing. These new piles were tested and showed ample supporting power.

A foundation dome for the main floor area is another distinctive feature of the work. In the basement a

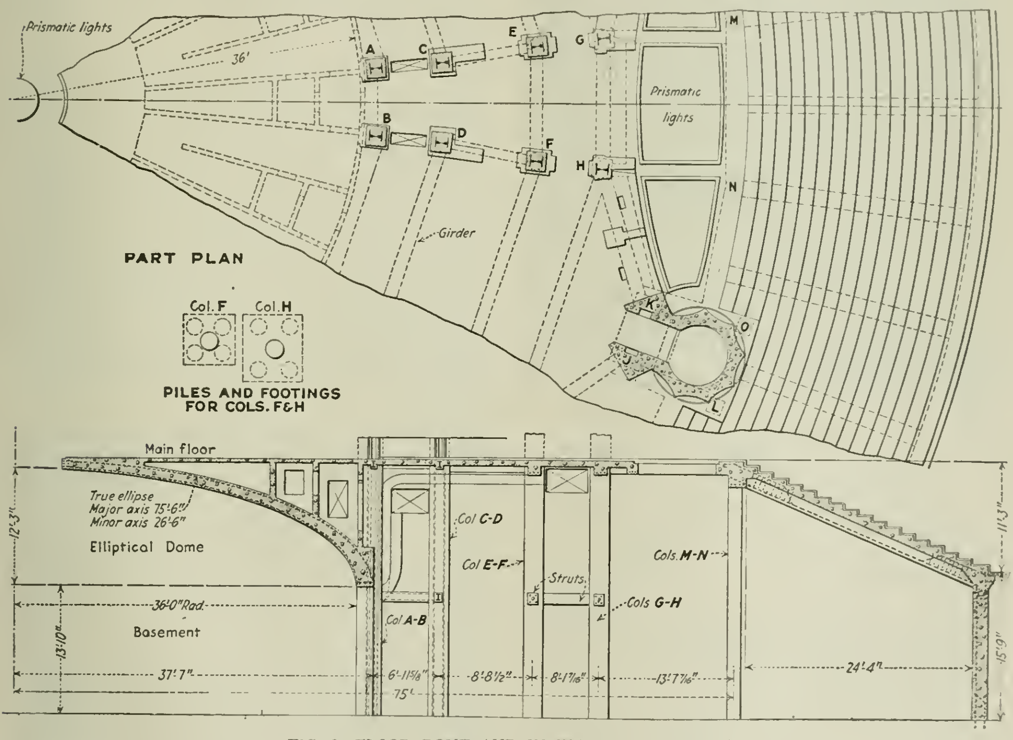


FIG. 3—FLOOR DOME AND FOUNDATION COLUMNS

the pier foundations, which were constructed in wells 6 ft. in diameter, sunk through clay and gravel. At a depth of about 80 ft. below the surface, water was encountered in considerable quantities so that the work could proceed only very slowly. At times three steam pumps were used in a single well to remove the water fast enough to permit digging. All of the wells were finally landed successfully on bed rock and then filled with concrete to elevation of base of steel columns.

Concrete cast in place and consolidated by dropping heavy weights was the method used for the concrete piling, but on testing some of the piles it was discovered that they would not carry safely the loads for which they were designed. Further examination showed that the piles had not been put in according to the prescribed method. As a result it became necessary to reinforce all of the minor footings. This was done by driving additional piles and placing concrete caps upon them,

clear space was required 72 ft. in diameter and unobstructed by columns. To meet this requirement a concrete dome is provided as shown in Fig. 3. This is formed as a true ellipse having a rise of 12 ft. 3 in. and giving a total clear height of 26 ft. from basement floor to crown. It springs from the concrete casing of the nine groups of steel columns, already mentioned. As this dome is regular in shape and is uniformly loaded, its design and construction did not involve particular difficulties. Its shell is 12 in. thick, reinforced near the inner and outer surfaces by a network of radial and circumferential rods. The floor load which the dome is designed to carry is 100 lb. per square foot.

The general plans and models for the building were prepared by Louis Bourgeois, architect, New York, with H. J. Burt, Chicago, as consulting engineer in the structural and foundation design. The foundations and basement were completed just before the winter of 1922.

The Four Refuse Disposal Plants of Paris, France

Contractors Collect Mixed Refuse in 700 Motor Trucks and Deliver to Sorting, Screening, Grinding and Destructor Plants Operated by Another Company—Fertilizer, Brick and Electricity Produced

By Russell L. Willard
Assistant Technical Director, "Traitement Industriel des Residus Urbains," Paris, France

IN PARIS, the different kinds of refuse from a population of about 3,000,000 are not collected separately. All ashes, garbage, and other household residue or rubbish, as well as matter from the markets and certain street litter, are taken up together. Street sweepings have most generally been flushed into the sewers. Since the war the collection has been made every day and at one time only, early in the morning. This method of a total collection daily is expensive but very satisfactory.

The collections are made in some 700 motor trucks

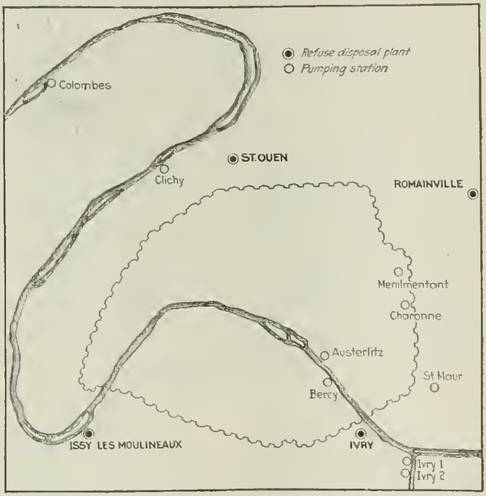


FIG. 1—LOCATION OF PARIS REFUSE DISPOSAL PLANTS
City pumping stations for water and sewage use large amounts of electric current generated from steam raised by heat from the destructors.

which are owned by private companies. At present there are three companies that supply trucks with their chauffeurs for this service. The city indicates and directs the itinerary and answers for the loading of the refuse. The contracting companies are required to have a reserve supply of trucks representing one-fifth of the total; that is, the regular service is carried on with four-fifths of the trucks at the disposition of the city. The city of Paris has, in case of emergency, a reserve of 200 trucks of its own which may be put into immediate use. Every truck is motor-driven and of about five tons capacity (metric tons or tons of 1,000 kilograms used throughout this article). The remuneration of the companies is calculated from the number of trucks held daily at the disposition of the city and the distance covered by those that are used. Each of these items has a unit price but it is agreed that these prices shall be varied according to the salary that the companies are forced to pay the chauffeurs, the market price of gasoline and the amount of the current government tax on automobiles. Once the collection is made for Paris, the companies may use their trucks, under certain conditions, for other purposes or they may collect refuse in the suburbs when the city of Paris agrees to receive suburban refuse. Actually the city receives in its plants considerable quantities of refuse from the suburbs, some of which still is transported by horse-drawn vehicles.

The refuse is hauled to four disposal stations, all of which are now operated by a single company. At these stations there is some variation in methods of treatment, but the method most generally used, which has been adopted for the enlarged stations under construction or proposed, is sorting, screening and grinding, the coarse screenings going to destructors and yielding heat that is converted into electric current and clinkers that are made into brick, while the fine screenings go to farmers for use as fertilizer. Only three of the four plants have destructors, with a combined capacity of 46 metric tons per hour. Enlargements in progress at two of the disposal stations and the provision of furnaces at the one which lacks them will bring the destructor capacity up to 122 metric tons an hour. A further increase to 160 tons an hour in the near future is probable.

It should be clearly understood that of the total amount of refuse collected actually not half goes to the furnaces, the rest is picked from the sorting conveyors and goes to agricultural land, or, in some cases when the plants are overcharged, a part is sent to special discharge areas. The comparative percentages of these divisions vary enormously with the season but in what follows it will be made clear that the city of Paris intends eventually to be equipped to burn all the refuse collected daily in the city as well as a large part of that taken up in the suburbs. Many large farms to the north of Paris receive the refuse fertilizer regularly each year but whether the farmer will pay and how much he will pay depends upon the supply in the market and it is dangerously easy to get overstocked with this kind of product.

Historical—Until 1899, the refuse of Paris was disposed of by teaming contractors who negotiated with the suburban farmers for the reception of their loads. A large percentage of this refuse was used as fertilizer. In 1899, a private company, the Societé des Engrais Complets, established a plant at St. Ouen (see map, Fig. 1) for the treatment of refuse. The process consisted in sorting out tin cans, bottles, old iron, etc., and in grinding what remained. This considerably reduced both the volume of refuse and the railroad freight charges. In its new form the refuse had a much less repulsive aspect, was sought after by farmers and brought prosperity to the disposal company. In 1904 and 1905, the Societé des Engrais Complets opened two other plants, one at Issy les Moulineaux, the other at Romainville. The success of the pioneer company did not go unnoticed and in 1905 another company built a plant at Vitry.

Incineration—Just before 1906 some changes took place that affected directly the trade in refuse fertilizer. The price of sugar fell and in addition certain legislation discouraged the general cultivation of sugar beets, the cultivators of which were the most important buyers of ground refuse. The resulting inconveniences were immediate, and, to meet the difficulties, the S. E. C. was encouraged by the city to equip its three sorting and pulverizing plants with incinerators. Each incinerator consisted of three groups of Meldrum furnaces of 75 metric tons capacity in 24 hours, one battery at each plant being considered as a reserve. These incinerators were completed in the following order: St. Ouen, August, 1907; Romainville, December of the same year; Issy, February, 1908.

Poudro—At Vitry no incinerator was installed. The original company began operation at a bad time and the plant went under the control of another group in 1907. This new company, La Societé des Engrais Organiques, supplemented the sorting and grinding process by screening the ground refuse. It was possible to find people who would take without charge the part retained on the screens, if it was given to them, and the fine matter was sold at a rather good price, under the name of "poudro." The first production of poudro is mentioned because screening has since been considered more important than grinding in the preparation of marketable fertilizer. The sale of poudro compelled the S. E. C. also to install screens in 1909. Fig. 2 shows a typical cylindrical screen and Fig. 3 shows the screened product as compared with ordinary refuse.

The competition in the sale of refuse as fertilizer, the increasing annual tonnage to be disposed of, the growing population of the suburbs, the more numerous restrictions imposed by the suburban mayoralties against the disposal of Paris refuse within their boundaries, and the consequent rise in the cost of transportation, soon made the first incinerators insufficient.

Existing Plants—The execution of the city's program of 1910 may be considered substantially as having brought the equipment of Paris to where it is today, although several changes have been made since July, 1922. The refuse is delivered to four plants, well located (see map) to shorten the haul of the collected

FIG. 3—UNSCREENED AND SCREENED REFUSE OR "POUDRO," PARIS

refuse. The plant at Vitry was abandoned. The plants of St. Ouen and Issy, since 1910, have been the mainstay of the disposal system, and St. Ouen, in particular, will not suffer in comparison with any plant in Europe in regard to the quantity of refuse treated and the efficiency of the exploitation. The standard method of French treatment today is best described by outlining the procedure at St. Ouen.

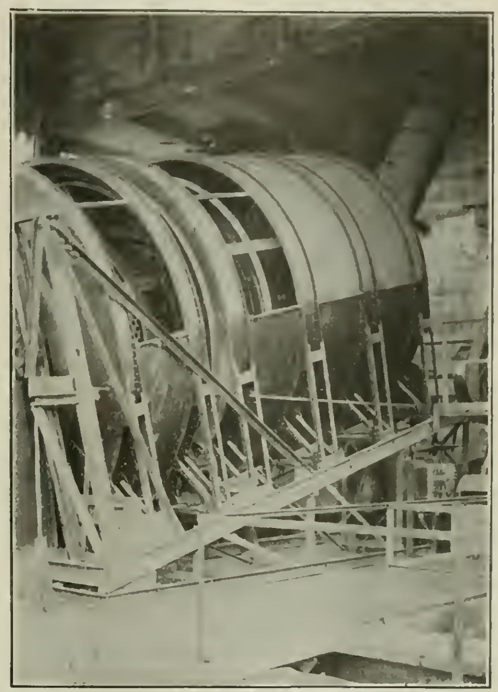


FIG. 2—REFUSE SCREEN AT IVRY PLANT, PARIS

St. Ouen Plant—The collecting trucks dump into a long pit, Fig. 4, the bottom of which is provided with belt conveyors. In passing along the conveyors the refuse is sorted. Among other things set apart is an enormous quantity of tin cans and boxes which are pressed, baled and sold (see Fig. 5). The conveyors discharge the refuse into elevators, which deliver the refuse to cylindrical screens. The fine screenings are sold as fertilizer and the coarse matter is passed on to the furnaces. The grinders previously mentioned are still a part of the installation, but their greatest utility now is simply to reduce the volume of the refuse when the plant is overcharged and it is found necessary to get rid of a few cart-loads by rail.

The original Meldrum furnaces have been transformed into Boussange furnaces and in addition five batteries of Heenan & Froude furnaces of six cells each have been constructed. The incineration capacity is thus about 500 tons per day. The heat combustion from the incinerators is used to produce electricity for plant purposes and for sale.

Clinker—The furnace clinker is drawn or pushed out in a block and moved by a traveling crane to a crusher, which in turn feeds a series of roller mills and screens. The ground clinker is fine enough to be used for brick making. Considerable quicklime is contained in these cinders, but this becomes slaked if they are left stored in piles for some months. If it is desirable, as is often the case, to use the clinker immediately, treatment is necessary. This consists of passing the clinker into huge metal cylinders, which are rotated slowly as steam is introduced. On leaving the cylinders the clinker is relieved magnetically of the large percentage of metal

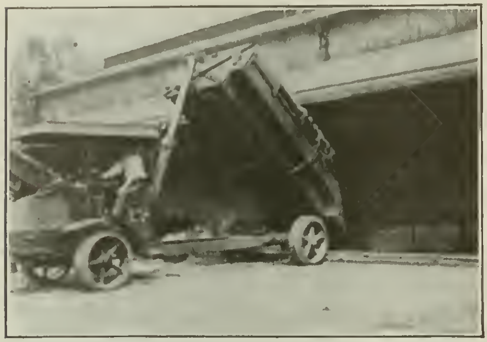


FIG. 4—ONE OF 700 REFUSE TRUCKS DUMPING IN PIT AT ROMAINVILLE DISPOSAL PLANT

fragments which it contains. After mixing with lime the material is fed to the presses by means of a helicoidal screw. The raw brick are baked by steam.

During 1922, the St. Ouen plant received approximately 235,500 metric tons of refuse, 52 per cent of which was burned. Nearly 90 per cent of what remained (or some 43 per cent of the original volume of refuse) was taken by the regular customers as fertilizer. Electric current totaling 9,500,000 kw.-hr. was produced over and above the uses of the entire plant. Of this current 68 per cent was taken by the city sewage pumping stations and the rest was sold to private companies. About nine million bricks were sold at a price slightly below that of the ordinary red clay brick. In short, since the war the St. Ouen plant has gained money for its stockholders and economized for the city of Paris.

St. Ouen (see layout plan) is the oldest of the Paris plants. It was developed little by little. There are details in the operation that do not conform to the most modern practice. These will be modified in the installations that are now under construction.

Unfortunately, all the plants have not the same record as St. Ouen. No other of them has found such a good market for refuse as fertilizer. The plant at Issy follows exactly the same process as that described for St. Ouen, but the incineration capacity is not so large. Romainville is not equipped to make brick and the incinerator is even smaller than at Issy, while at Ivry no refuse is burned. The program of 1910 provided furnaces at Romainville in addition to those in use, as well as an incinerator at Ivry, but these installations were a failure. These last were a sort of cupola furnace with revolving grate about a vertical axis. Their complete abandonment was due to the impossibility of making function the apparatus provided for the ejection of the clinker, the furnaces clogging after being a short time under fire.

The New Program—The contract of July, 1922, for the exploitation of the existing plants provides for their control by a single corporation, the Traitement Industriel des Residus Urbains. The company is forced to receive the entire collection of the city and there is a penalty for every ton not disposed of by the company. On the other hand, a price is paid to the company per ton received in the plants, which price varies with the market price of the kilowatt-hour sold by the large lighting and power companies. Receipts from the sale of the products of sorting, sifting or grinding, of the electric current, of brick, etc., go to the company to defray the expenses of exploitation. The city has an option on all the current produced up to and including the total needs of the pumping stations and pays the market price for such current.

The company is allowed to earn 6½ per cent on its capital account, under the conditions noted above. A deficit or profit recorded by the company at its annual closure of accounts is considered as an increase or economy made by the company in the subsidy accorded by the city per ton of refuse received by the plants and in the case where the company just makes expenses 6½ per cent is paid on the capital actions as previously mentioned. When a profit is recorded, this profit is divided between the city and the company in such a manner that as the profit increases the amount due the company is finally limited. In the event of a deficit, the 6½ per cent payable to the stockholders is diminished in proportion to the deficit until it is 4 per cent. The company is guaranteed 4 per cent on its capital, however, whatever may be the deficit.

Enlargements—A contract for the enlargement and modification of the equipment has been accepted by the city and part of this work is already under way. The expense of this work is covered by bond issues by the company and guaranteed by the city, the city reserving the right to buy any portion of the bonds. The city may eventually and as especially provided in the contract inherit all the installations old and new.

The incinerators of the cupola type at Ivry and at Romainville that were not a success, are being replaced by other furnaces, and the new ones are nearly completed. These furnaces will be ready to operate this winter. The resulting increase to the capacity of incinerators at Romainville will be two Bréchot furnaces of four cells each and one of two cells. At Ivry the new installations will consist of three Bréchot batteries of four cells each and six Boussange groups of two cells each. The original three Meldrum furnaces at Romainville have since the first of the year been fitted with Boussange cells and are again in service. Each of these two plants is to be provided with equipment for making brick from clinkers.

The transformation of furnaces mentioned in the foregoing is not meant to imply any adverse criticism

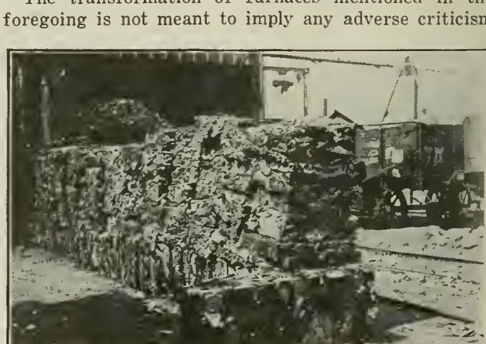


FIG. 5—BALED REFUSE, METAL AND WOOD, READY FOR SALE

of these older installations. The original Meldrum furnaces had already been in use fifteen years. During this time it was found advisable to divide these furnaces into batteries of separate cells. With this modi-

fication these furnaces were more adapted to work with a forced draft and the manipulation of the clinker became more convenient.

The Boussange and Bréchot furnaces are both of French manufacture. The existing furnaces of each type have given very satisfactory results and it is natural therefore that these furnaces should appear in the new installations rather than additional furnaces of foreign make. In both the Boussange and Bréchot furnaces the refuse is introduced by means of a cylindrical chute fixed at the top of the furnace. Each chute is provided with a mechanism to regulate the quantity of refuse falling in order not to extinguish the fire. In the Boussange incinerator the refuse falls directly onto the floor of the cell; in the Bréchot it falls first upon a preliminary drying shelf, from which it is raked into the furnace proper. Both are arranged to run with forced draft, which at the same time protects the cast-iron envelope of the cell. This envelope being hollow, the air before penetrating the small holes in the bottom is directed around it, making an air jacket. The clinker is extracted from the Boussange furnace in a block by a hydraulic or steam pusher. The Bréchot has a revolving cell which may be inverted, thus throwing the clinker out.

These furnaces burn something more than one ton per hour and they may be counted on to produce steam at the rate of from 75 to 110 per cent by weight of the weight of Paris refuse burned, depending upon the season. The calorific value of Paris refuse is distinctly inferior in the summer to the refuse collected the remainder of the year. This drop is due to the profusion of green vegetables and fresh fruits in summer and the lack of household stove and furnace ash.

At Issy les Moulineaux, a completely new plant is to be built beside the existing plant. The new plant will have ten Boussange batteries, of five cells each, constructed in pairs one on either side of a steam boiler and with one pair held in reserve. Its incineration capacity will be about 1,200 metric tons in 24 hours. The electric plant will have three steam turbines of 5,000 and one of 1,000 kw. capacity, with steam raised entirely from the refuse incinerated. The entire installation attached to the existing plant for converting clinkers into brick will be doubled.

No immediate changes are contemplated at the St. Ouen plant although the turbines may be replaced later by new and larger units.

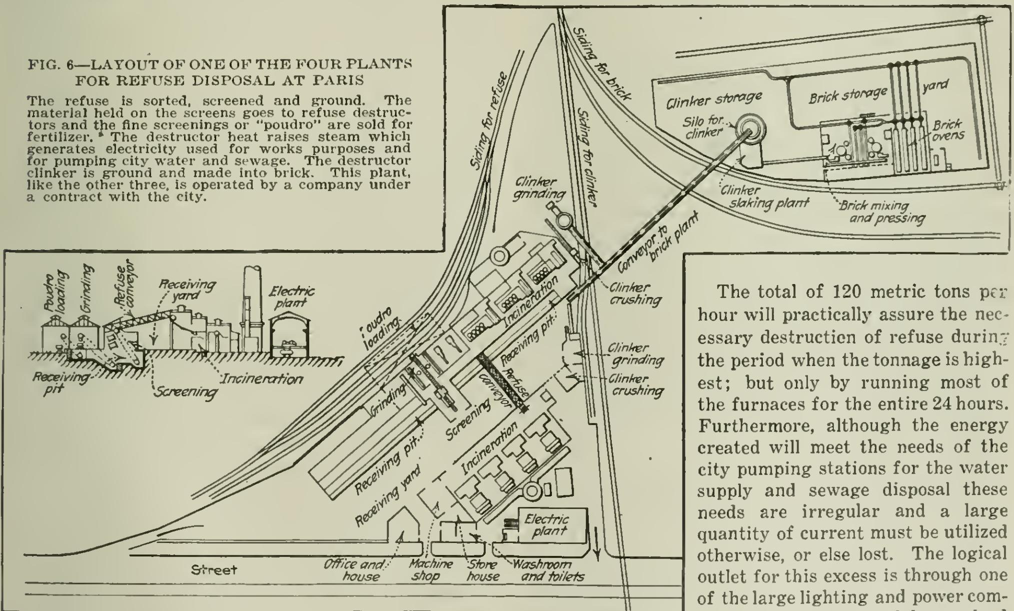
The additions to the incineration capacity may be summarized as follows:

INCINERATION CAPACITY IN METRIC TONS PER HOUR

Plant	January, 1922	December, 1924
St. Ouen	20	20
Issy	12	62
Romainville	14	20
Ivry	..	20
Total	46	122

FIG. 6—LAYOUT OF ONE OF THE FOUR PLANTS FOR REFUSE DISPOSAL AT PARIS

The refuse is sorted, screened and ground. The material held on the screens goes to refuse destructors and the fine screenings or "poudro" are sold for fertilizer. The destructor heat raises steam which generates electricity used for works purposes and for pumping city water and sewage. The destructor clinker is ground and made into brick. This plant, like the other three, is operated by a company under a contract with the city.



The total of 120 metric tons per hour will practically assure the necessary destruction of refuse during the period when the tonnage is highest; but only by running most of the furnaces for the entire 24 hours. Furthermore, although the energy created will meet the needs of the city pumping stations for the water supply and sewage disposal these needs are irregular and a large quantity of current must be utilized otherwise, or else lost. The logical outlet for this excess is through one of the large lighting and power companies. The hours of heavy load made necessary by the demands of the ordinary consumer of electric current must therefore be considered. To meet this condition the destructors must be capable of burning the total daily collection of refuse in less than 24 hours. The problem is being studied at the present time and before long the total of 120 metric tons per hour designated as the capacity for the immediate future may be increased to a capacity of 160 tons per hour.

Small Water Mains in Denver

One-sixth of the 54,911 water taps in Denver are on the 100 miles of 2-in. water lines privately owned and 19 miles municipally owned. It is not the policy of the board of water commissioners to lay 2- and 3-in. mains where it can be avoided but to pursue any other course than to lay these sizes when it means a small size or nothing is considered by the board bad business and would work a hardship on many people.

Through the Reclamation Country

By F. E. Schmitt
Associate Editor, *Engineering News-Record*

THIS is the eighth of the series of letters written by Mr. Schmitt during a journey recently made through the West in which he visited irrigation projects, studied developments, and interviewed builders, operators and settlers, in order to present to our readers the actualities of reclamation as revealed to an unprejudiced investigator.

The series of letters began in the issue of October 4.

Yuma, Ariz.

FROM THE situation on many of the projects it appears that if reclamation consisted only of irrigation and settling of vacant public lands it would be a simpler matter. But the fundamental formula assumed at the time the Reclamation Act was framed, namely,

arid public lands + public water + federal irrigation works = farm land available for homesteading

does not apply in most of the actual cases. The formula is complicated by added terms, which often tend to become predominant. In the great Southwest, a big extraneous factor consists of international water claims. since the two great streams of the region, the Colorado River and the Rio Grande (which the people south of the line call Rio Bravo), belong in part to Mexico. There are also competing state claims to water. An even bigger factor of trouble is the power question, which cannot be settled by businesslike negotiations leading up to a treaty, but calls for the formulation of broad public policies. Still another factor is flood protection, or, more broadly, river control. These four combine in the problem of the Colorado River, the biggest fighting problem of the West, and in the last analysis one of the biggest of the whole country.

Private Land Complications—A complication of quite different kind affects practically all the reclamation projects. This is the inclusion of privately owned land in the projects and the existence of prior water appropriations, which often took up more than the available summer flow, so that the government had to depend on storing flood waters. Nearly always, also, there existed private irrigation, covering the best part of the irrigable region and pre-empting the most favorable canal routes. These conditions, supplemented by diversity and conflict of water-right laws, gave rise in the early days of reclamation to a vast amount of trouble, unsatisfactory bargaining, and hard feelings; and some effects of these hard feelings survive. The actual record of nearly every reclamation project is therefore a tangled snarl of negotiations, agreements, purchases, and exchange of water or rights. often difficult to see through and containing occasional elements of injustice. Sometimes private interests in a strategic position drove a sharp bargain with the government, and sometimes it was the government that drove the sharp bargain. Unification of water ownership and distribution in a given region, which in general is desirable or even necessary for best utilization of the water, was not always feasible. The Service, being subordinate to state laws, had too little power to compel unification, and in consequence it was sometimes led into actions that may account for the charge that the Service was hostile to private irrigation. But, whatever griefs resulted from the unavoidable conflict of interests between the federal enterprise and private rights and from their jockeying and unfairness, they have all been chalked up against the Reclamation Service.

Yuma and the Colorado—For the present the other complicating factors are of more concern. There is a good case right here at Yuma. The lower valley on the Arizona side was long subject to overflow by the Colorado River, and to protect it a levee was built; but every May and June the river becomes so boisterous that a hard fight must be waged to protect this levee. The people complain much of the river-protection cost, and want the government to take care of it. Actually, the cost of the levee has already been paid by the Service, and deducted from the settlers' charge. But the annual expense of fighting the river, $90,000, represents an assessment of $1.50 on every acre of the projects, which doubles the yearly charge to the settler. Should this cost be taken over by the government? The settlers say emphatically yes.

Flood dangers and the cost of fighting them are not peculiar to Yuma, however. Districts above here are affected, and, in addition, there is the huge, unsolved problem of the lower river, where it flows through Mexico and both supplies and threatens the Imperial Valley. Also, silt is an important part of the matter. The river water is so turbid as to deposit several feet of silt each season in the Imperial canals even 50 miles or more from the intake. This means large maintenance cost; but the real menace of the silt is that it piles up as an inland delta in the lower valley and causes the river to run wild. The Imperial district has protected itself temporarily by making the so-called Pescadero cut, but this is probably only a short-time solution. Everybody hereabouts knows instinctively and positively that a single, unified treatment of the river is necessary, as furnished by the Boulder Canyon dam; and they need it urgently, and hope it will be built soon.

Whether flood protection benefits conferred by such a structure should then be assessed on Yuma and Imperial is a different question, however, not simply because of the serious burden it would place on the land, but because of the physical magnitude of the Colorado River problem as well as its interstate and international phases, which make it so decidedly a national matter that the Yuma people cannot see it any other way. The question of sharing irrigation waters with Mexico enters as an important element of the problem; the present arrangement of the Imperial Valley with the southern republic does not provide for all future needs, and as the doctrine of priority of beneficial appropriation of water which holds between the states (theoretically) has not been established as between the two countries, the relative rights are uncertain. So long as the river is uncontrolled, the rights will of necessity remain undefined and will be a constant source of worry and mutual recriminations.

Power Ownership—Just as the great dam scheme for the Colorado depends in part on power development and has given rise to much knife work in the West and in Washington over the ownership of this power, so also there is or has been fighting over power benefits in other places—Minidoka and Salt River, for instance—and there is an important power element in the Rio

Grande case. Unless a basic policy concerning power is soon established by Congress, such fighting may become the central feature of the whole reclamation problem. But it is important that in defining that policy, Congress should also establish quite unmistakably the ownership of present power in reclamation systems. The extreme farmers' advocates seem to think that everything should be made an appendage of irrigation: if irrigation storage also serves as power storage, they want the entire power revenue to be credited to the irrigation, as was done in Salt River, where the entire operating and maintenance cost of the irrigation system is covered by the power income. Presumably, in a case where the power revenue is large enough, it might even pay a bonus to those who reside on the irrigated lands—reside, rather than farm, because they probably would not farm under those conditions, and it might be just as well to omit building the irrigation canals. In the meantime, wherever there is power in connection with reclamation, the farmers do not concede that the government owns this power or that it may be sold to any one else, but they hold that it is their property by natural right, because the dam was built primarily for supplying their irrigation water.

An Arizona Scheme—State claims inject further life into the Colorado River case (and practically the same thing might be said of any other interstate stream in the arid West). This is illustrated by a very recent happening in Arizona. A filing has been made on a very large block of river water—some 20,000 sec.-ft.—by parties who are believed to be close to the state government. In support of this filing a scheme has been proposed for irrigating 2,000,000 or 3,000,000 acres (much more than is included in the famous Columbia Basin scheme) by a water system that puts all past conceptions of canals, tunnel and flume systems to shame altogether. One alleged reason for claiming so much water is that arid Arizona includes half the drainage area (*area*, be it noted) of the Colorado, hence the state is entitled to half the total flow. The argument may be absurd, but it probably could be supported just as strongly as some of the water claims that have been made by other states, for instance Colorado in defending diversions that deprive other states of water. The Arizona filing ought to make good horse trading whenever a new interstate agreement on the Colorado River problem is placed on the green table.

Offhand it is hard to see why this "navigable" river, of very great size and presenting in every one of its aspects so great a problem that it is undoubtedly national, is not *in toto* a national stream and is left subject to the capricious notions of various states. On the other hand, Los Angeles sweeps aside all notions about geographical rights by making a bid for some of the Colorado River power (after the United States Government shall have developed it by building a dam) in order to further upbuild the territory surrounding what one enthusiast called the "wonder city." And, to make the picture complete, various corporations also want the Colorado River power, for their profit.

Internationalism on the Rio Grande—Flood protection, power, and international and interstate water rights complicate irrigation in the Rio Grande case as seriously as in that of the Colorado, though in different proportions. There is a special complaint along that stream, however, due to a peculiar historical incident. An agreement was made twenty-five years ago between the United States and Mexico that 60,000 acre-ft. of water should be delivered each year below the international dam free of charge to Mexico. For this purpose Congress appropriated (on the account of the State Department) $1,000,000 toward the Elephant Butte dam costs; the proportionate share of the dam costs would be less than this, but the remainder would provide for operation and maintenance expense. On this latter point the farmers are not satisfied, and in the arithmetic by which they back up their case they go to the length of charging up part of the operating cost of their own distribution laterals against Mexico, which kind of figuring will probably hurt their case when the matter comes up for serious consideration. At any rate, they ask for another $1,000,000 as a gift from the national government, and, remarkably enough, A. B. Fall, when Secretary of the Interior last year, favored his own state of New Mexico by recommending such an appropriation. Congress did not pass it, being very busy.

Just at the present moment the Elephant Butte dam is in the public eye in another way, that has some relation to the back history of the matter just mentioned. A concession to build a dam on that site was granted by Congress to a private company in the nineties, with a right to all the flood waters of the Rio Grande, *gratis*, though Mexico laid claim to some of the waters of the river. Later, this concession was voided by the court for non-completion of the work, though it is alleged that acts of the U. S. Government made it impossible for the company to proceed with its work. After this happened, the people of the valley strongly importuned the Reclamation Service to build a dam there for irrigation, and still later the State Department urged the Interior Department to build a dam for carrying out the Mexican treaty provision. The Reclamation Service then, with the help of the State Department's added million, built the present dam, so that it appears everybody should be satisfied. But now comes a claim by a British subject who had had an interest in the dam concession, for loss on account of the voiding of the concession. The government's expert in its defence of this suit is Arthur P. Davis.

Overburned Lime Causes Plaster "Popping"

Lime which has been overburned or which has been burned during hydration is the cause of popping in plaster, tests made at the Bureau of Standards have shown. In this type of failure small particles appear to expand and push themselves out of the plaster, leaving tiny holes. In extreme cases these holes may be sufficiently large or numerous to be unsightly. It has been shown that popping will not be serious if the lime is ground fine enough to pass a No. 50 sieve, as in that case the lime will be completely hydrated during the mixing and application, or else the particles of defective lime will be too small to cause noticeable holes. These tests were made in co-operation with the National Lime Association, the Contracting Plasterers Association, and the International Plasterers Union. Ninety-eight panels were erected containing different impurities in different sized particles. It was found that, with the possible exception of sand, impurities other than overburned lime did not cause popping no matter how coarse they were.

City Problems Discussed by A. S. M. I. at Atlanta

Many Engineering Topics Discussed by American Society for Municipal Improvements, Atlanta, Ga., Nov. 12-16, Include Responsibilty as to Health, Pavement Design, Newest Ideas in Street Lighting

Report of Committee on Street Lighting

By Ralph Toensfeldt
Chairman, Committee on Street Lighting; Engineer, Division of Street Lighting, St. Louis, Mo.

PROBABLY the most interesting developments to the larger municipalities who have ornamental systems under consideration is the asymetric lantern. It consists of a frame in the usual lantern form in which are mounted glass panels of a slightly diffusing character. Within this lantern and surrounding the incandescent lamp is mounted a cylindrical prismatic refractor whose prisms are so designed as to give an asymetric distribution, that is, a non-symmetrical distribution. This new development not only sends the upward light from the lamp downward so that it will be useful on the street surface but in addition reclaims, to some extent, the light which is ordinarily thrown onto the lawns and front porches *bending* it outward onto the street, thus avoiding the undesirable strong light on the front porches and increasing the illumination of the street. Experiments indicate that with this type of unit a given minimum illumination can be produced at a considerable saving in energy over systems formerly in use, and furthermore, that an unprecedented uniformity in illumination can be obtained with a minimum number of units.

Another development which will interest municipalities which hold to the center suspension type of unit in some districts, is the four-way reflector. This is essentially a suspension type of unit based upon somewhat the same principles as the asymetric above described except that it produces four beams of light at an angle of 90 deg. with each other, instead of two. It is made to be suspended over the center of intersecting streets throwing its maximum beam up and down each street. It is a highly efficient and very economical unit for such uses.

A third development which may be useful in undeveloped territories which are traversed by heavily traveled highways is the highway lighting unit. There are three types of these on the market today, essentially different in principle but all aimed to produce the same results. They are designed for a mounting height of from 25 to 35 ft., a spacing of from 300 to 400 ft. and will produce a fairly uniform illumination of low intensity almost entirely confined to the surface of the roadway. The illumination produced by this type of system will be sufficient to obviate the necessity for light glaring headlights, thus eliminating one of the most potent sources of accidents.

* * *

The Why and How of Street Lighting

By Stephen Carleton Rogers
Commercial Illuminating Engineer, Street Lighting Department, General Electric Co., West Lynn, Mass.

IN THE luminous or magnetite arc lamp, the light i given off by the arc flame or the vapor stream whic' conducts the current across the gap between the copper electrode, which is practically non-consuming, and the composition electrode, which is encased in a metal tube. The light is produced by electro-conduction of particles of the light giving materials given off by the negative (composition) electrode. The other type of light source is the Mazda C lamp, which produces light by high temperature incandescence.

As an illustration of what might be accomplished in the way of highway lighting from an economic point of view take for example Massachusetts (and the same might apply to any other state). There are at present roughly 1,500 miles of improved state highway, which should be scientifically lighted. This would mean an initial investment of about \$5,000,000, with a yearly maintenance cost of \$1,500,000 (figuring an average cost of \$60 per lamp year to the city or state). A few years ago drastic headlight laws were enacted, which it has been conservatively estimated cost the automobile owners more than \$2,500,000 at that time, plus the additional amount necessary for their upkeep. If this money had been expended in the proper direction, headlights would be unnecessary and safety to all would have been increased.

Traffic Control—On account of the vast amount of travel and vehicular traffic on our main streets and thoroughfares, some means must be employed to control or regulate it in order to further protect life, property, and the rights of each and all of us. For this reason, there have been developed a great number of various types of traffic lights or signals, etc., some of which are purchased outright by the city, some by the police department, etc. Since these devices are installed in the street, over the street, on the street or adjacent to the street, this type of unit logically should be a part of the street lighting system and controlled and owned by the central station (or by the electrical department if a municipal plant), a rate being made on the basis of a 24-hour service.

* * *

The Cost of Adequate Street Lighting

By L. A. S. Wood
Manager Street Lighting Section, Westinghouse Electric & Manufacturing, Co., South Bend, Ind.

IT IS generally conceded that the cost per capita for an adequate street lighting system should not be less than one dollar, and yet, an investigation into this subject disclosed the fact that there were only nine states in the Union in which the per capita expenditure of municipalities for street lighting exceeded 90c., and only four where the expenditure was more than \$1. At the time the investigation was made, it was found that the average expenditure for the whole of the United States was 71c. per capita. (Report of the Lighting Sales Bureau, National Electric Light Association, 1921.)

The cost of adequate street lighting systems can often be reduced if the street lighting improvement schemes are carried out under a comprehensive program co-ordinated with and included in city zoning plans. A scientifically derived, comprehensive, far-sighted street lighting program correlated with a city zoning plan is not easily worked out. It calls for specialized talent in many lines of work, and, in most cases, city officials can profit by bringing into consultation the engineers found in public utility companies, whose success depends largely upon their ability to foresee future requirements and to meet them with a minimum loss in reconstruction. This nation is becoming possessed of many vast cities and most of them—like "Topsy"—"just growed." Our large industrial establishments and other privately owned projects exemplify the economy of employing talented engineers and architects. The city is, of course, more important than any of its contributing factors; and it is unfortunate that some of our cities do not appreciate the necessity of providing sufficient appropriations for this type of personnel.

Possible Causes of Failure of Pipe in Sand Sewage Filters

By Harrison P. Eddy
Consulting Engineer, Boston, Mass.

WORCESTER, Mass., has the most extensive intermittent sand filters of any city in the United States, the net area being 66 acres. For underdrains, precast cement-concrete pipe, laid 35 ft. apart, were used. The mix was relatively dry and the pipe was carefully cured. The Worcester sewage is heavy with acid pickling wastes from wire and other iron and steel plants.

Iron was precipitated in the beds, clogging them and making it necessary to dig up the underdrains. Some of the pipe went to pieces. It was found that grooves had been formed spirally around the pipe, in such fashion as to suggest that the grooves followed the layers of the wet concrete as the shell was built up by tamping.

Three explanations of the disintegration of the pipe were offered: (1) Effect of underground water in the peaty soil in which trenches for the pipe were dug, these trenches having been backfilled with sand: (2) acid in the sewage, equivalent to 1 lb. sulphuric acid per 165 gal. of sewage; (3) putrefaction of sewage in the pores of the sand beds, due to the sulphur which occurs in all sewage or due to the pickling wastes in the sewage, either of these producing sulphuric acid.

* * *

The Engineer's Responsibility in Malaria Prevalence

By L. M. Fisher
Associate Sanitary Engineer, U. S. Public Health Service, Columbia, S. C.

MALARIA, one of the most widespread diseases according to Sir Ronald Ross, causes in the aggregate more human sickness and misery than any other illness. The engineering profession must take the responsibility for causing a large part of this illness and death together with the heavy loss occasioned by the disease. Today, in the United States, engineering works are being constructed which will cause many persons to have malaria who would otherwise not have had it. Their efficiency will be greatly lowered for weeks or months and a recurring attack years hence may again result in a considerable economic loss to the persons who suffer and to the communities in which they live, and even death may ensue for some.

Dr. Carter, the foremost authority on malaria in this country has repeatedly stated that in many localities half of our malaria is man-made. Railroad builders have placed many culverts too high, and they have left many borrow pits undrained. The highway engineers engaged in building good roads are making the same mistakes. Paradoxical as it may sound, there have been drainage works which have temporarily caused an increase of malaria, either by obstructing small water courses with spoil from the large drainage ditches or from new breeding grounds for malaria mosquitoes caused in times of low water by large, wide ditches on nearly flat grades, or by both conditions. Hydroelectric developments have very frequently caused an increase in malaria prevalence because of the almost innumerable new breeding places caused by large bodies of impounded water created without regard to the conditions which permitted mosquitoes to breed profusely and entirely unhindered by the numerous aquatic enemies which are to be found in old pools or in pools properly constructed and cared for. The municipal engineer has some interest in this problem for his own water supply reservoirs may offend in the same way as a storage reservoir for a power company.

One of the sharpest outbreaks of malaria in South Carolina occurred in Greenville ten or twelve years ago, in a section of the state where little malaria prevailed at the time and where little exists now. It was attributed to the installation of storm drains and catchbasins all over the city. Prolific malaria mosquito breeding occurred in these basins and, augmented by the breeding from nearby river flats, causes a rapid spread of the disease. Instances have been reported where faulty drainage of irrigated land was responsible for an outbreak of malaria. Leaky water tanks on railroad property have caused breeding places to develop in towns and because of their location close to houses have contributed to the malaria mosquito population. Abandoned rock quarries, and even quarries in operation, containing pools of water, gravel pits along the roadside, old phosphate rock mines, abandoned rice fields, have al contributed generously to man's misery because of the malaria pestilence they have spread among persons living in the vicinity.

In some sections of the South the work of the engineer has locked up the agricultural resources of many square miles of country by making a section relatively free of malaria an intensely malarious one so that people were forced to sell or abandon their property and move away. When we stop to recall that agriculture is an industry on which many other industries are based the tremendous economic damage that is occasioned by such a procedure becomes apparent.

* * *

Relation of Depth of Foundations of Pavements to Their Strength

By Clarence D. Pollock
Consulting Engineer, New York, N. Y.

USUALLY in city streets the most satisfactory foundation is one of portland cement concrete, commonly mixed in the proportion by volume of 1:3:6 and generally laid 5 or 6 in. deep upon a well compacted subgrade. Where the subsoil is sand or sufficiently porous material to provide good drainage, these depths have proven sufficient even for present day traffic. Some cities have had a tendency to lay heavier foundations, but with good subgrade material it would seem to be expensive insurance.

When the subsoil is of clay or other material which cannot be readily drained, it would seem advisable to improve the subgrade rather than to weight it with a heavier foundation. A dry clay is usually capable of sustaining a load of five tons per square foot, but when very wet the same clay may not sustain more than one ton per square foot. By excavating a few inches more and refilling with sandy or gravelly material the load will be spread so that with this and the better drainage a much greater load may be supported.

The foundation cannot act as a beam until the subsoil gives away sufficiently to allow it to act as such. The better the subsoil the greater the load required to deform the foundation. The Washington tests show that with the subgrade support the sustaining power of the concrete foundation varies more nearly as the square of the depth than directly as the depth.

Measurements show that the foundation in transmitting the load to the subgrade does not transmit it so that the pressure intensity is uniform. The pressure intensity is highest directly under the load, and spreads out over a considerable area, diminishing to nothing at some distance from the load. The intensity of pressure under the load must exceed the bearing value of the soil underneath before the foundation can act as a beam. Even a macadam, bituminous macadam or bituminous concrete foundation will not be deformed until the intensity of pressure directly under the load exceeds the bearing value of the subsoil. If the load is stationary or if the surface of the pavement is very smooth there will be simply the static pressure, but if the surface of the pavement is a little rough there will be impact and if the surface is quite rough this impact may amount to four to five times the static pressure. This is greatest when the tires are badly worn. With good well cushioned tires the impact apparently approaches more nearly the static load, and hence the advisablity of securing as uniformly smooth a surface to the pavement as possible in order that the impact of moving loads may be eliminated as completely as can be done.

In the Bureau of Public Roads tests with slabs on wet

and dry soils, the impact tests punched through the 4-in. slabs, but those 6 in. and more in depth were merely cracked while those 10 in. thick could not be broken by their apparatus even on the wet subgrades. According to this a thickness of 10 in. should be sufficiently great to carry any load that might come upon the pavement even with a wet subgrade which may be more or less plastic. However we are not so likely to have wet subgrades in city streets subject to heavy truck traffic, as the pavement is usually impervious to water and likewise the sidewalks are generally paved so that there is much less likelihood of subsoil troubles here than with suburban roads. But should there be bad subsoil conditions in general it will be found much less expensive to improve the subgrade than to pay for 4 in. of extra concrete in addition to the extra grade removal which alone would in most cases be sufficient when replaced by a more porous coarse grained material which is not affected materially by water as are the very plastic soils such as many clays. With proper support from the subsoil and a reasonably smooth surface to the pavement, a thickness of 6 in. for the concrete foundation seems adequate especially as most heavy loads are now hauled on auto-trucks having rubber tires. The trucking interests have found that it is not economical to carry loads in excess of about 750 lb. per inch width of tires. This insures wide double and triple solid rubber tires on each rear wheel and a good distribution of the load over the pavement so that by the time it is spread through the thickness of the pavement and the concrete foundation the pressure intensity is usually well within the supporting value of the soil. Some states have limited the loads permitted on their highways, but here we have a limit placed by the effect on the truck owners' pocketbook which is more easily enforced.

When in exceptional cases it may be necessary to use a greater depth of concrete than 6 in., it should be remembered that the supporting power of the concrete foundation varies about as the squares of the depths.

Another matter that the tests have brought out is the fact that while the compressive strength of 1:3:6 was 50 per cent of that of the 1:1½:3 concrete, the difference between the beam and slab strength of these two mixtures did not exceed 20 per cent.

In addition to damage from heavy loads the pavement including its foundation may be injured by water entering a clayey or other plastic subgrade material from terraces or sidewalks and lifting and cracking the foundation and pavement by the swelling of the subsoil. Sometimes this may be caused by frost heaving the foundation when there is a large amount of water in the plastic soil under the foundation. During the past season the writer was engaged upon an examination of some breaks in foundation and pavement where a study of the conditions shown by openings and the history of the breaks as to when they were noticed after the completion of the pavements and before freezing weather and the soil condition in the terraces on the uphill side and the clay of the subsoil showed conclusively that the breaks were due to the soil conditions and not to loads to which the pavement was subjected.

* * *

Miscellaneous Discussions

Technical Papers—Many technical papers were listed on the program. Some of these are abstracted in this issue, and of the others some are mentioned briefly below.

A plea for more palatable drinking water was made in a paper sent by John R. Baylis, principal sanitary chemist, Baltimore water-works, who stated that if the people want water of that sort it can be provided at reasonable cost. The new water supply of Memphis, Tenn., was the subject of a paper sent by J. R. McClintock, of Fuller & McClintock, and read by Mr. Cunningham, associated with that firm. An entirely new plant, except for distribution system, is being provided at a cost of $2,800,000. In will be the largest municipal plant in the country taking its supply wholly from wells. The water will be treated to remove carbon dioxide and iron.

Zoning plans for Atlanta were reviewed by Robert Whitten, city planner, Cleveland, Ohio. Atlanta was the first Southern city to adopt a zoning ordinance some two years ago. Buildings in the business district are limited to a height of 150 ft., partly because of the narrowness of the streets. G. J. Requardt, consulting engineer, Baltimore, outlined the publicity work which paved the way for the Baltimore zoning ordinance.

Sand-clay and top soil roads, with special reference to his own state, was the subject of a paper by W. R. Neal, state highway engineer of Georgia. In sand-clay roads the sand may be regarded as aggregate and the clay or silt as filler. Earlier practice was to give these roads a high crown, as much as 1 in. per foot in some cases, but this has been reduced to as low as ¼ in. The latter should be used only where the maintenance will not be good. The lime rock asphalts of the South and their use for paving were described in a paper read by E. A. Kingsley, city engineer, Dallas, Texas. In 1922, some 2,000,000 sq.yd. of this pavement were laid in Texas by the Uvalde Asphalt Co. Besides the mines near San Antonio, some are about to be opened in the Florence section of Alabama.

Sewage and Garbage Disposal—Two papers on night soil disposal were read. One, by Milton J. Ruark and C. E. Keefer, of Baltimore, Md., described the dumping into the sewers of night soil collected in cans from outlying districts. The other, by Mr. Decker, of the Tennessee Coal & Iron Co., Birmingham, Ala., outlined a system of collection by cans, dilution and sedimentation in tanks, and treatment on sprinkling filters, as used for more or less temporary mining camps. In discussion, H. P. Eddy, Boston, said that this is the first case to come to his attention where night soil is converted into sewage and then treated. The Imhoff tank capacity is about 10 gal. per capita, a low figure, but the night soil is free from bath and sink wastes with their loads of grease. The process is not patented.

In a paper on the Maclachlan process of treating activated sludge, J. S. McVea, city engineer, Dallas, Texas, described work now going on at Dallas to perfect the process. After the use of sulphur dioxide for conditioning the sludge before drying the sludge is being passed through a rotary screen press, and then passed between rolls. A new filter press and rolls were installed in June and quite recently the apparatus has been modified. The sludge resulting from the Maclachlan treatment, with a moisture content of about 82 per cent, goes to driers for reduction to 10 per cent. These and other papers on sewage and a series of reports on garbage disposal practice occupied a whole evening.

A paper on valuation of property for taxation purposes, by Walter W. Pollock, Manufacturers' Appraisers Co., Philadelphia, described the Somers' system of valuation of real estate. The author said that by applying scientific methods in like manner to utility rate and purchase valuations the present large differences in the figures set up by the experts of the opposed sides could be eliminated. He would use the reproduction new less depreciation method of appraisal, but based on fixed unit and other standards.

[*Further abstracts of papers presented at this meeting of the American Society for Municipal Improvements will appear in an early issue.*—EDITOR.]

From Job and Office

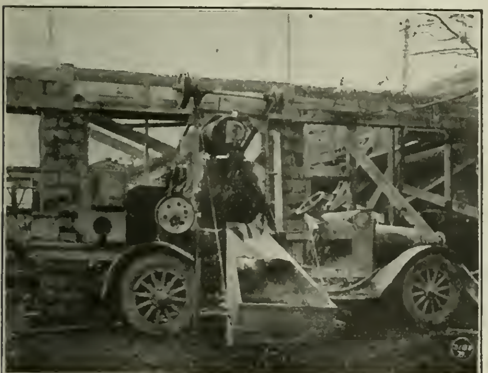
Hints That Cut Cost and Time For the Contractor and the Engineer

Mounted Concrete Mixer Saves Time and Labor for Contractor

CONTRACTORS using concrete mixers where portability is desirable may be interested in the experience of George Leavens, of Lansing, Mich., who has been able to effect savings of approximately 25 per cent in labor and even greater amounts in time by the use of a mounted mixing machine. Mr. Leavens mounted a 10-ft. mixer, which is one size larger than the average machine used by contractors on light work, on a speed-wagon chassis obtained from the local representatives of the Reo Motor Car Co.

His knowledge of gasoline engines warned him that it would be far from economical to attempt to run the mixer from the 45-hp. engine of the speed wagon when a 6-hp. gasoline engine would furnish ample power for the work. Using the speed-wagon engine for this work would also have meant wear and tear on transmission parts which might have decreased the life of the chassis by a couple of years. For these reasons a 6-hp. engine was mounted on the rear of the chassis to operate the mixer.

Mr. Leavens saves in labor through the fact the machine can be run into any desired position on the job for operation, eliminating most of the wheeling of mixed concrete. For instance, in pouring concrete for a sidewalk, he drives the speed wagon parallel to the sidewalk, pouring as he goes. The same system is employed in pouring outside foundation walls, while in pouring inside walls, the speed wagon is driven as close as possible to the point at which the work is being done.



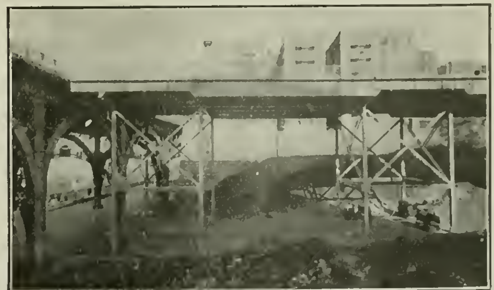
MIXER MOUNTED ON SPEED-WAGON CHASSIS

Perhaps the greatest saving in time occurs when one job is finished and the outfit must be moved to another. The jobs are seldom less than a mile apart and are often two or three times this distance from each other. With the mixer mounted on the speed wagon, however, the changes are made in negligible amounts of time.

Unique Two-Level Street Obviates Costly Grading

By Harry W. Levy
Dept. of Public Works, Borough of Manhattan

DUE to the great difference in elevation between Broadway and 12th Ave., two parallel streets in upper Manhattan, New York, near 134th St., the latter street was left ungraded until this year. When it was decided to open the street, two possible methods of doing it presented themselves. The first was to run a uniform grade of 8.3 per cent from Broadway down to 12th Ave., a distance of about 800 ft. The other was to run a nearly level grade from Broadway out to the viaduct which carries Riverside Drive above 12th Ave. at this point. If the first method was followed it would necessitate a cut of some 10 to 45 ft. within the street line and ultimately over a considerable area outside. This would be complicated in the future by the fact that the grading of the lots on the north side would require permanent shoring for the rear walls of the buildings on 135th St.



TWO-LEVEL STREET IN NEW YORK CITY

The second alternative would require very high retaining walls at the west end of the block and consequent expensive foundation work for future buildings on the adjoining property unless these retaining walls could be extended over the building line to form the footing for such buildings along their street face. Legal restrictions, however, prevented the city from doing this and it was decided that the best plan was to build low retaining walls for the upper end of the street and then to carry the remainder on a viaduct to connect with the Riverside Drive viaduct and to grade a low-level street connected with 12th Ave. below the viaduct. This latter plan makes it possible for the owners of the lots facing the viaduct to use the lower floors of their buildings which open on the low level street for business purposes and the upper floors for high-class residential purposes.

The economic point at which the street structures should change from filled retaining walls to a viaduct was determined by the relative cost of the two classes

of work and the structures were laid on that basis. House connections for the sewer were carried through the retaining walls on two levels in the east end of the street and then the sewer was run to the lower level in a drop well built into the abutment of the viaduct.

The steel viaduct comprises two four-columned towers, made up of continuous H-columns with horizontal and diagonal bracing supporting the viaduct deck structure. Transverse girders extend over each pair of columns and cantilever some 15 ft. beyond to the building line. To these cross members are framed six lines of longitudinal girders which in turn carry the viaduct deck members. The inner and outer pairs are set higher to avoid a floor slab of varying thickness due to the roadway crown and sidewalk elevations.

At the extreme west end of the new viaduct, where a connection is made to the existing Riverside Drive viaduct, a short cantilever was inserted to avoid increasing the load on the latter structure.

The P. T. Cox Contracting Co. was awarded the contract for this viaduct at the price of $60,787.50.

Construction work was done under the supervision of the Bureau of Engineering, Department of Public Works, Manhattan, of which C. M. Pinckney is chief engineer and Ralph Lewis, construction engineer. Assistant Engineers Joseph Collyer, D. Nelson West and the writer are mainly responsible for the design.

Tile Drains Collect Water for Small City Supply

THE CITY of Condon, Ore., with a population of about 1,300, is located on a plateau some 2,900 ft. above sea level on which there is no water suitable for a city supply. Except for a small stream called Hay Creek, 700 to 800 ft. below this plateau, the only streams within 15 or 20 miles of the city that might be used after purification lie from 1,000 to 2,000 ft. below city level. For some years a supply was pumped from Hay Creek at a point about four miles from the city; the water was taken directly from the stream without any purification treatment. This source was subject to pollution and when the time came for increasing the supply it was decided to use the natural gravel deposits of the stream as filtration beds, collecting the subsurface flow in a small reservoir built below stream-bed level from which the water was pumped to the reservoirs serving the city's gravity distribution system. The cost of this work, covered by bond issue, was $90,000.

The accompanying plan shows the general arrangement of the collection works which consist of a main line of 8- and 10-in. collecting pipe with tight joints to exclude surface water, extending up the creek bed, and several 6-in. agricultural tile lines with open joints placed 6 to 12 ft. below the stream bed and located so as to pick up as much as possible of the flow from springs which form the headwaters of the stream. Measurements in the stream bed indicated a minimum flow below the surface of about 127,000 gal. per day.

The filtering afforded by the gravel backfilling, that was carefully placed over the collecting tile, was not expected to purify the water in the sense of removing bacteria, but rather to give clear water at all times. All pumped water is chlorinated before going into the city distribution system. There are two or three ranches on the watershed above the collecting system and the chlorination is to protect from possible pollution from that source. Since the completion of the system there has been little flood water and hence the degree of clarification that will be secured is not yet known.

The reservoir is a reinforced-concrete box built across the stream bed so as to form a dam and having a watertight concrete roof so all surface water passes over it. The reservoir has a capacity of 109,000 gal., is about 10 ft. deep, and 34x46 ft. in plan. The walls are 12 in. thick and the roof 5 in. thick.

There are some small springs along the creek bed below the collecting works. Water from these flows into a gravelly backfill on the upstream side of the reservoir. When the reservoir level is pumped low enough, this spring water is admitted through the 6-in. drain-pipes shown, which are at other times closed off by flap valves. The 12-in. pipe under the reservoir was put in

From Job and Office

Hints that Cut Cost and Time

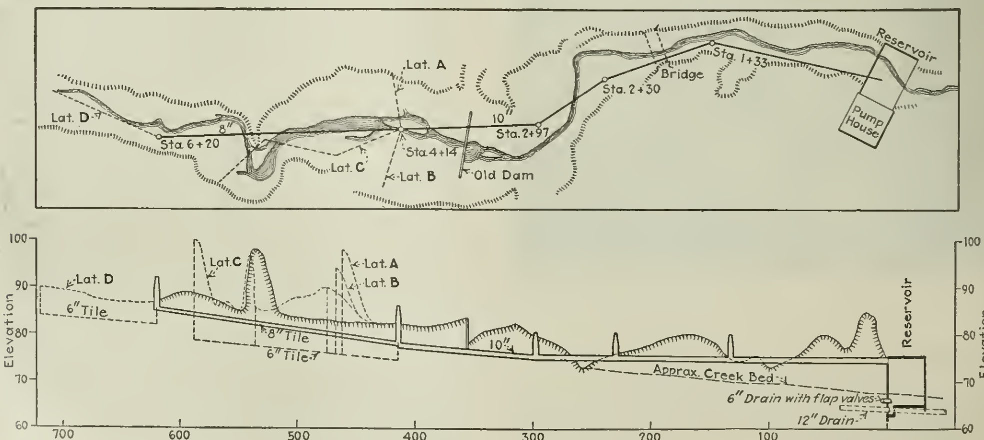


FIG. 1—PLAN AND PROFILE SHOWING ARRANGEMENT OF COLLECTION SYSTEM

From Job and Office

For Contractor and Engineer

primarily to provide a bypass for stream flow during construction and was later made to serve as a drain.

The pump house is built just out of the stream bed and above it at one end of the reservoir just described.

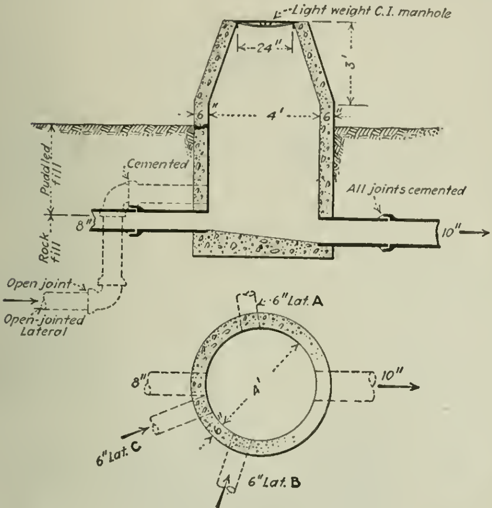


FIG. 2—TYPICAL MANHOLE DETAILS

The floor of the pump house, 17 ft. above the bottom of the reservoir, is considered to be safely above flood level.

The pumping equipment consists of two independent units. Each of these is a 50-hp. modified Diesel engine, direct-connected to a vertical, triplex, single-acting pump. These pumps deliver through 22,000 ft. of 8-in. main against a static head of 723 ft. and an estimated friction head of 57 ft., making a total of 780 ft. The engines operate on oil of 24 deg. Baumé gravity and are guaranteed to consume not more than 0.52 lb. or 0.068 gal. of fuel per horsepower per hour when operated at three-quarter load, which is approximately the operating requirement of the plant. Each pump unit has a plunger displacement of 155 g.p.m. and a nominal rated capacity of 150 g.p.m.

After operation for some time to test out the system the pumps were declared to be wholly satisfactory, operating without vibration and with a minimum of attention. Air chambers specially designed to meet the unusually high pressure requirements were installed, but some doubt is expressed as to whether these afford any advantage. Hand operated bypass lines are provided so that heavy water hammer due to starting and stopping the flow in the 4-mile line can be prevented. The pumps also have pressure relief valves set to operate at a pressure of 400 lb.

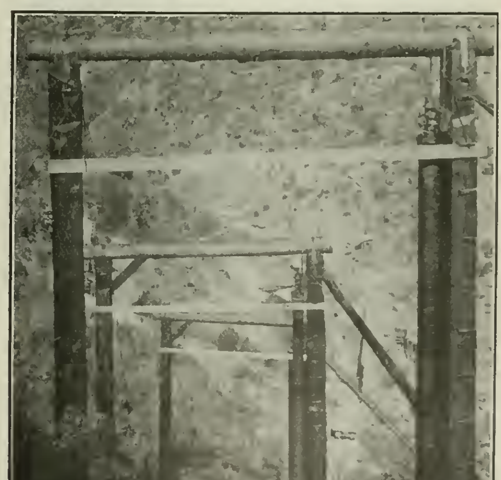
The design and construction of the system was carried out under the direction of R. E. Koon of Stevens & Koon, Portland, Ore.

Incline Railways Facilitate Dam Construction in the West

HYDRO-ELECTRIC jobs in the far West that involve the construction of dams or power houses in deep ravines are frequently reached to best advantage by incline railways, on which flat cars, equipped with a heavily reinforced end called a "strong back," are operated with a cable and hoist. To cite three California examples: An incline on the Hetch Hetchy project has a 70 per cent grade and a drop of 1,700 ft.; another on the Big Creek project drops 2,000 ft.; while one used in building the Kerkhoff Dam was 3,000 ft. in length and had a maximum grade of 92.5 per cent.

Long steep inclines are chiefly confined to the larger jobs, such as those just cited. Sharp curvature, on the other hand, is common to inclines on jobs of all sizes, the arrangement of rollers for guiding the cable being similar to that used in logging camps. The accompanying picture illustrates the strength and simplicity of roller-guide construction commonly used on sharp curves. The use of portals instead of posts on the inside of the curve only affords opportunity for the effective use of cable sway-bracing in addition to the batter posts that take thrust directly.

The rollers are made of pipe with special fittings on each end, terminating in solid shafts of considerably smaller diameter. Rollers that carry the heaviest load are made of fairly large size, usually 6 in. in diameter. Both horizontal and vertical rollers are put in wherever the cable would otherwise come in contact with ground or structures. Special attention is paid to fitting the



GOOD PRACTICE IN ROLLER GUIDE CONSTRUCTION ON CALIFORNIA HYDRO-ELECTRIC JOB
Note grease cups at tops of rollers

bearings and keeping them well greased so friction will be reduced to a minimum. The inclines and their guide rollers are built to handle any load that a "strong back" car can safely transport.

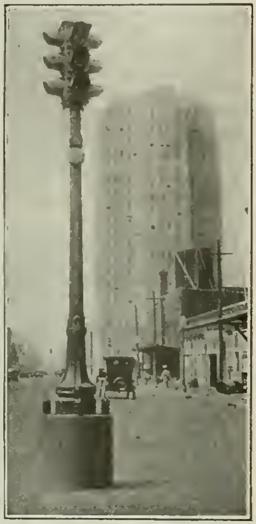
Electrically-Controlled Traffic Signals Adopted in Dallas

By W. J. Powell

Chief Engineer to the Supervisor of Public Utilities, Dallas, Tex.

TRAFFIC CONTROL in the business district of Dallas, Tex., is effected by means of electrically-operated signals, centrally controlled from a traffic tower at Elm and Ervay Sts. The signals flash alternately red and green lights, at intervals adjusted by the operator to suit traffic conditions, with an amber light and warning bell to mark the changes. This system has been in operation for several months with most gratifying results in the way of speeding up traffic and decreasing accidents.

Except on Pacific Ave., the traffic control signals are suspended over the street intersections at a height of 18 ft. and are served by overhead wiring. Pacific Ave. was formerly occupied by the tracks of the Texas & Pacific Ry., but since the tracks have been removed the street has been greatly improved, all the electrical conductors have been put in conduits below the street surface, the street repaved, and a new lighting system with ornamental standards along the curb has been provided. For this reason the traffic signals on Pacific Ave. are mounted on cast-iron standards, designed to harmonize with the lighting standards, and placed on concrete pedestals in the center of the street intersections. At first there was considerable opposition to placing any such obstruction in the roadway, but this opposition has not been justified by results, as the heavy concrete pedestals carrying the signals serve to separate the traffic lanes and prevent accident. At some points police and fire-alarm boxes are installed on the same standards.



TRAFFIC SIGNAL AT DALLAS, TEXAS

The system is served by underground cables connecting with the central control tower at Elm and Ervay Sts. The concrete pedestals are 30 in. in diameter and 30 in. high above the street grade, and 48 in. in diameter at the base, which is 3½ ft. below street grade. They are heavily reinforced and protected above ground by a ¼-in. boiler plate shell. The standards are painted a dark green and the pedestals bright orange, because of the high visibility of that color under all conditions. Four small red lights mounted on top of the pedestal further mark its location.

The Ashe Electric Co. of Fort Worth had the contract for the installation of the ornamental lighting system and for the conduits and concrete pedestals of the traffic control system. This work was done under the supervision of the writer and A. R. Henry. Traffic signal units were supplied by the Crouse-Hinds Co. of Syracuse, N. Y., and were installed under the supervision of Henry Garrett, superintendent of the police and fire signal system. The cost of the control system was about $12,000.

From Job and Office

Hints that Cut Cost and Time

New Portable Tide Gage for Temporary Use

By G. T. Rude

Chief, Division of Tides and Currents, U. S. Coast and Geodetic Survey

THE U. S. Coast and Geodetic Survey has recently developed a small automatic tide gage for the purpose of providing a portable, easily-installed gage which can be used to advantage by hydrographic and tidal parties in the field at stations where it is necessary to obtain observations extending over only a few days or weeks for the reduction to a datum plane of soundings taken during a hydrographic survey, or for comparison of short series with long-period tidal observations obtained at principal tidal stations of the Survey. In designing this instrument, the main objects sought were ease of installation and minimum size, commensurate with the desired accuracy in the resulting record of the rise and fall of the tides.

General Description—The essential features of the gage are its small size, its single drum (*b*) in the illustration—on which the paper record is fastened by means of a spring clip, a single clock movement installed within the drum, a cast base with sleeve (*c*) to fit on top of a float tube of stock 3½-in. iron pipe (*d*). This pipe, in addition to serving as a float well, also acts as a support for the instrument, thus obviating the necessity of providing elaborate platform and cumbersome float well. This feature alone renders the gage more adaptable for use by field parties, particularly in remote localities where wharves and docks are not available. Another departure from the usual design of automatic gage is the use of a spring counterpoise instead of counterpoise weights for taking up the slack of the float wire on a rising tide.

The gage is 10 in. square on the base and, with its weatherproof metal cover in place, is 10 in. high. The gage base locks by means of two hook screws (*e*) into the top section of the float well. This top section (*d*) of the float well is furnished with the instrument; the remainder of the well, since it is stock pipe, may be purchased in the field from local dealers. The weatherproof cover is locked in place by two padlocks, so that the mechanism is completely covered and cannot be tampered with when the gage is installed in exposed places.

Recording Device—The drum on which the paper record is wound is a single cylinder 7 in. long and 19.2 in. in circumference. This drum is geared to a clock movement carried within the drum, so as to rotate once in 48 hours, giving a time co-ordinate of 0.4 in. to the hour. Upon clamping the milled-nut (*a*), the drum may be freely turned and the pencil set on the cross-section marigraph paper to the nearest ten minutes of the time co-ordinate of this specially printed cross-

From Job and Office

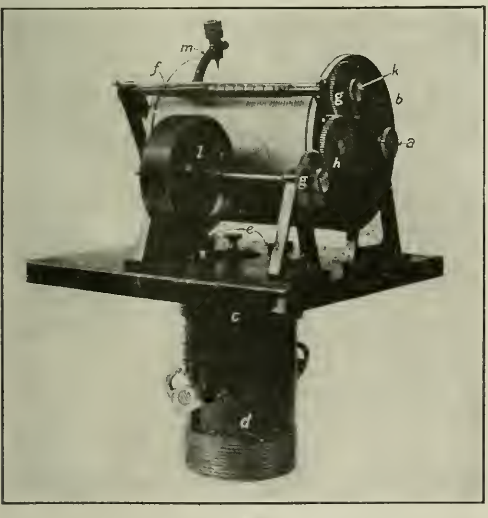
For Contractor and Engineer

section paper. A tangent screw (added after photograph was taken) on the pencil arm (m) permits of setting the pencil to the nearest minute.

The tidal graph is made on a special cross-section paper furnished with the gage. The record paper is wrapped around the cylinder and held in place by a metal clip, running lengthwise of the drum. The use of five different scales of cross-section paper permits the reproduction of tidal graphs to five reduced scales, allowing, therefore, for the accommodation to suitable scales of ranges of tide from 0 to 25 ft. The scales as printed for this gage are as follows:

1:11¼	for a maximum tide of	6 ft.
1:16⅞	" " " " "	9½ ft.
1:22½	" " " " "	12½ ft.
1:30	" " " " "	17 ft.
1:45	" " " " "	25 ft.

The change from one scale to another is accomplished by changing the relation between the upper and lower gear wheels (gg), the middle one (h) being an idler



PORTABLE AUTOMATIC TIDE GAGE

gear. Several sets of these gear wheels are furnished with each instrument.

The pencil screw—(f), made of phosphor bronze is connected to the axle of the float pulley (l) by means of two gear wheels (gg) and an idler gear wheel (h).

For adjusting the pencil, when installing the gage, to the height of the tide as read on a fixed graduated tide staff, the milled nut (k), holding the upper gear wheel to the pencil screw, is unclamped and the pencil screw then turned freely without connection to the float pulley until the pencil point indicates on the cross-section paper record the height of the tide at that particular time on the graduated fixed staff. This milled nut is then clamped and the penciled curve will thereafter indicate on the record the reading at any instant of the water level on the fixed tide staff as the tide rises and falls.

The clock is an ordinary eight-day movement, mounted within the drum (b) which carries the paper record. The gage, when properly adjusted, will operate for eight days without attention in the meantime. The drum turns once in two days; and, since the lunar and solar days are of different lengths, the tidal curve advances sufficiently from one turn of the drum to the next to obviate any interference of the curve for one day with that of the second day following.

Counterpoise Spring and Float—Instead of employing the usual counterpoise weight for taking up the slack of the float wire on a rising tide, a coiled flat spring 18 ft. long, is used. This spring is coiled within the case of the float wire pulley (l), one end fastened to the inside of the outer periphery of the metal case, the other end fastened to a separate extension of the pulley axle. This subsidiary axle, extending from the float pulley (l) in a direction opposite to the gear wheels, is controlled by a ratchet and pawl, so that any desired tension may be put on the spring.

The float, a hollow brass cylinder 3¼ in. in diameter and 15 in. long, connects the water level to the mechanism by means of a phosphor bronze wire. This float is weighted with shot to float in kerosene oil with its upper end ½ in. above the surface, the oil preventing freezing of the water in the float well in winter. The weight of the float and shot is sufficient to wind the counterpoise spring on a falling tide and at the same time to actuate the recording pencil uniformly.

The float pipe consists of a section, or sections, of ordinary stock galvanized 3½-in. iron pipe. A special bronze base-casting is furnished with the gage, having an inverted cone cast inside. A ¼-in. or a 5/16-in. hole drilled at the bottom of this inverted cone allows ingress and egress of the tide to the float well.

When it is necessary to install the gage in a place at which no wharf or platform is available and to have the float pipe carry the weight of the gage as a standard, another length of pipe is screwed into this cone casting on its bottom end and perforated with a number of large holes to allow free access of the water.

Records Which Should be Kept at a water-works plant should show all facts relating to the operation of the plant—not merely financial items but also an inventory of plant equipment, a record of the amount of water furnished to the distribution system each day, amount of power used per plans of the distribution system, all changes in the distribution system, installation and removal of meters, meter testing, quantities of chemicals used for treatment, data concerning treatment and the results of the examination of all samples of water which are analyzed to determine the quality. The records should enable the superintendent to operate the water-works plant in the most efficient manner. If the plant is not operated continuously a study of the operating records should show at what times and for how long a period the plant can be most economically run. Variations in quantity of water available at the source of supply and the variation in ordinary demand together with the effect of fire demand should be shown, as well as the effect of the seasons both on the quantity and quality of water and on the plant and distribution system. Some old operators know these things but such information cannot be as reliable as the written record, and the new man coming onto the job does not inherit his predecessor's memory.—*Prof. Earle L. Waterman at Iowa Section Meeting, American Water Works Association.*

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Should Swimming Pools Be Emptied in Winter?

Sir—We would like to know the best practice of leaving a concrete swimming pool during the winter in this vicinity where the frost strikes into the ground to a depth of 4 to 5 ft.; that is, should the tank be left full of water, so that expansion of the ice will counteract the expansion of the surrounding earth, or is it considered better to leave the tank empty during the winter season?

ADAMS & RUXTON CONSTRUCTION CO.

Springfield, Mass.,
Nov. 10, 1923.

[So far as our experience goes pools are always emptied in winter, but if there is experience to the contrary we would be glad to put it on record.—EDITOR.]

"What Is the Matter With Reclamation?"

Sir—To the reclamation settlers the reply to the editorial query, "What Is the Matter with Reclamation," raised in your issue of Oct. 25, p. 665, seems a very simple one. After 21 years there is not a project upon which the construction debts, first crediting all payments which have been made, are not greater than they were before payments began, or when original contracts were made. Always under the same direction and control, the settlers have steadily sunk farther and farther in debt, in spite of payments.

To them the basic problem seems to be not engineering, not political, although related to and complicated by both engineering and politics, but strictly economic. How shall reclamation pay out?

In other words the reclamation settler is in very much the same condition, in contrast to the average farmer, which the little boy complained of to his mother—"Ma, these pants are tighter than my skin." Nonsense, Johnny, there's nothing tighter than your skin." "Yes, Ma, these pants are, I can sit down in my skin, but I can't sit down in these pants!" Our reclamation clothes don't fit us. They were built by engineers and politicians according to preconceived theory and the general opinion seems to be that *we* were made wrong and must be altered to fit them. If we lose a toe or finger, arm or leg in the process or have rather frequent funerals, that is only what is naturally to be expected and should not cause protest, or repudiation of what we never were consulted about, because the Civil Service Commission and the American Society of Civil Engineers have O.K.'d the architects and approved the patterns, and the only other side of the question is politics!

We have the right, as one distinguished engineer stated briefly and emphatically a few years since, "only to pray and pay." If we criticise, we will start against us "the influence of the most powerful engineering organization in the world." Is this true?

Reclamation settlers have seldom been able to feel that the engineers in the service as a class and as an organization take a human, or often even a humane, interest in our personal problems and welfare. Due chiefly to this fact we feel they are not properly qualified to direct to ultimate success a problem so complicated with the human element as reclamation, in contrast to strict engineering. This feeling seems to be justified both by the condition of the reclamation fund and by the present trend of the discussion of the problem by engineering societies and journals; as if the technical and not the human factor is paramount, and entirely ignoring the settlers' wishes or opinions.

It is on the human and economic side that reclamation is failing, so that the fund has ceased to revolve, and it is upon this ground that Secretary Work's action must be studied and sustained or condemned.

The very able series of articles upon reclamation now running in *Engineering News-Record* will fail to properly enlighten your readers to answer your own question unless you also present the settlers' viewpoint.

Carlsbad, N. M. Nov. 15, 1923. FRANCIS G. TRACY,
President, Pecos Water Users' Association.

Effect of Curing Methods on Concrete Roads

Sir—In *Engineering News-Record*, Sept. 20, p. 466, there appeared an article on "Effect of Curing Methods on Concrete Roads" by H. J. Kuelling, construction engineer of the Wisconsin Highway Commission. This article is an instructive and valuable one but I do not believe the results of tests reported warrant the conclusions drawn.

This is especially so in the following paragraph of the report: "In both the field-made and laboratory specimens cured by calcium chloride, the modulus of rupture dropped considerably at 21 days. Because of this rather startling defect some studied consideration should be made before the acceptance of this material as a curing agent."

From the table of this report, which is on page 467, you may observe that in the field specimens cured by calcium chloride the modulus of rupture decreases from 686 lb. per square inch at 14 days to 623 lb. per square inch at 21 days, or 9 per cent in seven days. In the same table under Hay Covered (Field Specimens) the record shows the modulus of rupture decreases from 418 lb. per square inch at 20 days to 333 lb. per square inch at 21 days, or 20 per cent in one day. Still further under Straw Covered (Field Specimens) the results show an increase in modulus of rupture in one day from 420 lb. per square inch to 505 lb. per square inch, or 17 per cent increase. Such losses and gains in strength for one day are absurd. These figures are only given to show the non-uniformity of the strength tests of the concrete after receiving an initial wear test. I do not consider that one should draw conclusions to the extent of condemning a curing agent that shows a 9 per cent variation in strength in seven days when in the same table an approved curing agent shows 20 per cent variation in strength in one day. Furthermore the strength tests in this investigation can be classed only as secondary tests as the modulus of rupture specimens had previously been tested for wear. Therefore, the wear tests are the primary tests. The results of calcium chloride cured field specimens in this primary test show that there is an increased resistance to abrasion between 14 and 21 days. The Calcium Chloride (Laboratory Specimens) show contradictory results, but again collectively showing less wear in time.

A further criticism of this investigation and the extent of conclusions drawn is the lack of a sufficient number of specimens and the failure of rechecking tests. Only three specimens were averaged for each value given in the table and no rechecking of field or laboratory methods is noted.

The Illinois Division of Highways has tested to date over 900 specimens cured by calcium chloride and has not noted any retrogression in strength. Eight hundred of these specimens have been tested for modulus of rupture strength.

Springfield, Ill. H. F. CLEMMER,
Oct. 23, 1923. Engineer of Materials,
Illinois Division of Highways.

[Copy of the preceding communication was forwarded to Mr. Kuelling whose reply follows.]

Sir—The writer realizes that the number of specimens covered in the table was more or less limited, but the fact that in every case the calcium chloride specimens showed a decrease, both as to modulus of rupture and as to compression, is, in his judgment, a danger sign and worthy of consideration.

In contradiction to Mr. Clemmer, it should be borne in mind that the cylinders were not subjected to abrasions before compression and are true results. His criticism of

the abrasion tests on the slabs is true, but nevertheless they are comparative as all specimens were subjected to the same treatment.

His criticism of the change in strength over one day periods is, of course, just, but the writer still believes that the results warrant the conclusions as given.

Madison, Wis., Nov. 8, 1923.
H. J. KUELLING,
Construction Engineer,
Wisconsin Highway Commission.

Dealers' Profits on Cement to Large Users

Sir—Referring to Mr. Cormack's letter in your Oct. 25 issue, p. 592, defending the cement supply man, it is astounding to find how little even those who are employed to look after the interests of so great an organization as "The National Builders Supply Association," and others intimately associated with the marketing of cement, really know—or rather profess to know—about the ramifications of the business which they are guiding and counseling.

Mr. Cormack intimates that I am quoting ancient history in the incident I mention bearing on the "spread" between the mill and the consumer. I beg to assure him that in September of 1923 I was quoted cement by two reputable dealers at a price 76c. per barrel higher than I had been paying for it for county use—buying through the regular channels—and that on the same day rather than lose the business these dealers met the price I demanded, and one of them conceded another 10c. per barrel when he found that I was willing to go to the plant for the cement. There was no difference to me as to whether I took the cement from a car or from the mill, and 10c. per barrel was worth saving. So Neosho County—hat in hand—and with the dealer's order, went to the plant and secured her cement—and paid her tribute. But she had saved from the rapacity of members of the National Builders Supply Association the tidy little sum of $324 on a mere bagatelle of 400 bbl. of cement.

No one expects these men to do business with the county or any other unit or individual at a loss; they are entitled to a living profit from their business, and no one suspects that they lost any money in the above named transaction; on the other hand they made as they were entitled to make a reasonable profit.

If it is argued that their prices were based on warehouse delivery, I might answer that we are able to unload and store our cement, hauling one mile from side track to our storage at a cost of 6c. per barrel.

That the cement dealer is a necessary factor I freely admit, and for the small consumer he is indispensable. But my letter in your issue of Oct. 4, p. 567, was a plea for the recognition of the larger consumer—whose unit is car lots—who takes his cement from the car, pays the cash, and who gives the dealer no concern as to whether any, or how many, barrels will be spoiled in storage before being disposed of. I fail to see, however, just how, as Mr. Cormack claims, the elimination of the local dealer in these larger transactions would add to the cost of cement. We have demonstrated from our own experience that the closer we get to the mill door the lower to us is the cost of our cement. The local dealer lives from the profits of his business, supports his various "associations" out of his profits, and hedges against the possible loss of stock by adding to the margin of his profits. To claim that the elimination of all these factors of retail cost would cause the price of cement to skyrocket, sounds like a fairy tale, or a "bogy man" story told to scare the children into being good. The children, in this case the consumers, have been good a long time, but they are getting to the truth of the bogy man stories.

Now comes Mr. Brobston, vice-president of the Dexter Portland Cement Co. (*Engineering News-Record*, Nov. 1, 1923, p. 730), with his defense of the cement maker, and giving voice to an earnest disclaimer of any knowledge of any "association" which has to do with the marketing of his product, or the fixing of prices, or the naming of conditions under which it will be furnished.

How short is memory! Only a few weeks ago "The Cement Manufacturers Protective Association," of which Mr. Brobston's concern was a member, was dissolved by Federal Judge Knox, as being inimical to the best interests of the country!

In my letter of Oct. 4 I mentioned a dinner tendered my commissioners and myself by a certain cement producing company, at which there was a full and free discussion of the methods of marketing their product, in which they defended their system of doing business only through the recognized dealer. At the conclusion of that conference the general manager assured us, in the presence of other high officials of the concern, that they would be only too glad to recognize the car lot customer as represented by the counties and cities, but it was a matter in which they could not act alone, it would have to be taken up and worked out through "the association." He had already been to great pains to explain to us just how docile, and harmless and powerless "the association" was, and yet he was afraid to act independently, even in the marketing of his own product!

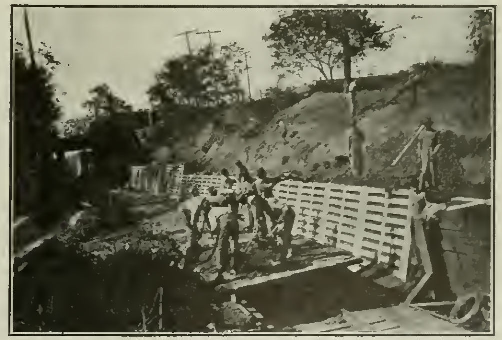
And in the face of all these outstanding incidents we are solemnly told that no one knows of any association, or agreement, or tacit understanding, or any other such thing which would in any way prejudice the cement producer who chose to market his own product in his own way. The public at large, and the users of cement in particular will believe these statements when they can drive to the mill door and buy their cement without an order from a local, or any other dealer.

If Mr. Cormack, or Mr. Brobston needs to be given names and places substantiating any of the statements I have made, he has but to write me personally, and I will be glad to go into the particulars of multiplied instances which, however, have no place in these columns

Erie, Kansas, Nov. 6, 1923.
O. T. REECE,
County Engineer, Neosho, County, Kansas.

Concrete Crib To Prevent Land Slides

Sir—At Utica, Miss., the Illinois Central is using precast concrete cribbing similar to that described in *Engineering News-Record*, Nov. 1, p. 718, to protect against the sliding of the 25-ft.-high hill on either side of the track.



CONCRETE CRIB RETAINING WALL AT UTICA, MISS.

The accompanying view shows a part of the cribbing in place. This design does away with the row of stretchers on the back side of the cribbing, only the headers running back into the hill. However, the cribbing is given a batter of 3:12 instead of 1:12 as in the Rock Island design.

The Illinois Central requires a concrete foundation for the cribbing. On the Utica cut this consists of a curb one foot wide, top even with the base of rail, and deep enough to rest on rock or good foundation material. With this arrangement it is possible to hold the cribbing to perfect alignment and elevation with no danger of any of the sections settling.
KENNETH L. DEBLOIS.

Utica, Miss., Nov. 6, 1923.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

On Dec. 4, the Civil Service Commissioners of Colorado, will hold an examination for the purpose of selecting an engineer to fill the position of railway and hydraulic engineer for the state public utilities commission, the place made vacant when C. D. Vail left it to become manager of parks and safety for the city of Denver.

Reports that the Pennsylvania R.R. plans to electrify a portion of its system over the Allegheny Mountains, quoted in our last week's issue, is not confirmed. The chief engineer states that no recent consideration has been given to this subject.

A Chair of Transportation Has Been established at Yale University in honor of the late Thomas de Witt Cuyler. This action was taken by the Association of Railway Executives at the recent meeting of the American Railway Association. The chair is to be maintained by voluntary subscriptions from individual railroads.

The National Executive Committee of Stevens Institute of Technology, the nation's first college of mechanical engineering, announces that the pledges of the first week of their world-wide campaign for a million-dollar endowment total $200,460. This amount includes a contingent gift of $100,000 from Edward S. Harkness.

Cook County (Ill.) Civil Service Commission will hold examinations Dec. 6 7, and 8 for civil engineering positions as follows: Inspectors, salary $200, and junior civil engineers, salary, $240. The positions are open to residents of Cook County only. About 35 inspectors and 15 engineers are required, largely to fill positions occupied by temporary appointees.

The Cascade Power Co. Has Filed a "declaration of intention" with the Federal Power Commission for a 17,000-hp. development on the Cowlitz River at a point between Portland and Seattle. The project involves the construction of a dam, tunnel and a pipe line. The power will be used for the manufacture of pulp. While the mouth of the Cowlitz River is navigable this development will not come under the jurisdiction of the Federal Power Commission unless it can be shown that it will affect the navigability of the stream.

Virginia's Highway Program Will be much curtailed, it is believed, as a result of the defeat recently of the proposed bond issue. An analysis of the situation since the election indicates that the pay-as-you-go advocates have overestimated the revenue which will come from a three-cent tax on gasoline and one mill on general property. It is believed that the aggregate of the revenue from those two sources will be sufficient only to match federal-aid funds.

Greene to Reduce Personnel in Canal Bureau

According to an announcement made last week Col. Frederick Stuart Greene, state commissioner of public works, has decided upon a reorganization in the Bureau of Canals whereby 100 of the 949 employees are to be dropped from the payroll. By this change Col. Greene hopes to save the state $100,000 yearly, the present payroll of the bureau now being $1,335,852. In the new consolidated Department of Public Works, Col. Greene plans to save the state at least $200,000 a year, the saving being effected in reduction in rents, salaries, and traveling expenses.

County Liable for Bridge Failure

In a decision filed recently by the Supreme Court, Washington State, Cowlitz County is held liable for damages resulting from the collapse of the Kelso bridge last January, with a heavy loss of life (*Engineering News-Record*, Jan. 11, p. 88; Jan. 25, p. 134). The Supreme Court reverses the decision of Superior Judge Reynolds of the Cowlitz County Court, who dismissed the action, and remands the case for trial.

Cowlitz County contended that the Kelso bridge was solely within the city limits of Kelso and that the county had no jurisdiction over it. The Supreme Court opinion asserts that records show the county and city bought the bridge together from a private holder, and that the county has exercised control over the bridge since its purchase.

Rivers and Harbors Congress to Be Held Dec. 5-6

The 19th convention of the Rivers and Harbors Congress is to be held in Washington, D. C., Dec. 5 and 6. Though work on the program is not yet entirely complete, the following projects are to be discussed: Cape Cod Canal (speaker to be announced); Port of Los Angeles, John D. Fredericks, Congressman of California; Port of Hampton Roads, Mayor Albert H. Roper, Norfolk; Intracoastal Waterway, C. S. E. Holland, Houston, Tex.; Pittsburgh's three rivers and their connection with Lake Erie, W. H. Stevenson, Pittsburgh. Other speakers will make brief addresses on the various routes proposed for a canal connecting Lake Erie and the Ohio River.

An interesting feature of the convention will be a discussion on the diversion of water through the Chicago sanitary canal and its effect upon the levels of the Great Lakes. Other features will be the Panama Canal, levees and navigation, shallow water assets, and co-ordination of rail and water transportation. The speakers on these subjects include Senator Ransdell, of Louisiana, and Representative W. J. Driver, of Arkansas.

Many Topics Presented at A.S.M.I. Convention

Paving, Sewage and Garbage Disposal, Water Supply, Street Lighting, City Planning Reviewed

Engineering News-Record Staff Report

Including guests from outside the meeting place about 250 persons attended the 29th convention of the American Society for Municipal Improvements, held in Atlanta, Ga., Nov. 12 to 16. As usual, the program was crowded, but there was more time for discussion than usual. Nearly the whole field of municipal engineering, including city planning and street lighting, was surveyed. Four specifications were passed to letter ballot.

President Horner's Address—The advantages that would result from having a full-time secretary was one of the first things mentioned in the presidential address of W. W. Horner, chief engineer, sewers and streets, St. Louis, Mo. Other suggestions made by Mr. Horner were that the committees of the society might go beyond the standardization of specifications and make reports on the merits of new materials; that more attention might be given to contract forms; and that methods of financing local improvements, the cost of which is met by assessments for benefits could well be taken up. It sometimes happens, said Mr. Horner, that the cost of contract work for local improvement is increased 30 per cent because the contractor has to accept tax liens in payment. Co-operation between the A.S.M.I., the Investment Bankers' Association and the Associated General Contractors was proposed by Mr. Horner.

Officers Report

On motion of T. C. Hatton, it was voted to appoint a committee of three to co-operate with like committees from the Am. Soc. C.E. and from the Sanitary Engineering Section of the A.P.H.A. in obtaining American representation at the International Sanitary Engineering Congress to be held in London next June in connection with the Empire Exhibition.

Reports of Officers—The Executive Committee recommended that the Society endorse the reduction in paving brick and in asphalt standards agreed to by the Simplified Practice Committee of the Department of Commerce and the manufacturers. This was done through the adoption of the report of the Executive Committee. The report of the secretary, C. C. Brown, city engineer, Lakeland, Fla., showed a net membership gain of fourteen for the thirteen months ended Oct. 1, and a total membership on that date of 677, of which 521 are active, 30 affiliates and 126 associates. The debt of the society was reduced by half during the 13 months ended Oct. 1, $200 being paid from ordinary receipts and $500 from the sale of Liberty Bonds. The

time and place of the next convention was referred to the Executive Committee, in accordance with a proposed amendment to the constitution which it was voted to send the letter ballot.

New Officers—Ellis R. Dutton, assistant city engineer, Minneapolis, was elected president for 1923-4. Vice-presidents elected are: E. L. Dalton, Dallas, Tex.; T. C. Hatton, Milwaukee; and C. A. Poole, city engineer, Rochester. C. C. Brown, Lakeland, Fla., and Robert Hoffman, Cleveland, Ohio, were re-elected secretary and treasurer, respectively.

Reports of Standing Committees—The Committee on Public Safety, Alcide Chaussé, Montreal, chairman, is at work on a building code. The committee, aware of the studies of this subject being made by the Department of Commerce, is giving particular attention to the logical arrangement of a code. The Committee on Public Welfare through its chairman, J. C. Grinnalds, zoning consultant, Baltimore, is giving particular attention to markets, baths and comfort stations. A study of public markets at Baltimore has convinced the committee (1) that stalls should be rented to the users of the stalls only, and that as a rule public markets should be located on the outskirts rather than at the center of the city. H. F. Bascom, a member of the committee, submitted a report on baths and on comfort stations. The latter are more necessary than ever since the eighteenth amendment has closed so many saloons.

Fuller Makes Report

George W. Fuller, for the Committee on Water Supply, sent a report reviewing the committee work of the A.W.W.A. and outlining current waterworks activities in other fields. The Committee on Street Lighting, through its chairman, Ralph Toensfeldt, Engineering Division of Lighting, St. Louis, Mo., laid stress upon the new system of a symmetrical lighting. E. R. Conant, chairman Committee on Street Paving and Street Design, presented a lengthy report which will be abstracted in a later issue.

Specifications Passed to Letter Ballot—Out of a large number of specification committees listed on the program, most either made no report or else merely suggested slight changes. Four specifications, which had been before the association in printed form for some time, were sent to letter ballot: asphalt, stone block, street railway pavement and track construction, and sewers. From the latter, a proposed form of contract was withdrawn in order that it might be made as nearly uniform as possible with other standard contracts to be taken up in the future.

The program called for reports from representatives on committees of other societies. Two or three made program reports and the others did not respond.

Moving Pictures—Films to illustrate how Bridgeport, Conn., salvages worn-out pavements were presented by Charles E. Murphy, of the Texas Co., New York City. Some 140,000 sq. yds. of old macadam was scarified, regraded, top dressed with broken stone and treated with asphalt by the penetration method in 140 working days by using, successively, four gangs of men and machines. Five reels called the "Story of Fire-Clay Refractories" were shown. These were the joint production of the U. S. Bureau of Mines and the Laclede-Stacy Co., St. Louis. Moving pictures were used to illustrate papers on street lighting by L. A. S. Wood, of the Westinghouse Electric & Manufacturing Co., South Bend, Ind., and S. C. Rogers, of the General Electric Co., West Lynn, Mass.

South Street Bridge Opened

The city-built bascule bridge over the Schuylkill River in Philadelphia at South St., was officially opened to traffic Nov. 9. The main structure was completed about a month ago, and the approaches have now been finished. The American Bridge Co. was the contractor, and the work was done under supervision of the Bureau of Surveys.

New Chicago Terminal Project

A new terminal station fronting on Van Buren St. and extending between LaSalle and Wells Sts., Chicago, is proposed by the New York Central R.R. as a substitute for the LaSalle Station (one block north of the proposed site), the Dearborn Station and the Grand Central Station. But the Chicago & Western Indiana R.R. already has plans for a new Dearborn Station to replace the same three existing stations, and the Baltimorde & Ohio R.R. is understood to have similar plans for combining all the facilities in a new Grand Central Station (see *Engineering News-Record*, Feb. 22 and March 8, pp. 354 and 453). Negotiations between the several railroads and between the railroads and the city will have to determine which one, if any, of the three rival projects should be carried out.

Steel Bridge to Replace Burned Springfield Structure

The joint committee for Springfield and West Springfield, Mass., on the construction of a new bridge across the Connecticut River to replace the North End Bridge destroyed by fire last September has unanimously decided in favor of an open-deck steel bridge, 1,135 ft. long and 70 ft. wide, estimated to cost $873,000. The J. A. L. Waddell Co., engineers, submitted alternative plans for steel and concrete structures, and the steel bridge was preferred on the score of cost and expedition in building. It is estimated that the bridge can be made ready for use in six or eight months, but this is conditional on prompt approval of the plans by the War Department and necessary legislation by Congress and the Legislature.

Part of the bridge is to rest on the old piers, and the contract will require that that portion, 18 to 20 ft. wide be built first. The roadway will be 54 ft. wide, with an 8-ft. sidewalk on each side. It is proposed to improve the architectural effect with pylons.

Estimates call for $56,000 for electric railway tracks, including metal to carry the rail base, of which the Springfield Street Railway Co. will be called upon to pay about $25,000. They also call for $38,000 to be expended for ducts, this to be borne by the telephone, gas and electric light companies. These items, totalling $63,000, are in addition to the estimated cost of the bridge.

It is hoped that the contract for the bridge may be let by Feb. 1.

Bascule Counterweight Falls; Drops Bridge

Counterweight Hanger Members Break While Bridge Is Being Closed—New Structure Planned

A 65-ft. highway bascule bridge over the Lachine Canal, at Ville St. Pierre, near Montreal, failed on Oct. 3 by the breaking of the counterweight hanger members, which dropped the counterweight and the bridge span. The accident occurred while the bridge was being closed. When the free end of the span was yet 20 ft. above the abutment the rear hanger at the upstream side of the counterweight broke through just inside the concrete. The downstream rear hanger then broke and the counterweight swung forward on the two forward hanger members, breaking off one of them and shearing the rivets at the other one. The span fell from a height of about 7 ft. above the abutment. The bridge was built in 1912 by the Dominion Bridge Co. to designs by the Strauss Bascule Bridge Co.

To clear the canal for traffic, the operating link connecting the forward end of the counterweight walking-beam with the top chord of the bridge was cut near its lower end by torches, and the heel pins of the span were withdrawn, permitting the span to be lifted and rolled out of the way longitudinally.

No information about the accident has been obtainable from the Canadian Department of Railways and Canals (W. A. Bowden, Ottawa, chief engineer).

Strauss Company Issues Statement

The Strauss Bascule Bridge Co. says: "The Lachine Canal bridge was one of the earliest heel trunnion bridges built, having been designed in 1911 while the first of the type was completed in 1910. There existed no specification for bascule bridges such as have now been developed based on experience, and we had not yet developed that perfect co-operation with the fabricator that now obtains. In the early bridges of heel trunnion type steel plates were used for partial support of the counterweight, these plates covering the two entire side surfaces of the counterweight. This detail was long ago abandoned and replaced by embedded members.

"Some five or six years ago these plates were removed from the Lachine Canal bridge without the co-operation of all parties interested and without due regard to the function performed in taking part of the stress involved in the support of counterweight. The result, evidently, was to overload the remaining members connecting the counterweight to the counterweight trusses. In spite of this only half of one of the embedded members failed initially, the character of the fracture showing that this failure was one of long standing and evidencing that the bridge continued to operate even with the overstressed member.

"The Department of Railways and Canals has authorized us to prepare plans for placing the bridge back in service, and we are building into the counterweight our later details, which fully provide for secondary stresses and for reversal of stresses and similar considerations, knowledge of which grew out of our experience with these early designs. The heel trunnion type has now been reduced to standardized design in both theory and practice."

U. S. Chamber Reports On Transportation

Recommendations Made Based on Theory Best Service Is Possible Only Through Co-operation

After a careful study of the recent developments in the transportation situation of this country caused by the great increase in the use of motor transport on paved highways, the Committee on the Relation of Highways and Motor Transport to Other Transportation Agencies of the Chamber of Commerce of the United States has come to the following conclusions:

1. The best interests of the public and the rail, water and motor carriers lie in the co-operation between the various agencies of transportation rather than in wasteful competition; 2, the greatest opportunity for co-operation is at the point where the capacity of the railroads is most limited and expansion is difficult and costly; that is, in the terminal areas of our great cities; 3, store-door delivery by motor transport is the greatest contribution which can be made to the solution of the terminal problem; 4, organized motor transport can also relieve the railroad from various forms of uneconomical service, such as switching between local stations and short-haul shipments within the terminal area;

5. To secure the fullest benefit from this organized motor transport will require the utilization and further development of modern technical equipment, such as demountable bodies, trailers, container cars and mechanical handling appliances; 6, outside of the terminal areas there are distance zones in which one type of carrier, the motor for short haul and the railway or waterway for long haul, is clearly more economical than the other, and intermediate zones in which competition is inevitable; 7, it is to the interest of the public and the carriers that the economic limitations of each type of carrier be recognized, that the railroad be permitted to discontinue unprofitable service to which the motor is better suited, and that the motor abandon its efforts to handle general traffic over excessive distances; 8, to insure to the public continuity and reliability of service, sound financial organization of motor transport is necessary as is public regulation of common-carrier motor service; 9, passenger bus transport should be so regulated as to secure the best service to the public (rail lines can often advantageously extend or supplement their service by bus lines, and any restrictions against such service should be abolished);

10. Regulation of traffic and of size, weight and speed of motor vehicles should be made more uniform within states and the regulation of common carrier operation of motor vehicles, including rate regulation, should be handled by federal or state authorities, under the commissions which now control the operation of rail and water carriers; 11, truck highways in any area should be able to carry the normal vehicular traffic of that area, and, if the traffic economically justifies the use of specially heavy trucks, highways with stronger substations should be provided; and 12, investigations now under way by the U. S. Bureau of Public Roads state and highway departments and other agencies to determine more fully the economic role of the motor vehicle, should be continued.

A. P. Davis Is Honored By Washington Engineers

Arthur P. Davis, the past president of the American Society of Civil Engineers, who was summarily dismissed as Director of the Reclamation Service by Secretary Work, has been elected to honorary membership by the Washington Society of Engineers. This honor has been conferred on only four others. They are: Commerce Secretary Hoover, Admiral H. T. Endicott, Admiral D. W. Taylor, and Dr. F. H. Newell. Mr. Davis now is in England, representing the Department of State on engineering matters coming before the Pecuniary Claims Commission.

River Terminal for Cincinnati

A steamer dock on the Ohio River front with warehouse, railway connections and freight-handling equipment is to be built by the Cincinnati River-Rail Transfer Co., and it is expected to have this terminal in operation early in the spring of 1924. The purpose is to provide more efficient and economical handling of river-borne freight than is practicable with the old arrangement of a levee and wharf boats. The company was organized partly as a civic enterprise, backed by the Chamber of Commerce, charges to be regulated by the city and a fee paid to the city for each ton handled or for each vessel. J. A. Pollak, of the Pollak Steel Co., is president; Major Bert L. Baldwin is chief engineer.

Arizona Governor Fails to Extend Girand State License

Washington Correspondence

The governor of Arizona has declined to extend the time of the state license covering the Girand development at Diamond Creek on the Colorado River. Mr. Girand has filed the governor's letter with the Federal Power Commission.

This puts it squarely up to the Federal Power Commission to take action in this case which involves a \$90,000,000 transaction. If the Commission refuses to take action before Dec. 26 on the Girand license, it will mean, unless the governor reverses himself, that the Arizona copper companies would no longer be committed and might decide to rely for a longer period on fuel oil. The decision to resort to hydro-electric power was made at a time when the prospect for securing adequate supplies of fuel oil at reasonable prices was not as good as it is at present. Arizona would be the greatest sufferer were the scheme to fall through. For that reason, some are of the opinion that the state executive may change his mind as soon as he is sure the Federal Commission will not grant the Girand license before Dec. 26.

On the other hand, the Federal Commission must face a heavy moral, and possibly a legal responsibility, if through failure to grant a license, Mr. Girand, who has complied with all the conditions of the preliminary permit, should be subjected to great losses.

Federal Power Commission Issues Third Report

Plea Made For Settled Public Policy To Have Uniform Application In All States

Appreciating the desirability of common action in matters of hydro-electric development, the Federal Power Commission, in its third annual report, just made, makes a plea for a settled public policy which will have uniform application in all the states. Only by such a policy can the country be assured of a systematic development of its potential power possibilities into a great interconnected system without expensive reconstruction or unnecessary duplication. The commission advises that legislation which interferes with such a program should be repealed or modified, nor should it be permissible for any utility to draw plans for future extensions except in such manner that interconnections may be effected when feasible.

The commission points out that the ownership and control of water powers by public agencies should be made a policy of all the states as it now is a fundamental policy of federal water-power control. It also emphasizes the fact that values inherent in a public resource developed and used in the performance of an essential public service shall not be capitalized in excess of amount actually expended in acquisition. This policy is being carried out by the commission as far as all sites under its control are concerned, and these sites involve 85 per cent of the total water powers of the United States. If this principle is applied by the states to all structures and equipment erected or used on the site as well as to the power itself, the commission sees simplification of rate adjustment. Public regulation of rates has not been an entire success largely through the fact that public service commissioners have been chosen for their political affiliations only.

Funds and Personnel Lacking

The commission is now hampered by the lack of sufficient personnel and funds to carry on its work properly. At the present time its personnel is made up of the three departments part of whose work still has to do with the administration of permits issued under the provisions of earlier laws. The commission recommends that the act be modified so that the administration of all projects will come under the Federal Power Commission. Such a change would make available certain funds which other departments of the government are now using for water power investigations which largely duplicate work required by the Federal Power Commission when issuing permits for such projects. The commission lacks an adequate accounting department needed to control accounts in order that they are not padded with capital not actually put into the development.

The Water Power Act provided that the annual license charges should make the commission independent of support from the Treasury, but the greater part of such funds either are not yet available or are absorbed by prior liens upon them. The commission recommends that the act be amended to make these funds available for its use in order that it may obtain sufficient personnel and still be a self-supporting branch of the government.

Progress on Mississippi Freight Service

Colonel Ashburn's Report Mainly An Essay on Essentials of River Freight Transportation

Col. T. Q. Ashburn, Coast Artillery Corps, U. S. A., and chief of the Inland and Coastwise Waterway Service, has just rendered his annual report on the operations of that service, which has charge of the government fleet on the lower Mississippi and the Warrior Rivers. The report is mainly an essay on the essentials of river freight transportation and an explanation of the difficulties of freight operation on the lower Mississippi River where the government since early in the war has been trying to maintain an economic freight service.

Col. Ashburn lays down the following conditions precedent to success of any inland waterway service: (1) A suitable navigable waterway; (2) suitably designed equipment for each particular waterway, which equipment must be determined by experiment; (3) suitable terminals and balanced freight both ways; (4) interchange of freight with the railroads; and (5) equitable division of revenues accruing to both water and rail transportation for a combined haul. He said that none of these five essential elements is present on the upper Mississippi, so that it is not practicable at the present time to attempt government or any other freight operation above St. Louis.

Conditions Below St. Louis

Below St. Louis conditions are more favorable, but the government operation is difficult because of the lack of certainty on the part of the shipping public as to whether governmental operations may not be suddenly abandoned, the tendency on the part of individuals or communities to brings political pressure to bear upon the operation, and the inability of the government waterway line to finance itself in periods of depression. He, therefore, recommends a semi-public body to conduct the operations of the Mississippi waterway and presents a bill embodying his suggestions. This bill would create a corporation under government control but with private functions, which Col. Ashburn thinks would avoid most of the difficulties of the government operation of the Mississippi waterway.

Col. Ashburn holds that the lower Mississippi operation was successful, although it continues to lose money if the heavy charge of the war-time equipment is carried on the books. The eighteen months ending July, 1923, were particularly hard ones because of the tremendous flood which went down the Mississippi in 1922 and which very seriously affected the operation of any of the barges. The tonnage for the six months preceding the flood was 375,480; for the flood period, 224,206, and for the succeeding six months, 370,909, which, as the Colonel states, tells its own story. The lowest tonnage was due partly to the difficulties of landing and loading at high water, but mainly to the disturbances to the channel caused by the flood.

In figures, the total income on the Mississippi section from Jan. 1, 1922, to July 1, 1923, was $3,504,512.22. The total operating expenses during the same period were $3,961,989.47, of which $432,000 is depreciation. The main loss was, as noted, in the flood period. For the remaining twelve months actual profit was made.

On the Warrior River the losses were "staggering." According to the Colonel's report, this division has been handicapped by the railway opposition, has never had suitable barge equipment or towboat equipment. The average monthly loss on the Warrior River for the fiscal year 1923 was $54,132. Col. Ashburn estimates that with proper equipment on the Warrior River and with proper rates controlling on the railways, the revenue on the Warrior River would have to average $2.46 per ton in order for the operation to break even. At present, average figures for 1923 show an average revenue of $1.68 per ton and an average cost of $3.95 per ton, leaving a deficit of $2.27 per ton.

Marginal Belt Line to Be Set Up at Port of New York

The Port of New York Authority has announced that the railroad companies having terminals on the New Jersey side of New York harbor have agreed to allocate certain portions of their properties to be used for the Port Authority's marginal railroad No. 13 and have agreed to spend approximately $500,000 for the construction of certain railroad connections and signal systems to make such a belt line effective. The railroads have also agreed to appoint a director of operation for this belt line, who will be selected from among the officers of some railroad not directly interested in the property. Equipment will be supplied by the individual roads.

The Port Authority also announces that its engineers and those of the carriers' operating committee are continuing their studies of the outer belt line with the idea of being in a position to start construction of that railroad in the near future in order to relieve the marginal belt line from much of the interchange business which it now handles to the detriment of the switching along the water front.

LaDu Recommends Abandoning Black River Canal

State Engineer and Surveyor Dwight B. LaDu, in his annual report to the New York Legislature will urge the submission to the people of a constitutional amendment permitting the abandonment of the Black River canal which extends from Carthage to Rome. Mr. LaDu's position is that the period of usefulness of this section of the old Erie Canal, which has never been a part of the barge canal, is long past, but two or three boats passing through the canal each year. Mr. LaDu said he would also recommend the abandonment of a strip of the old Erie Canal near Buffalo.

The abandonment of the Black River canal will sound the death knell for another barge canal connection with Lake Ontario via Carthage, Watertown and Sackett Harbor, a project which has been advocated for many years. The nearest this proposal came to materialization was in 1913 when legislation was introduced providing for additional bond issues to the amount of $22,000,000, part of which was to be expended for a barge canal over this territory, which proposal failed of passage.

Engineering Employment Shows Slight Recession

Numerous Inquiries Being Received—Civil Engineers Hardest Hit—Los Angeles Permits

Employment conditions affecting engineers reflect considerable irregularity with special divergencies between the trends in different industries and engineering endeavors, but on the whole, engineering employment throughout the country is fair. Numerous inquiries are being received from all sections of the country from men desirous of making new affiliations, or who report the completion of their work, indicating that a slight recession in employment is apparent. These are the observations of E. B. Miller, employment secretary, American Association of Engineers. A fair volume of placements has been accomplished through the Chicago office of the association. The business of October exceeded that of September by 12 per cent. In the latter month there was practically no unemployment among engineers, but during October some unemployment was noticed and it is now increasing slowly. So far, however, most men requiring new positions were able to make connections in a short time which will last at least for the winter months. In the Chicago district more than 300 engineers were laid off during October and early in November 100 engineers had been given notice of discontinuance of their employment during the month.

Civils Hardest Hit

Civil engineers are hit the hardest at this time, particularly those on construction work, including superintendents, instrument and general field engineers. Practically no demand exists for men on irrigation, drainage, hydraulic or construction work. Manufacturing and industrial companies have reduced their technical staffs although a few lines continue actively, such as machinery, tool, railway equipment and automobile manufacturers. The greatest demand is for architectural engineers and draftsmen. A fair demand is evident for highway engineers, especially designers on plans and bridges. The railroad field for engineers is practically dormant. The electrical industry is fair with a good demand for junior men for minor positions and a fair demand for a few electrical technical experts. The chemical and mining fields have not shown any great changes, but not much unemployment is noted in these two lines.

The greatest number of building permits during October for any city, was issued in Los Angeles, exceeding the building permits for Chicago, which so far this year had held first place. Positions for engineers on the Pacific Coast and Southern California are fair. In the Northwest, conditions are tightening with little work for engineers in the states of Washington, Montana and Idaho. The Middle West is fair for employment and men can find something to do if they are willing to accept what is offered. The Eastern section is not very desirable for employment; more men are looking for positions than there are positions open. The South is starting considerable activity with a good demand for engineers of the junior grade. The greatest unemployment at the present time is in the Northwest and Eastern sections of the country.

Random Lines

Animal Magnetism

Sir—There are several different ways of finding the points of the compass, but the following, while it is not a new method, is a new one to me. I have clipped it from "Century Readings in American Literature" published by the Century Co. 1923:

"In 1729, William Boyed was a member of the expedition sent to determine the dividing line between Virginia and North Carolina. In his 'The History of the Dividing Line,' 1841, he writes:

"'He told us a Canterbury Tale of a North Briton whose curiosity spurred him a long way into the Great Desart (The Dismal Swamp) as he called it, near twenty years ago, but he having no compass, not seeing the sun for several days together, wandered about till he was almost famisht; but at last he bethought himself of a secret his Countrymen make use of to pilot themselves in a dark day.

"'He took a fat louse out of his collar, and exposed it to the open day on a piece of white paper which he brought along with him for his journal. The poor insect having no eyelids, turned himself about till he found the darkest part of the heavens, and so made the best of his way toward the North.'"

C. D. P.

* * *

Query? Does The Engineer Need a Broader Education

SIGN ON THE BROADRIPPLE SWIMMING POOL AT INDIANAPOLIS, IND.

* * *

The Supply is Getting Low

We think we have about exhausted the supply of adjectival engineers, because our voluntary scouts are beginning to report duplicates. Two new ones have shown up, though, one bona fide, a "*dehydration engineer*" who advises California farmers how to dry fruits, and one hypothetical, the "*psychic engineer*," who, a certain professional spiritualist claims, is needed today by the world. This latter brother will "spend his time and life, if need be, to the study of high tension and grasping the messages from the other side of life on this side."

* * *

Standardized and Replaceable?

"Engineer To Be Man of Many Parts in Future," says a Cleveland paper in reporting the Carnegie Foundation's new study into engineering education.

Large Power Development Proposed for Columbia River

The Washington Irrigation & Development Co. has applied to the Federal Power Commission for a license covering its development at Priest Rapids on the Columbia River between Spokane and Portland, and has stated in the application that it will start work immediately upon issuance of a license with the idea of having the first lot of power, amounting to about 200,000 hp., ready for delivery within four years. The development as now proposed calls for the construction of a dam partly of concrete and partly of earth fill 2½ miles long. The power house will be built in the dam, the initial section being 660 ft. long, with a provision for a 700-ft. extension. The spillway section will contain 127 gates 30 ft. long with a flood discharge capacity of 1,200,000 sec.-ft., or almost double the amount of the largest flood on record, which is 710,000 sec.-ft. The head to be developed is 70 ft. The initial installation will be six 40,000-kva. and two 29,000-kva. units, and the additional future installations will be ten 40,000-kva. units. The initial installation will cost approximately $28,000,000 while the project in its final form is expected to represent an outlay of $41,000,000. The dam will be provided with two navigation locks and a fishway.

George P. Coleman Chief Speaker at Highway Officials Session

Due to the fact that C. J. Bennett, nominal head of the American Association of State Highway Officials, though no longer a highway official, cannot be present at the New Orleans Convention Dec. 3, 4, 5 and 6, the principal address will be delivered by George P. Coleman, of Virginia, the retiring chairman of the Association's executive committee. In that address, Mr. Coleman will review his eleven years' service as a state highway official during which he has been particularly active in connection with federal legislation pertaining to highways.

J. M. Parker, the Governor of Louisiana, and Andrew McShane, the Mayor of New Orleans, will speak at the opening session to welcome the delegates to the Louisiana metropolis.

Arrangements have been made to present during the convention, the new films of the Bureau of Public Roads entitled "Motoring Through Maryland" and "The Changing Road."

In compliance with an invitation from Tulane University and the University of Louisiana, the Association has agreed to arrange with highway engineers to lecture before classes at those universities, during the time that the convention is in session.

Reports will be submitted by the Committee on Standards including subcommittees on plans and surveys, design, specifications, traffic control, bridges and structures; Committee on Administration, and the Committee on Construction.

Besides Mr. Coleman, speakers will be Henry G. Shirley, F. S. Greene, J. H. Mullen, G. W. Hutchinson, Clifford Older and Thomas H. MacDonald.

F. R. White is acting president of the association.

Coal Commission Urges Profits Tax on Coal Operators

The Coal Commission in its latest report on the profits of anthracite coal operators recommends that a profits tax be applied to the operations of the coal mines. It finds that no sweeping horizontal cut can be made in the price of coal at the mine, or in the margins, without serious injury to many high cost operators whose output is needed. The consumer will benefit indirectly through the lightening of taxes elsewhere. In addition the commission again recommends requiring complete publicity of the operators' accounts and urges the public to resort to the use of substitutes in order to protect itself against unreasonable profits.

These recommendations are based on a study of the coal operators' margins, which study shows that these margins range from nothing to over $2 per ton, and that the per cent return on the book value of the investment ranges all the way from a loss to a return of 138 per cent. The book values have had very large increments in recent years and are largely shrouded in mystery but there is ample evidence of certain "write-up" amounting to at least $186,000,000 and in addition there were memorandum accounts kept for Federal tax purposes indicating further appreciation of $40,000,000. These however are 1913 figures and if the valuation of $989,000,000 placed on the mines and minerals by the commission's engineers are to be taken as correct there will be much greater increases because the owners book valuation is now only $600,000,000.

The commission finds that the practice of carrying large reserves of coal lands adds to the cost through taxes and conceals profits. The largest of the railroad coal companies, the Philadelphia & Reading, a high operating cost company, has sufficient reserves to last 200 years. On this total investment it has shown an inadequate return, the loss having been made up out of the earnings of the affiliated railroad. The commission calls especial attention to the matter of the increasing value of these reserve coal lands, both for anthracite and bituminous coal, and points out that if it is allowed to continue indefinitely, piling up carrying charges to be added to the current price of coal an intolerable burden will be laid on the consumer. Taxes and interest on coal not to be mined in the next forty years are not properly chargeable to present operations.

St. John Opens New Drydock

The new drydock of the St. John Drydock and Shipbuilding Co. at St. John, N. B., has been opened with a formal ceremony by the governor-general of Canada, Lord Byng. The new dock, according to its owners, is the largest of its kind in the world. Its extreme length is 1,225 ft. and the length on the block is 1,150 ft., and it is so arranged that it can be used as two drydocks, one 650 ft. long and the other 500 ft. long. The patent slipway is 720 ft. long, and the cradle 240 ft. The depth of the sill at high tide is 42 ft. and the draft of the keel block at extreme high tide is 14 ft. The dock is equipped with a 70-ton fixed crane and a 20-ton traveling crane.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, Washington, D. C.: Annual Convention, New Orleans, La., Dec. 3-6, 1923.

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 10-11, 1924.

AMERICAN ROADBUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 14-18, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York, Jan. 16-18, 1924.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Chicago, Ill., Jan. 21-24, 1924.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich. Annual Meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

The Engineering Society of Western Massachusetts at its meeting Nov. 20 in Springfield, Mass., was addressed by Charles E. Wells, consulting civil engineer of North Adams, Mass., on the "History of the Hoosac Tunnel," and by Col. B. A. Franklin, head of the Bridgeport Division of the Ordinance Department, on the subject, "If the United States Were Again Forced to Fight Would She Be Prepared?"

The Engineers' Club of St. Louis discussed the question, "How Engineering Leadership Can Reduce Seasonal Unemployment" at its meeting of Nov. 9, with A. P. Greensfelder, secretary of the Fruin-Colnon Contracting Co., St. Louis, and E. A. Hadley, chief engineer of the Missouri Pacific R.R. Co., St. Louis, as the principal speakers.

Personal Notes

MICHAEL C. HINDERLIDER, consulting civil engineer, Denver, Colo., has been appointed state engineer for Colorado to fill the vacancy caused by the resignation of A. J. McCune. Mr. Hinderlider is a native of Indiana and a graduate of Purdue University. He went to Colorado in 1900 and was soon appointed engineer of the Denver Board of Public Works. From 1902 to 1908 he was engineer in charge of hydraulic work for the U. S. Reclamation Service in the Rocky Mountain Division, embracing seven states. Later he was engineer in charge of construction of the hydro-electric power plant at Shoshone Falls, Colo. Since 1909 he has been in private practice and has designed irrigation systems and earth and masonry dams.

DR. D. B. STEINMAN sails Dec. 4 on a four-months' trip to Sydney, Australia, where he will submit plans which he has been retained to prepare, in partnership with Holton D. Robinson, for the $30,000,000 Sydney harbor bridge.

STEPHEN T. DE LA MATER, chief of the amortization section, income tax unit, Bureau of Internal Revenue, Washington, D. C., has resigned and will return to private practice as consulting engineer with offices in the Insurance Bldg., Washington, D. C., specializing in problems of taxation, operation and valuation as related to construction.

COL. W. J. BARDEN, Corps of Engineers, U. S. Army, was the honor guest and principal speaker at a recent joint meeting of the Seattle Section, American Society of Civil Engineers, and the American Society of Military Engineers at the Engineers Club, Seattle. Col. Barden spoke on "The Muscle Shoals Power Development," of which work he had charge for three years.

DANA PIERCE, first vice-president of Underwriters Laboratories, in charge of the New York office, and an electrical engineer, has been elected president succeeding William H. Merrill, whose death was noted recently in these columns. R. R. SMALL, one of the vice-presidents, has been elected first vice-president.

H. V. KNOUSE, construction engineer, Metropolitan Utilities District, Omaha, Neb., has taken charge temporarily of the operation of the pumping station at Florence, a position held until recently by A. B. Hunt, superintendent. Mr. Hunt, who has been an employee of the water-works for more than forty years, was relieved of the above duties following an investigation by the directors of the district into the responsibility for a deluge of mud which the city experienced in August. Mr. Hunt is still retained on the payroll.

JOSEPH A. MARTIN, former commissioner of public works for the city of Detroit, under whose direction a large part of Detroit's extensive public improvement program including the $25,000,000 sewer system was carried out, was elected city councilman in Detroit at the Nov. 6 election, and having received the highest number of votes of the nine members elected, will become president of the council.

ELISHA LEE, who is at present vice-president of the eastern region of the Pennsylvania R.R., has been appointed vice-president of the central region, succeeding Col. James A. McCrea, who died Oct. 17. Mr. Lee has been in the service of the Pennsylvania R.R. since 1892. During government control of the railroads he was federal manager of the Pennsylvania lines east of Pittsburgh and prior to that had been general manager.

CHARLES S. KRICK, who succeeds Elisha Lee as vice-president of the eastern region of the Pennsylvania R.R. system, entered the Pennsylvania service in 1887 as a rodman. He has since worked his way up through the positions of general superintendent, assistant general manager and general manager.

ROBERT V. MASSEY succeeds Charles S. Krick as general manager of the eastern region. He entered the Pennsylvania service in 1892 as an engineer in the construction department and later entered the operating department, becoming a superintendent, general superintendent, and then assistant general manager of the eastern region.

F. P. LARMON, chief engineer, Metropolitan Utilities District, Omaha, Neb., in charge of construction of the new filtration plant, tendered his resignation to Col. Theodore A. Leisen on the latter's assumption of the managership of the district, as noted in these columns last week.

DR. DOUGLAS W. JOHNSON, since 1901 professor of physiography in Columbia University, has been appointed exchange engineering professor to France and will represent seven American universities—Cornell, Harvard, Johns Hopkins, Massachusetts Institute of Technology, Pennsylvania, Yale and Columbia. He will lecture in all the principal French universities on physiography and its applications. Professor Johnson was chief of the division of boundary geography of the American Peace Commission to France.

Obituary

CHARLES T. HARDING, JR., for the past ten years superintendent of the water-works and the light plant at Virginia, Minn., was drowned in Pelican Lake, Minn., Nov. 1. Previous to 1913 Mr. Harding was associated with the Burns & McDonnell Engineering Co., consulting engineers, Kansas City, Mo.

PERCIVAL WALTER ST. GEORGE, civil engineer, Montreal, died in that city Nov. 12 in his seventy-fourth year. Mr. St. George was born in Scotland and was educated in France and at the University of Edinburgh. He went to Canada in 1866 and for some years was engaged in railroad construction for the Nova Scotia Ry. and Intercolonial Ry. In 1876 he was appointed deputy city surveyor of Montreal and in 1883 became city surveyor, in which position he was noted for his work in flood prevention, drainage and city paving. Since 1900 he had practiced as a consulting engineer. He was one of the original members and a vice-president of the Canadian Society of Civil Engineers.

HORACE R. CARPENTER, assistant chief engineer of the Missouri Pacific R.R., was found dead at the door of his apartment in St. Louis on Nov. 12. Mr. Carpenter, a graduate of Yale, class of 1883, had been with the Missouri Pacific R.R. for eighteen years. Prior to that he served as consulting engineer for various railroads and mining properties. During the world war he was chief engineer for the railroads in Louisiana and Arkansas.

THOMAS R. H. DANIELS, chief civil engineer of the Terre Haute, Indianapolis & Eastern Traction Co., Indianapolis, died of heart disease Nov. 8 after an illness of two days. In 1898 Mr. Daniels was assistant engineer of track and roadway of the Rhode Island Co., Providence, R. I.; and in 1904 became assistant engineer for Westinghouse, Church, Kerr & Co., New York City, in the construction of the new terminal station for the Pennsylvania R.R. Two years later he took charge of the rebuilding of tracks of the United Rys., San Francisco. For some time he was chief engineer for the Birmingham, Ala., Railway, Light and Power Co.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Tardy Orders for Supplies Upset Building Schedules

Manufacturers Cannot Always Satisfy Eleventh-Hour Demands of Engineers

In the Nov. 8 issue of "Engineering News-Record," p. 783, a manufacturer of waterworks equipment deplored the insufficiency of time usually allowed for preparing estimates or bids on proposed work. Manufacturers of other products used in the construction field were asked for a statement of their experience or an expression of their opinon. Some of the replies follow.—EDITOR.

Steel Doors and Partitions

BY ERNST DOSCHER
The J. G. Wilson Corp., New York

WE DO not have much cause for complaint because of the shortness of time to submit bids on our products, as it takes but a few moments for us to figure a proposal.

Our chief complaint is that on account of the fact our products (rolling and folding doors and partitions) are about the last things to be installed in a building, contractors delay placing their orders with us until they are almost ready to have the products installed. Our lives are then made miserable by their pounding us for shipping dates.

This is especially true in August and September on school work. Many contractors delay until June or July before they order the partitions and wardrobes that we manufacture and which are required for the opening of schools early in September. This floods our factory with orders and it is impossible to ship in time to meet all demands.

The same thing is true as regards our rolling steel doors used on the exterior of buildings. The contractors wait until the fall before placing their orders and then are in dire need of the doors to protect the building against the weather. We have tried to get them to place their orders well in advance and let us manufacture our products based on sizes which are guaranteed by them, so that there will be no delay when the building has progressed to the point that installation can be made. In this, we are only partly successful.

Cement Tile Roofs

BY L. J. WILHARTZ
Federal Cement Tile Co., Chicago

RELATIVE to the period of time generally allowed for the submission of bids on proposed contracts, in a great many instances we could use additional time in the more careful preparation of our bids. In the main, however, we do not feel that we have a legitimate complaint in our particular line of business. Taking into consideration the pressure under which most business concerns operate today we feel that we are receiving all of the time that we could reasonably ask for.

Water Filters and Softeners

BY GEORGE F. HODKINSON
American Water Softener Co., Philadelphia

WE HAVE noted and heartily indorse the views expressed by C. G. Richardson in his article appearing in your issue of Nov. 8. In many instances the time allowed between date of advertisement and date set for receiving bids is so short it is impossible for us and many others to bid, and this may exclude some low and desirable tenders.

If ample time is allowed, bidders have an opportunity to shop around for prices which might enable them to bid a lower figure than if compelled to make wild guesses. It is often necessary to visit the site of the work, to become acquainted with local labor and other conditions and to get information from the engineers by correspondence, in order to bid intelligently, and this takes time.

Too much publicity cannot be given to this matter, as a reform is urgently needed.

Reinforced-Concrete Chimneys

BY R. A. STEEN
Weber Chimney Co., Chicago

IN OUR line, which is the construction of reinforced-concrete chimneys, probably 50 per cent of the cases offer sufficient time for preparing estimates or bids, which is desirable and which naturally results in a saving to the purchaser if the bidder has an opportunity to check over prices of materials and labor carefully, getting complete data as to working conditions. If in doubt, or if he lacks adequate information to protect himself from contingencies he is compelled to bid higher.

We certainly believe rush preparation of bids results in increased cost. On probably 25 per cent of municipal jobs there is barely sufficient time and on possibly another 25 per cent there is insufficient time to bid properly.

We would call attention to the following practice which we think is not fair to the bidder, although it seems to be coming into vogue: That is the practice of engineers preparing specifications for municipalities and then charging a fee for a copy of the plans and specifications. In some instances a portion of this fee is refunded if the plans are returned, and sometimes not. Of course it is quite proper in some cases to ask for a deposit for plans and specifications, although we think with reputable bidders that this really is unnecessary as the bidder is going to more or less expense in preparing his bid and sending a representative to the letting, and he certainly should not be asked to pay for copies of specifications.

Another hardship on the manufacturer is the unwillingness or failure of municipal authorities to give accurate information to the bidder as to when the actual letting will take place. This practice results in uncertainty and additional expense to the bidders for sending their representatives. In certain instances it is also difficult, after the bids have been considered, to find out who secures the business. Certainly every bidder who puts up his certified check and other necessary expenses should be entitled to full and complete information along these lines.

Fire Doors for Elevator Shafts

BY M. L. EDELMAN
The Peelle Co., Brooklyn, N. Y.

THE shortness of time generally allowed for the preparation of bids, does not effect us materially since the quantities for our products can be quickly ascertained from plans and specifications, and prices made up within a very short period of time.

Valves and Hydrants

BY C. A. ANDERSON
Chapman Valve Manufacturing Co., Indian Orchard, Mass.

MR. C. G. RICHARDSON'S comments are well worth consideration. We have noticed in many cases that too short notice is usually allowed to get in quoted prices. Mr. Richardson is quite correct in saying that the people who lay out work sometimes take months and even years to get it lined up, and then expect the contractor to get his prices in within a very short time.

There are many cases requiring special equipment that one manufacturer may not make and has to purchase outside. Often we have been called upon to name prices on short notice and have had to telephone long distances for information from other manufacturers. In doing this we could not, of course, submit complete details or prints of what we had in mind and it was more or less guesswork getting quotations out. Naturally when prices are made on this basis they are usually high and would be termed approximate, and consequently the customer does not receive competitive prices as would be the case if sufficient time had been allowed to go at the matter in a proper way.

Steel Window Walls

BY A. T. HOGG
Detroit Steel Products Co., Detroit, Mich.

WE have very little complaint to make about lack of time for preparing bids. I think, however, this may be due to the fact that we have a very efficient estimating organization in each of our branch offices and most of our principal agents also are equipped to give this service locally. For this reason our customers never have to wait for plans and specifications to be sent through the home office, as these are always handled locally, except in rare instances.

One of the items of service of which we are most proud, and concerning which we are frequently complimented, is our ability to estimate accurately and get our bids in quickly. We make a particular point of this with contractors and believe that the service is very much appreciated.

Road Show Space Allotted to 205 Exhibitors

Exhibit space at the Good Roads Show, to be held in the Coliseum, Chicago, Jan. 14-18, was allotted to 205 applicants in the manufacturing and allied fields at a joint meeting in Chicago, Nov. 1 and 2, of the executive committees of the American Road Builders' Association and the Highway Industries Exhibitors' Association and Charles M. Upham, convention and road show manager. The two executive committees were assisted by an advisory committee of six, each representing one of the six main classes of exhibitors.

Requests were filed for more than three and one-half times the main floor space available in the Coliseum. Applications for space in the Annex, the Ball Room, and the Greer Building also were in excess of the available floor area. While of necessity the space allotted to most applicants was less than they desired, the committee points out that due to a re-arrangement of aisles and exhibit areas every exhibitor will have adequate facilities for the display of his products.

Portland Cement Production

Production of portland cement established a new high record for the month of October when the output of United States mills, according to statistics of producers compiled by Ernest F. Burchard, of the U. S. Geological Survey, totaled 13,350,000 bbl. as compared with 13,109,000 bbl. in September, and 12,287,000 bbl. for October, 1922. Shipments for October of this year also showed a gain over those of the previous month, the respective figures being 14,285,000 bbl. compared with 13,698,000 bbl. Stocks, although diminishing, did not reach the low level of October, 1922.

Production of portland cement for ten months in 1923, amounting to 114,366,000 bbl., has nearly reached the total of 114,789,984 bbl. for the year 1922.

To Approve Use of Name-Plates for Standard Equipment

Until the Associated General Contractors' standardization organization is prepared to appoint a committee to test the individual types of concrete mixer equipment made by the various manufacturers with respect to adherence to the adopted requirements, affidavits by manufacturers will be accepted as indicating that equipment is complying with the terms of the coded standards. Upon receipt of each of these affidavits at headquarters, the privilege of using the standard nameplate will be granted.

The plates (see *Engineering News-Record*, Oct. 25, p. 699), will be furnished by the Joint Committee on Construction Equipment, of which Gen. R. C. Marshall, Jr., has been made trustee. The plates will be sold at nominal prices, probably ranging from 35c. to $3.50, the sum being dependent upon the selling price of the equipment on which the plates are to appear. Any profit resulting from this sale of plates will be used by the Joint Committee to further the work of standardization of equipment.

Counterbalanced Window Sash for Industrial Building

Installation and Design Details Given for 90,000 Sq.Ft. of Glass in Studebaker Structure

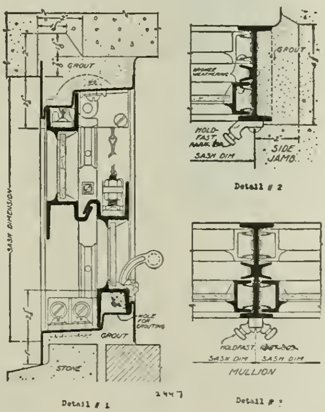
APPROXIMATELY 90,000 sq.ft. of glass and 50,000 pounds of putty were required to glaze 1,681 units of counter-balanced sash and 592 units of sidewall (used in monitors) in the new six-story Studebaker building at South Bend, Ind., erected by G. H. Christman & Co. The installation of this sash, as well as 30 worm and gear operated

STUDEBAKER BUILDING'S LARGE WINDOW AREA

power units, and 1,552 lin.ft. of pipe was accomplished in 5 months.

Counterbalance sash is more difficult to erect than common factor or sidewall sash because the operation of all moving parts of the former must be accurately adjusted. As a result, the frame members are shipped in knocked-down condition to eliminate chances of their becoming jammed by rough handling in transit. When on the job the frame members are fabricated around the sliding sections, which are shipped assembled and ready for erection. Most of the windows in the Studebaker building were installed in prepared openings after the walls were up, and consisted of large bays, each containing five units of Fenestra sash supplied by the Detroit Steel Products Co., the source of the following notes:

Typical installation details for counterbalance sash are shown in the accompanying drawings. The concrete frame at the head and jambs are built offset with a rebate to accommodate the frame members. It will be noticed that the rebates of the jambs are much larger to allow plenty of room to grout the frames securely in position.



WINDOW SASH DETAILS

Detail 3 shows the type of mullion generally used when more than one unit is to be inserted in an opening. Bronze weathering sections of flaring channel are inserted at the jambs of the sliding units. These are riveted to the I-beam section in such a manner that they are entirely covered by the equal leg jamb section of the sliding unit. The object of this design is to insure excellent weathering qualities.

Detail 1 shows a typical stone sill and brick curtain wall. Grout is poured into the frame through holes provided for that purpose.

For simple operation with this type of sash the upper and lower sections are hung at the ends of chains which run up over pulleys at the head of the jambs. When the lower unit is pulled up, the upper goes down. The overlapping members of the sash unite, provide effective weathering and prevent wind and rain from driving through.

When installing the sash head and jamb frame members are bolted together and set up in the opening. If mullions are to be used they are attached also at the head. Then the sliding sections are slid up in frame from beneath. The sill member is fastened to the jamb by means of adjustable sill clips, slotted, to allow proper adjustment of the sections and insure sufficient clearance for easy operations.

Glazing is done after the sash has been grouted in. The units are locked tightly shut; bed putty is applied and the panes of glass inserted. Glazing clips for holding the glass securely in place are inserted in the holes provided for them in the muntins. Then the final layer of putty is applied and the job is done.

Japan Awards Lumber Contracts

The Japanese Embassy on Nov. 14 advised the National Lumber Manufacturers' Association that the Japanese Government has awarded contracts for 97,150,000 ft. of lumber for use in building dwellings for Japan's homeless in the area devastated by the earthquake.

The Japanese Embassy said negotiations had been closed with these lumber companies: Douglas Fir Exploitation & Export Co., representing 108 West Coast mills, for 96,400,000 ft. of Douglas fir and Pacific hemlock; and Bratlie Bros. Mill Co., of Ridgefield, Wash., for 750,000 ft. of red cedar. The Embassy said that no information could be given by the Japanese Government at this time concerning the amounts involved in the contracts.

To Ratify Lumber Standards

"The lumber industry has taken a forward step in its plan for standardization of the industry."

Secretary of Commerce Hoover made this statement Nov. 15, commenting upon a plan submitted to him by the Central Committee on Lumber Standards. Mr. Hoover said he expected ratification of the Standardization plan Dec. 12, at a conference he has called, to be held at Washington, and to be attended by all elements of the lumber industry.

Municipal Equipment Shown at Atlanta Convention

Paving Materials Chief Feature at A.S.M.I. Meeting—Trucks, Sweepers, Pipe and Valves

EQUIPMENT and materials employed in municipal service were the feature of the exhibit held in connection with the annual convention at Atlanta, last week, of the American Society for Municipal Improvements. Paving materials predominated among the products on display; of 29 manufacturers represented 12 were in the paving field. The following list gives the companies which had exhibits and the nature of their products:

The White Co., Cleveland. Motor trucks in municipal service.

Phoenix Portland Cement Co., Birmingham. Cast urns, samples of raw materials.

Granite Paving Block Association, Boston. Granite blocks.

National Paving Brick Manufacturers' Association, Cleveland. Paving brick.

Portland Cement Association, Atlanta. Pipe, concrete blocks.

Smith-Winn Co., Atlanta. Insurance agents.

Philip Carey Co., Cincinnati. Elastite expansion joints for concrete paving.

Georgia Railway & Power Co.

Atlantic Refining Co., Philadelphia. Asphalt.

Yancey Brothers, Atlanta. Caterpillar tractors and contractors' equipment.

Birmingham Slag Co., Birmingham. Concrete aggregate.

W. S. Goodwin Co., Baltimore. Steel paving guards.

American City, New York.

Asphalt Association, New York. Asphalt pavement.

Shearman Concrete Pipe Co., Atlanta. Pipe.

Link Belt Co., Philadelphia. Brush and Brush Mount for Tark sewage screen. Also conveyors.

U. S. Asphalt Refining Co., New York. Azetc asphalt, filler for brick pavement.

Pittsburgh Testing Laboratory, Pittsburgh.

Ludlow Valve Mfg. Co., Atlanta and Troy, N. Y. Valves and hydrants.

Manufacturers Record, Baltimore.

Sam E. Finley, Atlanta, Ga. Pavements.

Kentucky Rock Asphalt Co., Louisville. Rock asphalt pavement.

Lock Joint Pipe Co., Ampere, N. J. Concrete pipe.

Catch Basin Products Corp., Indianapolis. Sewerage accessories.

Warren Brothers Co., Boston. Bituminous pavement.

Public Works, New York.

Willite Southeast Co., Atlanta. Bituminous pavement.

Elgin Sales Corp., Chicago and New York. Street sweepers, motor driven.

F. W. Sampson, Atlanta, Ga. Vibrolithic pavement.

Pumps Exported

According to figures issued by the Department of Commerce domestic exports of pumps for the month of September totaled 145 units valued at $63,816. Cuba was the largest purchaser with 28 pumps at $15,691.

Business Notes

CLEVELAND CRANE & ENGINEERING Co., Canton, Ohio, announces the opening of a new office in St. Louis, Mo.

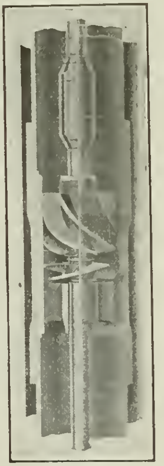
IRVING IRON WORKS Co., Long Island City, N. Y., manufacturer of subway grating and safety treads for stairways, held a three-day sales convention in New York recently, at which about 40 representatives of the company were present from various cities of the United States and Canada. The speakers at a banquet on the evening of Sept. 12 included W. E. Irving, president; P. L. Price, general manager; M. K. Griggs, representative at Houston, Texas; A. T. Vonier, representative at Milwaukee, and W. McKee, of the production department.

W. & L. E. GURLEY, Troy, N. Y., announce the establishment of an office at 364 Monadnock Block, Chicago, in order to serve mid-west customers more efficiently and expeditiously with their engineering and surveying instruments, plane tables, current meters, water-stage recorders and other appliances. C. H. Smart is in charge.

Equipment and Materials

Rotary Pump Delivers Continuous Flow From Deep Wells

For pumping ground water in connection with irrigation and drainage operations the Worthington Pump & Machinery Corp., New York, has developed the Axiflo deep well pump which, by means of an impeller of the general form of a ship propeller, and discharge vanes delivers a continuous flow claimed to be considerably greater than that obtainable from any other type of deep well pump except the air-lift. The unit is designed for operation within an 18-in. well casing and is driven through vertical shafting by an electric motor or a belt drive from steam or gasoline engine at the ground surface. For shallow wells a single impeller is used, but in deep wells their number is increased, thereby making the pump equivalent to a multi-stage unit.

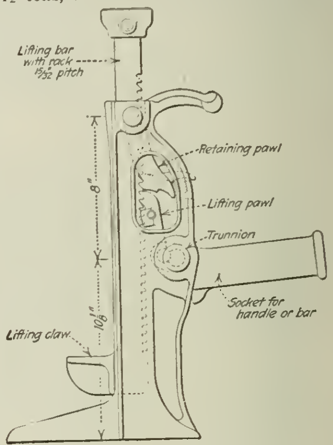


The impellers are made of bronze. The discharge vanes are designed to eliminate eddying currents and their accompanying waste. The shaft is of nickel steel and is divided into easily handled lengths, coupled together by long steel couplings. The weight of the moving parts and the water column thrust is taken up in specially designed three-plate, self-adjusting bearings, which run submerged in a water-jacketed oil bath.

Three of these deep well pumps were supplied to the Salt River Valley Water Users Association in Arizona for delivery of 4,000 gal. per minute each from 18-in. wells involving lifts of 30 and 40 ft. Tests after installation showed efficiencies as high as 72 per cent, delivering the specified flow.

A New One-Man Track Jack

A single-acting track jack for operation by one man in surfacing and under normal track loads has been brought out recently by Templeton, Kenly & Co., Chicago, and is known as the No. 217 Simplex jack. A load of only 27 lb. at the end of a 66-in. lining bar inserted in the socket is sufficient to lift 1 ton, so that a 150-lb. man can lift 4½ tons, which is well within the loads



encountered in ordinary work where main track is raised 1½ to 2 in. for surfacing. The total capacity of the jack is 15 tons, so that it is strong enough for such heavy work as raising crossings.

Increased power in the new design is obtained by the use of trunnion, instead of pin, construction for the socket, thus shortening the distance between the bearing and the pawl seat. It was necessary also to reduce slightly the pitch of the lifting rack, but it is stated that while the lift for each stroke is less the jack is more rapid in operation as it works so easily that the operator makes quicker strokes. The total lift is 13 in. All parts except the socket and standard are heat-treated forgings of carbon steel.

Publications from the Construction Industry

Power Drag Scrapers—SAUERMAN BROS., Chicago, has issued a 31-p. illustrated pamphlet on its power drag scrapers, with buckets ranging in capacity from ⅓ to 2 cu.yd. The text describes several forms of patented bucket including the Crescent and the LeClair, and then takes up power requirements and handling capacities. Succeeding pages describe both in text and picture the application of the equipment to different kinds of work.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Water-Works Installation This Year and Last

Water-works construction in the United States has followed a remarkably regular curve this year, according to *Engineering News-Record* statistics covering contracts of $15,000 and over. The first two months were normal, though about $2,000,000 per month above 1922. March was abnormally heavy, owing to $10,330,462 worth of Catskill Aqueduct contracts being awarded for a syphon to Brooklyn and conduits in that borough. Since March the slope has been fairly uniform, in August falling below 1922 figures. Contracts in the last two months have continued lighter than those let last year.

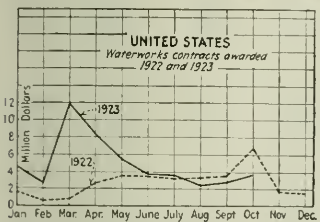
During the first nine months of the two years under consideration, 1922 had 327 awards with a total value of $25,000,000 against 335 for 1923 valued at $51,000,000. The average value of each contract in 1922 was $77,889 compared with $153,074 of this year. The trend of water-works installation for the United States during the last four years (for nine months in each case) may be gathered from the following figures:

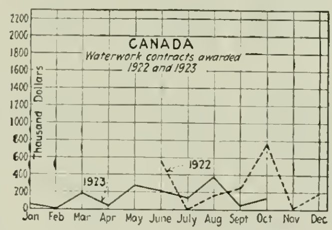
Year	Value	Monthly Average
1920	$16,401,000	$1,822,000
1921	24,252,000	2,695,000
1922	25,470,000	2,830,000
1923	51,280,000	5,698,000

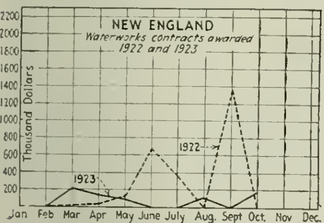
The significant fact is the same as that pointed out in the case of industrial work (p. 784, this section, Nov. 8 issue), that although the year started off with a rush of work, there has been a steady decline in the last half of the year. The Middle Atlantic states and the Mid West have been by far the most active in water-works construction this year, though both these sections are running low at present.

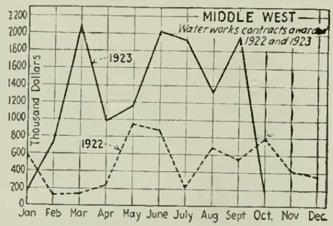
The October, 1923, record was hung up by the Far West, and included a 25-mi. conduit for Portland, Ore., price $2,571,404. A glimpse of the situation in the various sections of the country is given by the following comparison of the number and value of projects in the first nine months of 1922 and 1923:

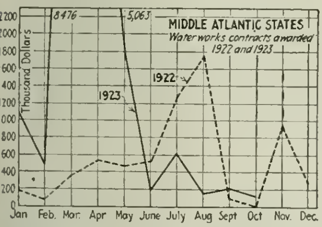
	1922		1923	
	No.	Value	No.	Value
New England	12	$2,754,000	8	$671,000
Middle Atlantic	56	5,972,000	55	20,706,000
Southern	40	2,602,000	25	2,676,000
Middle West	85	4,828,000	111	13,518,000
West of Miss.	103	4,899,000	116	10,320,000
Far West	31	4,414,000	20	3,389,000
Total	327	$25,469,000	335	$51,290,000

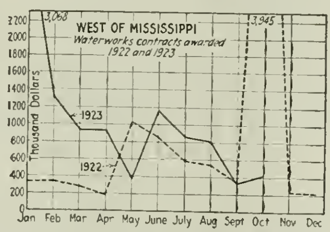


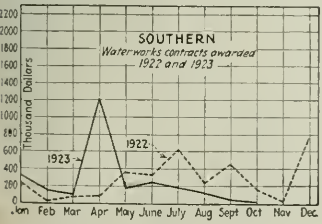


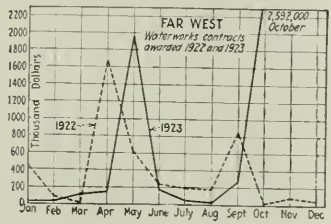












Importation of Foreign Cement Affects Sewer Bids

The importation of foreign cement at Los Angeles Harbor has been steadily increasing during the past year, and is having its effect on the local construction situation. The presence of foreign material at the harbor last summer seems to have resulted in lower bids for the large quantities of material required in the construction of the Los Angeles outfall sewer. At least this was the opinion of engineers connected with that particular job.

During July, August and September of this year, the total receipts of the foreign material amounted to 47,420 tons, while for the corresponding period of 1922, no receipts were recorded.

Segregation by countries from which cement was received during this third quarter of 1923 is indicated by the following table:

England	16,785 tons
Sweden	16,770 tons
Belgium	6,041 tons
Germany	3,761 tons
Norway	3,028 tons
Denmark	1,035 tons
Total	47,420 tons

The value of this cement according to figures of the City Harbor Commission was $503,769. During the busiest part of the 1923 building season in this vicinity, there occurred a shortage of native cement and this was the reason for the bringing in of appreciable quantities of the foreign material.

Whether or not the importing of the foreign cement will be continued, depends upon the ability of dealers in the local materials being able to meet the demands. It is understood that native cement is now being stored by local producers in anticipation of the heavy demands which are expected in the Spring of 1923.

Cement contracts for the outfall sewer were awarded to three American companies for 40,000 bbl. each, at $2.55 per bbl., without bags, f.o.b. cars at mill. Although foreign competition brought the bids to a comparatively low figure, the prevailing price in Los Angeles is $3.16 per bbl. in carload lots, without bags. Several Western cities, however, are reporting declines.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 279 to 290, are the following:

Hotel, Tacoma, Wash., Citizens Hotel Corp., Inc., $1,500,000.

School, Baltimore, Md., Johns Hopkins Hospital, $1,000,000.

High School, Brooklyn, N. Y., Supt. Bd. Educ., $3,000,000.

Hotel, Memphis, Tenn., W. W. Ahlschlager, archt., $3,000,000.

Seminary, Webster Groves, Mo., T. P. Barnett, archt., $1,000,000.

High School, Hartford, Conn., Bd. Contract & Supply, $1,200,000.

Canal, St. Catharines, Ont., Dept. Rys. & Canals, $5,000,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Nov. 1; the next, on Dec. 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	+$4.25
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.25	5.30	5.00	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.38	3.20	3.45	3.85	3.65	4.10	+4.00
Steel pipe, black, 2½ to 6 in. lap, discount	44%	40%	43%	47%	53–5%	36%	33.2@42.2%	35%	47.43
Cast-iron pipe, 6 in. and over, ton	—62.10@63.60	54.75	61.00	57.20@60.20	60.50	69.00	61.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.55@2.65	2.60	2.05	—2.10	—2.42	2.84	2.61	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	1.85	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	2.00	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	61.00	39.00	54.75	57.50	44.75@45.75	48.00	41.00	29.50	42.00
Lime, finishing, hydrated, ton	18.20	25.00	23.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.60	1.85	1.50	1.50	2.70	2.10	2.80	9.50
Common brick, delivered, 1,000	—21.45@22.55	11.00	11.60	11.00	16@18	12.00	15.00	15.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	.110	.0724	.075	.065	.....	.1'	.115
Hollow partition tile 4x12x12, per block	.1179	.102	.110	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.98	—.96	—1.03	1.14	—.97	—1.07	1.08	1.15	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.50@.55	.35@.50	.50	.62½	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93⅜c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on white pine lumber, free on cars at mill. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.80). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in., $119.

Changes Since Last Week

For every factor favoring the expansion of business in the current market, there appears one equally unfavorable in nature. For instance, the volume of business, generally, is large, particularly in the retail trade, with little falling off in consumption; export trade is gaining; an optimistic impression has been created by the suggested Federal tax reduction and price declines have occurred in pig iron, cement, clay products, linseed oil, lumber, leather, etc. In contrast with these, come reports of uncertainty in the stock market; lower foreign exchange rates and unemployment in certain manufacturing trades consequent to curtailment of output. It is also noted that buyers, having stocked up earlier in the season are now confining purchases to a "hand to mouth" basis.

The only price advances received from eight cities, reporting weekly to *Engineering News-Record*, was a rise in Montreal of 25 cents on steel shapes and 10 cents per 100 lb. on reinforcing bars. Seattle also reports an upward trend in lumber due to demand from Japan and California.

Declines, however, were reported in cast-iron pipe and common brick in New York; cement in Minneapolis; pine lumber in Montreal; linseed oil in Dallas, Minneapolis and Denver. The linseed oil drop reflects the influence of flaxseed receipts as well as of current demand for paint stuffs.

Bookings of commercial steel castings and steel structurals fell off perceptibly during October. Shipments of locomotives from principal manufacturing plants during the first ten months of 1923, increased 183 per cent over the corresponding period in 1922. Orders have been received by the American Locomotive Co. for eighteen locomotives for the Southern Pacific and twenty-five for the Delaware, Lackawanna & Western R.R. The Baltimore & Ohio R.R. awarded contracts to the Pressed Steel Car Co. for 500 all-steel hopper cars of 55 tons capacity, and to the American Car & Foundry Co. for fifty steel box cars.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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South Against West

WHERE shall national funds be spent for making unproductive land fit for agriculture? In the West, or in the South, or in both? That was the major theme of the reclamation conference held at New Orleans last week. The West had its innings during the past twenty years, and now the South is ready for its turn, and it calls upon the West to help it get it. There were addresses and thoughtful discussions of the common interests of West and South, it is true, and as our report of the conference (on another page) indicates there was a general spirit of working together. Yet at bottom the situation brought before the public by this movement is one of competing demands—of the West for further federal expenditure in irrigation, of the South for the financing of drainage and land-clearing work along its coasts. The question of paramount public concern of sound national policy in reclamation investment received only minor notice. It seems to be taken for granted that government funds should and must needs be given for land development work. Yet it is this point which the citizen at large demands to have settled first of all. Once a basic policy is established, and a system of administering it with full success is devised, the apportionment of expenditures between geographical sections will be easily accomplished, and no logrolling will be needed for satisfactory adjustment. The permanent Southern Conference can do nothing better than deal with the present reclamation problem and help in solving it; this once solved, and the need for federal reclamation work as well as a sound method for the work determined, the claims of the South will be satisfied without further demand.

Sources of Road Funds

A STIMULATIVE study in highway finance, as reported by the committee on finance of the Advisory Board on Highway Research of the American Research Council, is published in this issue. The road funds of four counties in Wisconsin are traced from source to destination. Incidentally the same sort of investigation is now being made in other states, with indications at present that the evidence will confirm the Wisconsin findings. In brief, these are that the bulk of all expenditures for all roads are county and township funds and that the bulk of all funds for all roads is provided by taxes on property and income. The precise figures are given in the committee report. Leaving the economist and the taxation expert to draw their own lessons from these figures, what conclusions do they suggest in respect to the extent of competent engineering direction of all expenditures for road improvement? We can reason only from inference as the committee report does not touch this subject. The inference is that the bulk of county and local road funds are spent under the sole supervision of county and township highway officials. State and federal expert engineering direction dictates only the lesser part of all highway expenditures. It influences county road expenditure in a varying measure and is altogether remote from township expenditure.

Misinformation on Muscle Shoals

ONE of the great disadvantages of having a silent President—we will not attempt to sum up the advantages—is that it affords such wonderful opportunity for the Washington newspaper men to put thoughts into the executive head. A sample is the recent flood of reports from the capital as to the President's attitude toward Muscle Shoals. These reports, whether they represent Mr. Coolidge's mind or not, are most discouraging for they indicate that Washington newspaperdom, in spite of its exceptional intelligence, does not understand the Muscle Shoals situation or the Ford offer. The gist of the reports is that the President is now contemplating the construction of a steam plant at Florence so that Muscle Shoals may be made sufficiently attractive to make Henry Ford forget his ill temper at the sale of Gorgas to the Alabama Power Co. and renew his offer for Muscle Shoals. This is pure Ford propaganda. Those who have followed the case know that the one or two million dollars involved in a steam plant is a drop in the bucket compared to the perpetual franchise Ford is asking the government to give him in violation of the water power law of the country. To present the government in the rôle of a suppliant to Henry Ford is ridiculous.

Municipal Treason

NEW YORK CITY'S commercial interests are in one of their periodical fits about the diversion of business to other ports. They have found out again, it seems, that while New York still gets almost all the transatlantic business certain other ports are growing faster and they scent a railway plot to build up a southern rival. Thereupon they urge the rearrangement of the port's facilities, not necessarily to reduce the cost of handling freight but to insure an increase in the amount of freight handled. And every New York business man, listening to the dire prospects of a luncheon speaker's prophecies, feels that somehow his personal fortune is dependent on that increase in amount of freight handled. This delusion of size is not confined to our largest city, but it is more ridiculous there than elsewhere. New York is big enough, but by its own metropolitan attraction it will continue to grow. In that growth it will not become a better place to live in or to do business in, nor will many individuals profit more than they already do. What will happen is that more individuals will flock there to take their profits, and by so flocking increase the unit cost of living and of doing business, an increase that is a charge against the whole nation which pays a tax on all the goods that moves through the metropolis. If some of

this new business can be diverted elsewhere, New York and New Yorkers will not suffer—except in self-esteem—and the rest of the country will benefit. No one can set the optimum limit of size in our cities but few will doubt that a number of our biggest cities have passed it. If this be treason let the Chambers of Commerce of our cities make the most of it.

Highway Transport Surveys

THERE is a distinction between a transport survey and a traffic census which needs to be more often remembered in taking account of highway traffic. There are few states which have made transport surveys of any sort and only one state which has carried to anywhere near conclusion a state-wide transport survey. More states, in all about forty, have made some sort of traffic count, most generally of a local character, which may be designated as a traffic census. These statements are drawn from a tabulation of "traffic surveys" by states prepared by G. E. Hamlin, whose report on highway traffic analyses to the Advisory Board on Highway Research of the National Research Council, is published in abstract in this issue. The significant value of this tabulation is the clear indication that beyond general observation highway engineers have no knowledge, except in one or two states, of state-wide traffic conditions. They are proceeding, with road planning virtually without precise knowledge of road use. They are entirely safe in doing this because no matter where or how fast roads are built the traffic is there, or almost immediately develops, to put them into full service. Conditions are arising, however, which put another aspect on the situation. The safe task of deciding that traffic warrants turning an unimproved trail into an improved road or a surfaced road into a paved road is giving way to the hazardous task of telling when three-way or four-way roads, with heavy pavement sections, are economically justified. The traffic counts of the past, either in scope or precision, are not sufficient for the present and are totally inadequate for the near future, and already in many states and localities, need to give way to the transport survey.

Unwise Taxing

THE United States is alone of the great commercial nations in levying an income tax on its nationals who are earning an income in trade or profession in foreign countries where they reside and where the local nation taxes all residents of whatever citizenship. For some years there has been agitation to abrogate this feature of the income tax law but it has been so far successfully opposed probably because there has been fear that any such revision would also relieve from taxation the expatriate who is living on a nonearned income. The law is so serious a drain on our foreign trade, however, that every effort should be made in the coming Congress to write an amendment which would not protect the expatriate capitalist but which would make foreign trading or professional practice less of a burden than it now is. Secretary Hoover in a recent address put the case clearly. In the field of engineering alone the situation is deplorable. "Before the war," said the Secretary, "there were at least 1,000 American engineers employed at substantial salaries in the territories of our former allies. These men went abroad to install American methods, American machinery and equipment in the production of raw materials, and in transportation. These salaried workers now find themselves subject to two gigantic income taxes and thus their foreign mission is unprofitable. I doubt whether there are 100 of them left in foreign territories today. A vast amount of American machinery and equipment that followed in their wake has dried up." So long as the other great producing nations absolve their foreign residing citizens from the rigors of a tax on earned income, there will be increasing difficulty in getting Americans to compete in a field where they have to pay a double tax.

A Demonstrated Danger

A DISTINCTLY new situation is created by the fact that on two separate occasions within the past couple of years secondary bending in the members of a framed structure has led to failure. In both instances the affected structure was a bascule bridge, a structure which experiences greater stress variations than a fixed bridge. It happens also that the two bridges were of the same type. This fact, however, is of less interest than the demonstration which the two accidents give that there are dangerous potentialities in an action which heretofore engaged little more than academic interest on the part of structural engineers.

Bending effects due to truss distortion, or secondary stresses, are accorded a courtesy recognition in textbooks and in design specifications dealing with bridges, but do not often receive more serious consideration. In structures other than bridges they are practically ignored. Many engineers lean toward the view that though they may theoretically exist they have no practical meaning, certainly none comparable to load or wind stresses—in effect that secondary stresses do not involve any risk of failure of a structural member. It is therefore of decided importance to learn from actual failures that these stresses represent a tax on the material in just the same way as direct load stresses, and must receive a similar accounting in the proportioning of members.

The first case, which occurred two years ago, involved the large double-leaf bascule bridge of the Canadian Pacific Ry. at Sault Ste. Marie, Mich. Each leaf is counterbalanced by a concrete counterweight hung from the rear end of a pivoted truss or walking beam that is trunnioned on a tower over the abutment. The bottom-chord member of one of these walking beams broke square across while the bridge was being operated, and the break opened up half in inch or so. The member in question is short, wide and very rigid, and, as the truss triangle of which it forms one side necessarily undergoes repetitive distortion under the varying stresses set up during the operation of the bridge, this rigid member was subjected to severe secondary bending whenever the bridge was raised or lowered. Such bending actions, continued for several years, evidently broke the stiff chord by detail fracture. Not as much is known about the detailed circumstances as would be desirable, as the railway company unfortunately has not made public any information concerning the accident, the analysis of causes or the repair operations; but there can be little doubt that the responsible action was as outlined. This view is confirmed by the fact that some time prior to the fracture an adjoining member of similar proportions and stress relations was found to require repair because of incipient frac-

ture. Moreover, both this weakness and the subsequent fracture were close to a heavy panel-point, where secondary stresses are at their maximum.

Last month a small bascule of similar type near Montreal was the subject of an equally interesting failure, again involving the counterweight support but this time localized in the members which projected down into the counterweight and carried its load as hangers. On this case a statement of conditions was made by the designers, as printed on page 861 last week. Excessive bending stresses, the statement indicates, resulted from the removal of side plating of the counterweight and from defects of the early design. Whatever their source, their effect in producing ultimate rupture of one hanger (which in turn led to failure of the others) presents a valuable confirmation of what the Soo accident indicated, namely that secondary bending is quite capable of producing failure.

Whether the potential danger from this kind of stress is as great in fixed as in movable bridges may be open to question, as the variable part of the truss distortion is generally smaller in fixed structures. This point will probably engage the attention of practical bridge designers, a remark which also applies to quantitative appraisal of the influence of secondary stress. Even without such detailed consideration, however, we gain from the two accidents the important knowledge that secondary stresses are by no means negligible but that on the contrary they threaten the safety of structures just as truly as do the more commonly calculated stresses. In the light of this new fact it would seem that safe designing will need to take account of them by calculation, as for the direct load stresses. The procedure now prevalent of assuming that secondaries do not exceed certain percentages of the lead stresses is hardly adequate to meet this requirement, especially since it is considered necessary nowadays to compute less vital actions to an accuracy of two or three places.

Associated Professions

SOME weeks ago we noted the strange situation in the State of New York whereby students of engineering are barred from aid of state scholarships and expressed some curiosity as to the theory which underlay such a peculiar law. Since then we have received a memorandum from the State Department of Education, which contains the following paragraph:

"The scholarship law provides that no scholarship shall include professional instruction in law, medicine, dentistry, veterinary medicine or theology, except so far as such instruction is within a regularly prescribed course of study leading to a degree other than in the above-named professions. Since the enactment of that law, pharmacy, chiropody, optometry, architecture, and engineering have been added to the professions and to practise in such additional professions a license from the state is required, as was true of those professions named in the original law. It was argued that if a person was to receive the manifest benefit accruing from a state license to an individual obtaining the same, the state ought not in addition thereto to contribute to the education of such individual and that the original purpose of the law was not to aid men primarily in securing an education in a school that was to prepare him for the practice of a profession but rather to encourage the higher education in those courses which are more largely literary and cultural."

The mystery as to the real reasoning behind the law becomes more involved than ever. Two things, however, are clear: First, that the state's educational directors conceive of the license to engineers as a beneficent bestowal of grace upon that profession and not as a protection to the public and second, that engineers in the State of New York now have been elevated to the same professional status as the chiropodist. We might also remark the state department's conjunction of the term "literary and cultural," though we had thought that in educational circles that synonymity was no longer accepted. The most pertinent conclusion that can be drawn from this strange combination of ambiguity and unfairness is that the New York State Department of Education needs a little educating itself in modernism.

Tardy Highway Research Records

A SIGNIFICANT comment on highway research is contained in the report of Prof. W. K. Hatt, Director, Advisory Board on Highway Research of the National Research Council:

> In the three years much progress has been made in quickening the will to research, in mobilizing the energies of research agencies and in assembling the data necessary for judgment upon questions of highway planning, construction and operation.
>
> It may be said with a large degree of confidence that at present a well trained and experienced highway engineer, in possession of available data, can select a type of highway suitable to the conditions of climate and traffic of a given situation, can specify the materials and design the section with a reasonable certainty that it will withstand the specified conditions of service.
>
> It is true that the communication of these data to engineers in general has not kept pace with the accumulation of the data nor has a working organization for the process of analyzing the data and translating the discovered principles for the use of engineers been adequately provided. The Advisory Board has published bulletins of information on existing research projects, on apparatus for research and the director has written many occasional papers. Its research committees have summarized progress. Much remains to be done, however, in unlocking the stored-up data in the files of the state highway commissions which are now such active agencies in highway research.

One who has some acquaintance with the research work being done will readily subscribe to Prof. Hatt's statement. It is the last paragraph however which commands particular attention. Research data in highway engineering and transport are being accumulated much faster than they can be communicated to highway engineers chiefly because means are lacking to undertake publication and because complete publication being thus denied there is a disposition by investigators to withhold summaries and conclusions brief enough to be given expression in engineering journals.

In most highway research investigations there is an unconscionable delay first in analyzing the amassed data and second by hoarding the results until the last drop of uncertainty has been wrung from them. It is these facts which hold back to a considerable degree financial support from commercial interests. Contributions for highway research would be far more plentiful were the donors assured of a reasonably prompt communication of results. Communication would be reasonably prompt if research workers utilized the means of communication available and trusted to future opportunity for publication of the compendious and definite report naturally craved by the investigator proud of his work.

Current Structural Research at Bureau of Standards

Many Studies of Metals and Structures Recently Completed or in Progress—Extensive Work Being Done in the Field of Cement, Brick, Hollow Tile and Stone, Including an Investigation of Stucco Foundations

MUCH WORK is going on at the Bureau of Standards that has direct bearing on the materials and design methods of civil engineering construction. Besides dealing with the properties of materials themselves, this work concerns the action of structures —from beams and columns to completed buildings and cranes—and their details. New materials or new difficulties figure in some of the work, as the duralumin members of dirigible airships, the low mechanical strength of zinc corrugated roofing, and disintegration troubles in Western sewers. Well-known constructions also present new questions constantly, as exemplified in tests of riveted joints recently begun for the Navy, and a reinvestigation of stucco with respect to the effect of foundations that is shortly to begin. Brief notes on various items of this work recently gathered at the Bureau are given in the present article.

Tests of Structures—Two interesting stress investigations of completed structures were carried out some time ago by members of the Bureau's staff, but only recently reported on. One of these was a measurement of stresses under measured floor loads in a reinforced-concrete building in Washington, the Arlington Building, undertaken primarily to give assurance of the safety of the structure after its floors had been strengthened by applying an additional thickness of concrete on top of the previously completed floors, to increase the load capacity of the floors. The tests showed that the expedient was reasonably effective.

Tests of stresses in the framework of the 350-ton tower crane at the Philadelphia Navy Yard, which were strain-gage measurements made under known loads, showed close agreement with calculated results. The tests were not fully informative because they related only to live-load stresses; dead-load stresses could not be measured because gage points had not been provided on the members before erection.

Column Tests—Much investigative work in the field of columns has been going on. In connection with test work, a theoretical study of column action along the line of Karman's attack on the problem is under way, and a restudy of the column tests carried out for the American Society of Civil Engineers seven years ago has been carried out, the latter by an outside investigator, Prof. O. H. Basquin.

The most elaborate of the column tests was a series of ultimate strength tests of about 150 members of the framework of the navy dirigible airship ZR-1, just completed at Lakehurst, N. J. Most of the members tested were of triangular cross-section, 8 to 13 in. in depth, and in 3, 5 and 10-m. lengths. About one-half of the total number were tested as columns, the others as beams or under combined column and beam loading. The column tests were made with round ends, using ball-bearing spherical blocks. In the beam tests, under distributed loading, a failing stress of about 22,500 lb. per square inch in the extreme fiber was developed, the results being quite consistent. The column tests were also satisfactorily consistent; ultimate loads ranging from 3,300 lb. per square inch for the longest columns to 22,000 for the shortest and thickest columns were obtained. The failures were substantially all flexural, that is, dependent upon the elastic properties of the material and dimensions of the structure, rather than due to passing the yield-point of the material in short-column action, and there were no rivet failures or failures caused by poor material or poor workmanship. In a few cases the buckling was integràl, with bending of the column, but in most instances the section of main channel between lattice bars buckled. The longer columns, from slenderness ratio 170 down to 80, fitted the Euler curve with modulus of elasticity taken at either 9,000,000 or 10,000,000 lb. per square inch. Shorter columns showed strengths flattening away from the Euler curve to a horizontal at about 18,000 lb. per square inch. The material itself is reported to have a yield point from 30,000 to 35,000 lb. per square inch.

The fact that channel buckling was found to be the determining factor in the strength of these girders has led to an investigation of the effect of channel thickness and shape upon the buckling stress. This investigation which has just been started is expected to continue during the year.

Compression tests on 170 structural steel angles, ranging in slenderness ratio from 350 down to 50, were recently reported. In the longer angles the effect of the end connections was marked, but became less noticeable in the shorter angles where the yield point of the material became the controlling factor.

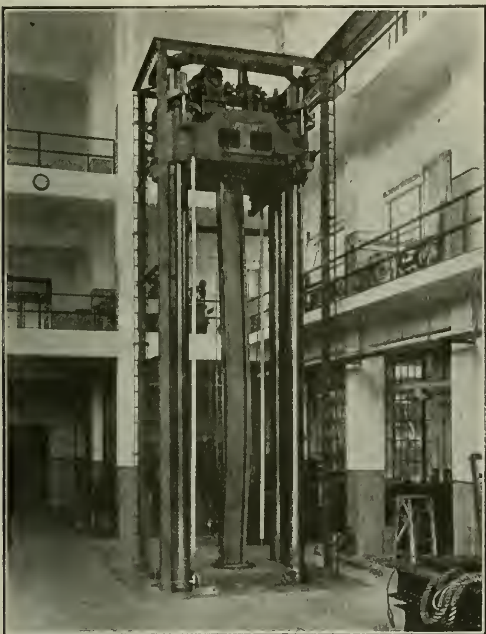
Fourteen wide-web columns were tested for the Delaware River Bridge Commission. The webs were 35 in. wide by 10 ft. long and ranged from $\frac{3}{8}$ to $1\frac{1}{2}$ in. in thickness, the thicker ones being made up of two plates. The flange angles were 6 x 4 x $\frac{3}{4}$ in., but were supported by stiff members transverse to the web plane, to prevent flange buckling. The strength of these assembled columns ranged up to 44,000 lb. per square inch, nearly all the specimens coming close to this value except one, in which the test conditions were somewhat irregular. Thorough exploration of the buckling action of the web plates was carried out, and this study appears to show that for the columns tested there is a critical value at about $\frac{5}{8}$-in. web thickness, the failure of the thinner webs being due to web plate buckling. When buckling does not occur the web remains undeformed until the proportional limit of material is reached.

Two extended series of tests of heavy structural columns were carried out for the American Bridge Co. and the Bethlehem Steel Co., including respectively about forty and thirty columns. In both series, built-up and solid-rolled column sections were included, and the length ranged up to 24 ft. and the metal thicknesses up to $2\frac{1}{2}$ in. in the flange, with total cross-sections up to 85 sq.in. In general, both series showed that difference in the strength of these columns were almost wholly due to differences in the tensile yield-point of the material. There was a wide variation in the yield-point of the material in the different specimens, but in all cases column strength was directly related to the yield-point of the material obtained in small specimen tests. Yield-

points as given by mill reports, however, could not be used in the comparison, being quite wild.

In the theoretical study of column strength in progress at the Bureau, small sized compression specimens of various lengths are to be tested, with knife-edge end-bearing carefully centered. The relation of column strength to compressive test specimen qualities will be one of the matters investigated. In the tests of large columns, above noted, only tensile specimen yield-points were available.

Tubes as Columns—A series of steel tubes of thin gage, in diameters ranging between $1\frac{1}{4}$ and $2\frac{1}{2}$ in., was



COLUMN TESTING IN TEN MILLION-POUND MACHINE

This specimen is a steel column of solid rolled H-section, and withstood 3,063,600-lb. total load before failing. The dimensions and weight of this specimen are as follows: Length, $23\frac{3}{8}$ ft.; sectional area, 85.1 sq.in.; total weight, 6,800 lb.; slenderness ratio, 74.0 The four vertical rods near the screws are attached to the upper head and operate dial micrometers attached to the lower head. They measure the relative movement of the testing machine heads and show any tilting as the test proceeds. Four other dial micrometers show any lateral displacement of the lower head. Four compressometers were attached to the column extending over about half its length, to measure the shortening of the column.

tested for longitudinal compressive strength. The specimens varied greatly in the tensile yield-point of the material, which was reflected in the compressive strength. Eccentricity of loading due to difference of thickness on opposite sides of the tube also was a factor, tending to produce early bending. In general, failure occurred by local buckling or crinkling rather than by integral bending.

Welding and Riveting Compared—Comparison of welding and riveting was carried on in several series of tests. Spot welded joints of plates were tested in comparison with similar riveted joints, and corresponding tests were made on plate girders and on built columns. The welding was done by two methods, in one of which the current was concentrated at the point to be welded by placing a small copper disk under the electrodes, while in the other the metal of the plate was embossed by a shallow die before applying the electrodes, for the same purpose. No perceptible difference between the two methods of welding was noted.

In plain tension tests of joints, the welded specimens showed up fully as well as the riveted, giving higher strength in a number of instances. In the tests of girders, no particular difference was observable, except that the welded girders showed about 5 per cent greater deflection than the riveted girders. The welded columns were weaker than the riveted, by about 13 per cent; this may be due to a greater flexibility corresponding to that found in the girders. In the opinion of the mechanical test department, these test series, while illuminating, were not sufficiently extensive to warrant definite conclusions as to commercial serviceability of the welding method. More extensive static tests and in connection with them some fatigue tests would be required. The fact that the welded joints in most cases showed greater elongation than the parallel riveted joints was, however, considered an important indication of the good quality of the joints.

Comparative tests were made of three welded and one riveted tank, for comparison with each other, extensometer measurements being made on the tanks. It was found that the commonly accepted theory for the design of tanks is, for all practical purposes, sufficiently accurate, provided the computed stresses are not influenced by secondary stresses. Secondary stresses which resulted in high stress intensity in these tanks were caused by (a) faulty design of the attachment of the spherical end to the cylindrical shell, (b) nonconformity of the shell to an accurate circular section, and (c) discontinuities in the shell for the manhole and fittings.

To aid in the preparation of the new A. S. M. E. Safety Code for unfired pressure vessels, over 40 welded tanks furnished by the American Welding Society were tested to destruction under hydrostatic and combined hydrostatic and hammer test. The superiority of the double Vee over the single Vee weld and useful information for the design of welded pressure tanks was shown by these tests.

Riveted Joints—An unusually elaborate set of tests on very large riveted joints has just been begun for the Navy Department. The tests have the main purpose of throwing light on the best proportion of riveted seam connections such as those used in ships' plating, when special steel is used for the plating. About 100 specimens are to be tested, each 22 in. wide, with as many as twenty rivets on a side. Three weights of plate and three grades of steel—structural, high carbon, and alloy—with rivets of medium and of high strength are included. The main objective is to determine the best distribution and the best type of joint, using up to four rows of rivets. The full program in prospect is much larger than that indicated by the above number of test specimens.

In these tests, the stress measurements will cover the middle 5 ft. of length, the test pieces being 8 ft. long overall. In addition to extensometer measurements, the cement wash method of outlining the stress line produced during deformation will also be applied. The specimens have widened ends, bolted to machine head

fittings, to make the stress distribution on the test length as uniform as possible.

Wall Tests—Walls of hollow tile were tested under endwise loading during the past year, with results just made public. The walls were 6, 8 and 12 in. thick, 4 ft. long and 12 ft. high, all laid up in cement (4) lime (1) mortar. The ultimate strength of these carefully built walls was in the neighborhood of one-third the strength of the tile tested singly, but quite wide differences in strength of the tile did not greatly influence the results, and the stress at failure (net sectional area) did not appear to depend to any noticable extent on the thickness of the wall or the size of the tile. End construction walls were about twice as strong as side construction walls. Strain-gage readings on the walls proved to be of little use. Tests on a few walls with eccentric loading applied over half the thickness of the wall gave reduced strength. These tests were reported by H. L. Whittemore and B. D. Hathcock.

Tests of brick walls and piers are to be continued. In the former, the effect of cement, cement-lime and lime ("Ideal" construction) mortars on hollow and solid walls, made of different kinds of brick, will be studied, in walls either 8 or 12 in. thick, and about 6 ft. long and 12 ft. high. The tests of piers are likely to be planned on a large-scale basis to develop the effect of bond, kind of mortar, method of laying, and the like.

Various minor tests of special structures have been carried out that may be noted here. They include tests of wire rope sockets and tests of large capacity crane hooks of the type used in lifting girders. In the latter, it was found that design on the basis of the method used for straight beams is satisfactory. In some tests of the effect of looseness of fit between nut and screw on the tensile strength of a bolt, little effect of the tightness of fit was observed. In connection with the miscellaneous work of the Bureau in this field, mention may be made of a specification for wire rope, recently issued, representing a compilation of commercial practice to represent a high grade of commercial steel wire rope manufacture, rather than a formulation based on test results. The specification is an attempt to standardize twist, core, quality of galvanizing, and strength, for four grades of rope in both galvanized and uncoated material.

Strength of Corrugated Zinc Roofing—Among the tests in the field of special materials, strength tests of corrugated zinc roofing are included. These developed from doubts arising out of practical experience as to the proper spacing of supports for such roofing. The material when under continuous load shows slow, progressive sagging, and no conclusions have yet been drawn as to the proper working stress for design, but the present result indicates that the purlin spacing must be considerably less than with galvanized steel roofing of the same gages. In connection with these tests, fasteners such as zinc nails are also being tested.

Fatigue of Sheet Duralumin—Elaborate flexural fatigue tests of sheet duralumin are in progress, being part of a program on which work has been proceeding for several years. Thicknesses of 0.020 to 0.120 are under test, in samples about 1 in. square. Bending is applied in alternate directions, the stress being measured at each alternation by a spring gage at one end of the specimen. The applied stresses are below the tensile yield-point of the material and the tests were carried to very high numbers of repetitions. Up to the present no "endurance limit" such as have been found for ferrous alloys has been found. Material from different shipments shows marked differences in number of repetitions that it will stand at a given stress, while in other tests (tension, tensile impact, cutting, hardness, etc.) they are comparable.

In the alternating flexural tests, special care has been found necessary to avoid vibration in the case of the thinner sheets. Unusually ingenious instruments and expedients have been devised in connection with this and the measurement of bending stress while the test is in progress.

Test of Limestone—Strength and time-load tests of Indiana limestone are in progress, with the co-operation of quarrymen, with a view to furnishing a basis for specifications for engineering and building use. In the time-load tests it has been found that loads of one-half to two-thirds the ultimate do not produce progressively increasing deflections. An extensive series of tests of lifting devices is shortly to be undertaken. Waterproofing and prevention of stain are also under test.

TESTING WALLS FOR FIRE RESISTANCE

Unexposed side of 8-in. solid Eastern surface clay brick wall at the end of the 6-hour fire test.

Stucco Studies—A reinvestigation of the subject of wall stucco is being started, using different reinforcement and methods of support for the stucco. All the material is portland cement stucco; the foundations are metal lath of various types on wood frame with and without sheathing. A large number of panels are to be exposed. The work is carried on in co-operation with cement, lumber and metal lath and fabric manufacturers.

Cement and Alkali—A detailed field examination of samples of cement and concrete exposed in alkali loca-

tions during ten years is now in progress, and the results should soon be known.

Related questions are under study in connection with sewer pipe troubles reported from a Western city. Both clay and cement sewer pipe are included in the investigation. Trouble seems to localize at manholes, and to be in direct relation to the amount of hydrogen sulphide present. Brick sewers shown similar mortar trouble.

Alumina Cement—Various high alumina cements are to be made this year and exposed to alkali and sea water. Georgia bauxite will be used in manufacture.

Test Methods and Instruments—Two interesting studies of tests for metals are in progress. The Humphrey method of testing notched test specimens by slow bending is being compared with the Izod impact method, and different methods of carrying out the Brinell hardness test are being studied. One of the questions of great practical importance in connection with the Brinell test is method of determining the hardness of material when in thin sheets.

A highly sensitive optical extensometer and a distant-reading extensometer using the principle of the varying resistance of a set of carbon disks were developed at the Bureau during the past year and have been described recently (*Engineering News-Record*, Aug. 16, 1923, p. 266). The optical extensometer is to be applied on a large scale to the Navy tests of riveted joints, above mentioned, some thirty instruments having been made for this test series. The carbon-resistance extensometer has been used in stress measurements on the Navy's great dirigible ZR-1.

Fire-Resistance Tests—Walls built of clay, sand-lime and cement brick have been tested under fire exposure and fire and water exposure, in 11 x 16-ft. panels, with exposure on one side up to 6 hr. The present indication is that an 8-in. solid wall will stop the progress of severe fire, though it will crack and deflect considerably. Where combustible members are framed into the wall they decrease the fire resistance. The 12-in. wall has been proved adequate for all fire conditions likely to occur in buildings although heavier thicknesses may be necessary from the standpoint of strength and stability. A number of hollow walls have also been tested, and it is concluded that when filled at the floor line around ends of combustible members they are adequate for moderate exposures.

Fire tests of panels of hollow tile are in progress on an equally large scale. The fire resistance of walls, 8 to 12 in. thick, has been found to depend on the mineral characteristics of the clay. Thickness of shells and design are also factors. Fire resistance is increased by plaster coatings that remain in place. Repeated freezing tests indicate advantage for tile having low porosity. Load tests of the panels are also to be undertaken.

Strength at High Temperatures—Tests have begun on the compressive strength and elastic properties of materials at temperatures up to 1,000° C. Structural steel begins to decline in strength decidedly beyond 400° C. and fails under working loads between 550° and 650° C. Timber loses one-half or more of its strength at 100° C., and further rapid loss occurs beyond 150° C. Where actual failure and distortion of shape has not occurred, both steel and timber recover their strength almost completely on cooling. The rate of expansion of steel increases with temperature to values more than one-half greater than obtain at ordinary temperatures; the maximum expansion under load approximating working loads in buildings is reached at about 500° C., where the yielding due to the load more than balances the expansion.

Fire Tests of Concrete Columns—A report is soon to be made on the results of about ninety fire and load tests of concrete columns made at the former Pittsburgh station of the Bureau. The tests showed the great effect of composition of aggregate: high-silica material gave the lowest resistance, and calcareous aggregates the highest, while trap rock and slag gave intermediate resistances. Fire resistance was increased by molded and plastered protection, and by metal binder in the outer protective concrete. There was little difference between round and square columns or between vertically and laterally reinforced columns, although the tendency to separate on the plane of the reinforcement was more apparent with the latter type.

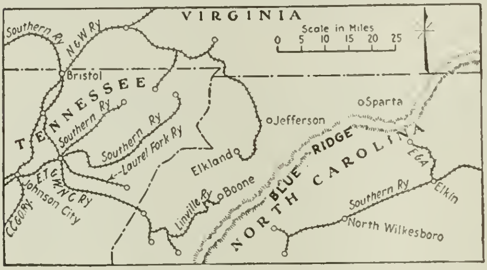
Fires in Buildings—To give information on the probable maximum intensity and duration of fires in buildings, tests have been made in a one-story brick and concrete building 16 x 30 ft. fitted up as an office, finished with different types of floor, and burned out. The results are compared with evidence given by melted metal and other fire effects in the ruins left by actual fires. Very tentatively, the tests so far indicate that buildings housing office occupancies may be subject to fire exposures equal to the first hour of the standard fire test.

Building Exits—Investigation is being made of structural conditions, exit facilities, and safety devices concerned with securing safe exit of occupants of buildings. The safety of motion picture projectors and booths has been examined, fire tests have been made of theater proscenium curtains and curtain materials. Rigid structurally framed steel curtains have been tested, and tests of flexible asbestos curtains are in progress. The latter investigation indicates that a rigid curtain designed for a lateral load of 10 lb. per square foot of proscenium opening and protected on the stage side is effective in preventing the passage of flames, smoke and dangerous temperature to the auditorium side in the time required to empty the building, with a considerable margin of safety. Its operation can be made reliable and positive under all probable fire conditions. The investigations of the flexible curtain are expected to reveal the extent to which the same performance can be given.

Fire Tests of Roofing—The fire hazard of common roofing materials is under study in a series of brand, flame and spread tests, recently begun, covering wood shingles, prepared roll roofing and shingles, and eventually metal, slate and tile. Various sizes of brands are used, with different wind velocities over the test deck produced by a propeller fan. Brand tests will also be made in connection with hot blasts representative of conflagration conditions. The sample roofs are seasoned in ovens and under ordinary room conditions. It has been found that there is a considerable difference in the flammability between oven-dry and air-dry samples of wood shingle roofing, for which reason care will be used in approximating the conditions of practice. Tests will also be made of samples of shingle and prepared roofing from old roofs weathered for years.

North Carolina to Build a State Railroad

AN UNUSUAL project now under engineering investigation is the construction by the State of North Carolina of a railroad across the Blue Ridge in the northwestern corner of the state to give a new trunk line to the west. This railroad, in connection with existing lines, will provide a direct route from the central and eastern parts of North Carolina to Cincinnati, Ohio, and the Middle West, passing through coal fields of eastern Tennessee and southeastern Kentucky, which will thus be given an outlet to the east through North Carolina. The new line will also provide communication with four northwestern counties (Alleghany, Ashe, Watagua and Avery) which are shut off from the rest of the state by this branch of the Appalachian range. These counties, known colloquially



WHERE NORTH CAROLINA WILL BUILD A STATE RAILROAD

The proposed railroad is to give the state a new western outlet and to connect the eastern section with northwestern counties now isolated by the Blue Ridge. The route has not been established but the crossing of the ridge will be probably from Elkin to Sparta, North Wilkesboro to Jefferson or North Wilkesboro to Boone.

as the "lost provinces," have no railroad connection with the main body of the state but two of them have railroad outlets to the west. The situation is shown by the accompanying map, in which all railroads are of standard gage with the exception of 3 ft. gage for the Linville River R.R. and the East Tennessee & Western North Carolina R.R. The Laurel Fork R.R. is operated for freight service only.

Since the proposed railroad will be of great public benefit but is not likely to be undertaken by private enterprise, the North Carolina legislature at its 1923 session enacted a law authorizing the construction by the state of a railroad across the Blue Ridge to be known as the Appalachian & Western North Carolina R.R. This law constituted a special commission in charge of the project and appropriated $50,000 for its use in determining by surveys and other investigations the best route for the railroad. The law also appointed individual members of the legislature to comprise the board of directors to organize the Appalachian & Western North Carolina R.R. Co., through which medium the construction and preliminary operations of the railroad will be carried on without the aid of the outside capital.

For the construction and equipment of the line, the law provides for a bond issue of $10,000,000 which is equivalent to a direct appropriation. The state will hold all the stock of the railroad company and will pay the entire cost of construction. To assist in the extension of existing short lines to connect with the new railroad, the law provides that if outside interests will subscribe 51 per cent of the cost of such extensions the state will furnish the remaining 49 per cent.

Heavy construction work and considerable tunneling will be required. Three passes under investigation are Roaring Gap on a route between Elkin and Sparta; Daniel's Gap between North Wilkesboro and Jefferson; and Deep Gap, between North Wilkesboro and Boone. Both Elkin and North Wilkesboro are on a line of the Southern Ry. running west from Greensboro and Winston-Salem, N. C., and terminating in the foothills. By any route the new line will be at least 75 miles in length. The passes mentioned are at an approximate elevation of 3,200 ft., which is that of the tableland on the west side of the range, while the general elevation of the country in foothills on the east side is about 1,500 ft. The grades are not to exceed 1 per cent (compensated) against eastbound traffic and 1½ per cent (compensated) against westbound traffic. Curvature is not to exceed 8 deg.

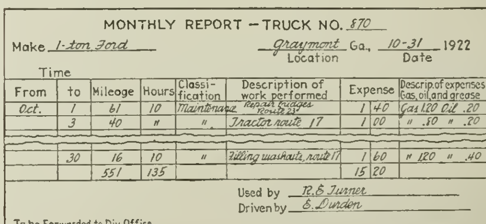
The work of the special commission is now more than half completed and it is expected that by next summer the board of directors will be called upon to organize and proceed with construction work. The surveys and preliminary work are in charge of Frank T. Miller, Greensboro, N. C., as chief engineer for the special commission and for the railroad.

Recording Road Maintenance Costs by Gantt Charts

Foremen's Field Report Made Simple—Computation and Charting Done in Office—Federal-Aid Costs Segregated

By H. J. Friedman
State Highway Department of Georgia, Savannah, Ga.

IT IS REQUIRED by the Bureau of Public Roads that data be kept on the cost of maintenance of federal-aid highway projects. These projects are comparatively short and it is necessary that separate costs distributed under various heads be kept on each. The method here worked out correlates the data necessary for federal-aid project maintenance costs, with various other highway maintenance costs, so as to secure figures which enable the engineer to draw the necessary conclusions for successfully directing the entire task of maintenance that falls within his jurisdiction. Incidentally this method of keeping cost data is that in use in the Georgia Highway Department division office at Savannah. It is here that cost data are assembled to the point where figures by counties or by projects are secured. The remaining work of applying the central office overhead and summarizing results for the state, is routine, and is not considered.



MONTHLY REPORT — TRUCK NO. 870

Make 1-ton Ford   Graymont Ga., 10-31 1922
Location   Date

Time From	to	Mileage	Hours	Classification	Description of work performed	Expense		Descrip. of expenses Gas, oil, and grease
Oct.	1	61	10	Maintenance	Repair bridges Route 23	1	40	Gas 1.20 Oil .20
	3	40	"	"	Tractor route 17	1	00	" .80 " .20
	30	16	10	"	Filling washouts, route 17	1	60	" 1.20 " .40
		551	135			15	20	

Used by R. E. Turner
Driven by E. Durden

To be Forwarded to Div Office

FIG. 1—MONTHLY REPORT OF TRUCK OPERATION

Specimen "B" DAILY TRACTOR REPORT

Tractor No. 26633 Make 10-ton Holt

Date 10-12-22 Used on project Route No. 21 County Jenkins

Distance traveled light (To or from work) ______ Miles

Distance traveled working (Pulling drag or grader) ______ Miles

Operators

Name	Title	Dragging surface, hours	Scraping ditches, hours	Travel light, hours	Repairs etc., hours	Total hours	Rate per hour	Amount
Turner	Foreman	6				6	.45	2.70
Durden	Machman	6				6	.30	1.80
Jones	Labor	6				6	.15	.90
Totals		18					18	5.40

GAS AND OIL USED TODAY

	For dragging surface	For scraping ditches	For traveling light surface ditches	Total gallons	Cost per gallon	Amount
Gasoline, gal.	24			24	.25	6.00
Oil, gal.	1			1	.80	.80
					Total	6.80

Remarks:— Road in good shape for dragging

Foreman ______

Date ______

FIG. 2—DAILY REPORT OF TRACTOR OPERATION

Since figures on direct charges are turned in, in most cases, by foremen, who naturally are not accountants or engineers, a system of applying code numbers to the distribution of accounts, or any similar system, is not considered practicable. Also in the matter of indirect charges, such as repair parts for equipment, it is not practicable to make an office or field distribution on each bill, as there are too many projects or counties to which each item must usually be distributed. The system described permits the proper distribution of direct charges by foremen without code numbers or excessive mental effort, and also provides a simple method of pro-rating the indirect charges in proportion to the actual work done on each project or unit considered.

It is best to have one person, preferably the office engineer, who will hereafter be referred to as the cost accountant, handle and be responsible for the maintenance cost data. He should work up his data from information and reports furnished by the division cashier, maintenance supervisor and foremen. It is necessary that cost data be summarized in such shape that the information is in compact form and adapted to ready comparison. The Gantt chart is believed to be the best medium for this.

Maintenance cost data should cover the following phases of work:

1. Cost and performance on truck and tractor operations.
2. Cost of maintenance of completed federal-aid projects.
3. Costs, as compared with allotments, by counties or divisions.

Maintenance foremen keep a daily record, Fig. 1, covering the operation of their trucks, which is turned in to the division office the last of each month. This report covers the cost of gas, oil and grease, and mileage covered. The data for each truck are platted on a Gantt chart similar to that in Fig. 3. The item of repairs is a difficult one for the foreman to determine, as he orders parts from the division office for which he does not see the bills. This item as platted by the cost accountant is secured from the records of the division cashier. Maintenance patrol cars are handled in the same manner as trucks.

Foremen also turn in a daily tractor report on the form shown by Fig. 2. This shows mileage covered and gas and oil consumed. It is necessary to consolidate these figures for each month's operation under the heads gas and oil, and mileage. The item repairs, as in the case for trucks, is best secured from the records of the division cashier. The results are platted on a Gantt chart similar to Fig. 3.

A report is required of each foreman for each federal-aid project he works on, on any day. On this report in addition to the time of his force and its distribution, a statement is made of the mileage run by trucks and tractors, respectively. The cost account-

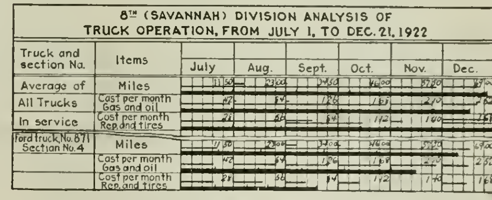


FIG. 3—TYPICAL GANTT CHART RECORD OF TRUCK OPERATION

ant enters these charges as on form Fig. 4, also noting the mileage run by trucks and tractors. At the end of the month these charges are footed. From the division cashier, the total division maintenance overhead charge is secured and pro-rated on a mileage basis to each project, under the charge division overhead.

The mileage run by each truck and tractor is reduced to a money charge and these charges, properly distributed, are shown below the footings. These charges are secured with the use of the charts, and the method is best explained by a concrete example.

Ford truck No. 674 was run 64 miles in connection with tractor operation on F.-A. Project 47, Screven County, during the month of June. The chart indicates that during June, truck No. 674 ran 1,160 miles at a cost for repairs, gas and oil, of \$83. Then the charge against F.-A. 47 is 64/1160 of \$83, or \$4.60.

It is realized that this is not an exact figure. How-

Specimen "D" FEDERAL-AID PROJECT COST SHEET 8th Division

County Effingham Maintenance section, No. 1

Road name F.A. Project 205 Route No. 21 Length 4.218 Miles Kind of road Sand Clay

0.0076% overhead

	Date 1922	Truck and Tractor Data: Truck No. 92 miles	Tractor No. 233657	Car No. 181 miles	MAINTENANCE: Dragging grading, patching, sur. joints	Cleaning ditches and culverts	Repairing bridges and culverts	Cutting brush and weeds	Building shoulders, filling washouts	White-washing	BETTERMENT: Guard Rails	Signs and mile posts	Rip-rap and revetment	Additional bridges culvt and Headwalls	Planting slopes	Month's overhead \$346.04	Grading	Drainage	Surfacing	Amount paid	Date	Total	Total to date

FIG. 4—FORM FOR FEDERAL-AID MAINTENANCE COST SHEET

ever, the result is well within the limits of accuracy to which the foreman can distribute his charge to the project.

The truck and tractor charges are entered below the monthly footings (which represent the direct charges and the overhead charge). A total is then struck, which represents the amount expended for the month under the different heads.

The figures secured take into consideration all costs except central office overhead and depreciation and interest charges on equipment, which should be applied from the central office on a pro-rata mileage basis.

Costs as compared with allotments by counties or divisions are obtained from the division cashier and platted as a Gantt chart similar to Fig. 3. It is necessary to make a schedule for costs per month and of mileage on which the chart is based. This is done from data on hand from past performance. If, after the chart is under way, performance shows a wide variation from schedule, the schedule may be changed at any point on the chart without difficulty.

Rochester Compares Three Types of School Buildings

Different Designs for Buildings of Similar Dimensions—Cost of Fireproof Construction Compares Favorably with Fire-Resisting Construction

By A. R. Reilly

Structural Engineer. Department of Buildings, Board of Education, Rochester, N. Y.

THE THREE types of buildings for which separate drawings were made recently by the Board of Education of Rochester, N. Y., furnish a basis for interesting studies of schoolhouse construction. Each of the three sets of drawings calls for a two-story building with accommodations for the same number of children.

Official bids were received by the board as follows:

	Cubage	Total Amount of Low Bids Without Addition	With Addition
Design No. 1	1,245,917	$411,577.50	.....
Design No. 2	1,245,917	435,252 01	$513,016.41
Design No. 3	1,396,265	444,187 70	581;334.15

Design 1—wood joists and floors in classrooms, with fire-resistive construction in corridors, stair halls, and toilet rooms; exterior and interior walls brick bearing; hollow gypsum tile partitions between classrooms and around flues; steel beams spanning classrooms transversely at the center of rooms and under gypsum partitions; No. 24 gage "tin pan" concrete slabs for corridor floors; roof over corridors as well as classrooms of wood construction; excavation of approximately 5 ft. under the entire first floor, which space is used for steam and hot air pipes to keep the floor warm in winter.

Design 2—is reinforced-concrete skeleton supporting walls and floors; exterior walls of hollow clay tile veneered with face brick; interior partitions hollow gypsum tile except in stair towers which are enclosed in solid gypsum tile; assembly hall structural steel skeleton with fireproofing of hollow gypsum tile and brick; one-way gypsum tile floors; excavation under entire first floor similar to design 1.

Design 3—an embodiment of ideas of a consulting architect who was employed by the city of Rochester to suggest some means by which the cost of school buildings might be reduced—brick bearing exterior walls with a reinforced-concrete skeleton supporting the interior, except the assembly hall which is similar to design 2; intermediate column along the corridor side of classroom; first floor laid directly on the ground with a space for pipes in the attic and concrete plenum chambers below first floor for ventilation.

All reinforced concrete of designs 1, 2, and 3 is designed in accordance with the Joint Committee Rulings of July 1, 1916, with a few exceptions which are considered ultra conservative. The live-loads of 70 lb. per square foot for the classrooms and 100 lb. per square foot for assembly halls seem excessive according to the growing opinion on the subject. However, this department has made a study of the effect of the physical exercises carried on in our classrooms and assembly halls and is convinced that school buildings should be designed to safely carry these loads.

Although the light No. 24 gage tin-pan slabs were called for in the corridors of design 1, it is considered that this type of construtcion is not good. The pans collapse under ordinary pouring conditions, allowing concrete to run in on metal ceiling lath, increasing loads allowed for in the design, wasting concrete, giving variations in joist widths and fireproofing, and very often causing honeycomb conditions. However, the heavier cross-ribbed pans were allowed to be quoted upon for designs 2 and 3. In many cases the metal ceiling lath used in connection with tin-pan construction is subject to considerable corrosion before plaster is applied.

Floor Construction—Contractors were allowed to quote two-way tile floors as an alternate in designs 2 and 3. Although the figure on 3 was not as favorable as on 2, the reason is very evident. The slabs, having no restraint and only simple bearing at exterior walls, require an additional moment factor, involving thicker slabs and heavier reinforcement. The figure for two-way tile floors on design 2 was not received with formal bids.

There is a question in the minds of some engineers as to the advisability of reducing moment factors as suggested by the Bureau of Standards Report 220, but as the United States Bureau of Standards considers this type of floor construction safe and as we know structural formulas are theories proven empirically, there is no reason to doubt the safety of such floors. Economy is good engineering. The history of flat-slab design offers a precedent. As the system lends itself to light loads and panel dimensions of school construction, the girders along peripheries give a better distribution of loads to columns than the one-way systems, thus reducing the unbalanced moments transmitted thereto. The tie-through gives structural unity. The saving of plaster and simplicity of forms appeals to the contractor.

The intermediate column added along the corridor side of classrooms in design 3 is governed in minimum diameter by the height rather than economic design as in 2. Column forms cost more per square foot than beam forms. This, together with the saving of floor space by omitting the intermediate column, effects an additional economy of $1,200 by using design 2.

Most of the masonry contractors have enthusiastically approved of design 2 because it is possible to

complete the concreting operation before bricklayers are needed on the job. In the past it has been a piecemeal proposition involving laying off and re-employing men. It is also less expensive to lay up a 4-in. brick veneer with 6-in. hollow tile backing than a 12-in. solid brick wall. The heat loss through the former is less.

The first floor system of design 3 as indicated below, being laid directly on the ground, is not good construction. Experience has taught us that it is not only cold and damp underfoot but unsanitary. No precaution of preparation of foundation and waterproofing of strata will give to subsoil a uniform settlement. Cracking is bound to result and rotting of wood sleepers and flooring, or linoleum as the case may be, will cause a higher maintenance cost. Placing the floor on the ground requires that space for piping be furnished above the second story ceiling, which ceiling had to be designed to carry a live-load for the repairing of pipes. Metal ventilation ducts in the excavated basement of design 2 had to be replaced by concrete plenum chambers in 3. In the latter, cross branches and conduits required concrete trenches under the first floor slab. The attic of design 3 naturally involves a higher building and more exposed wall area.

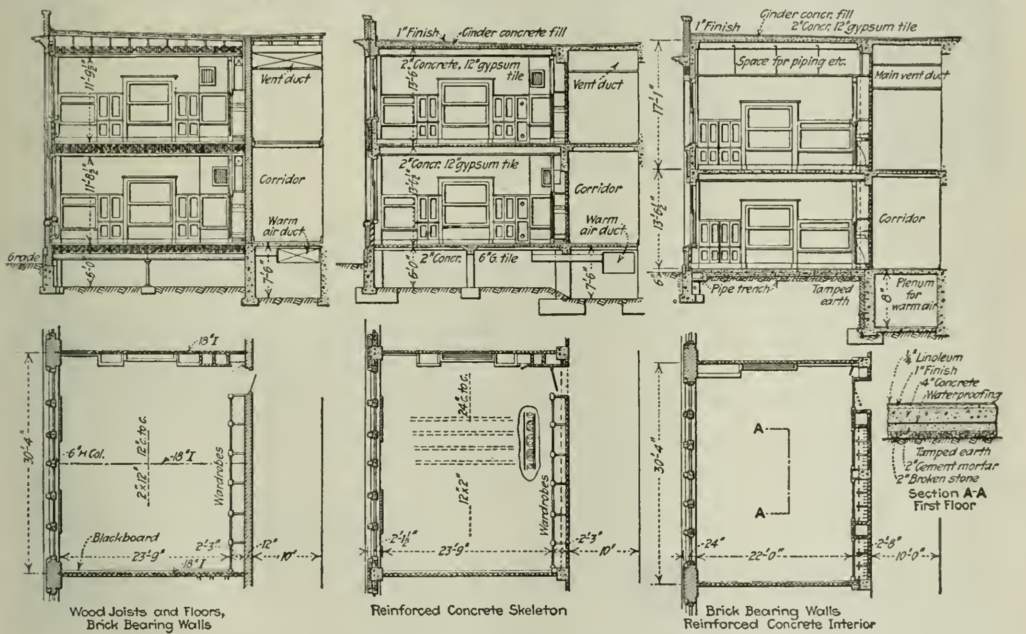
Division of Floor Areas—It should be noted that design 3 calls for a reduction in the width of classrooms from 23 ft. 9 in., Rochester's standard, to 22 ft. 0 in. Wardrobes are within the rooms along the corridor side. "The Candle of Efficiency" as published by the Committee on Standardization of School Buildings of the National Education Association was applied to all three designs. The following table shows the division of floor areas in percentages according to the above named standard:

	Without Addition Design 1 Per Cent	With Addition Design 2 Per Cent	Design 3 Per Cent	N. E. A. Average Per Cent
Walls and partitions	7.10	6.80	6.94	10 00
Flues	1.80	1.75	1.54	3 00
Corridors and stairs	22.70	20.15	22 02	20 00
Accessories	0 00	0.00	0 00	1.00
Instruction	54.70	59.00	55.00	50 00
Administration	13.70	12.30	14.50	16 00
	100.00	100.00	100.00	100 00

Much could be said about maintenance and more thought should be given to it. The first design is not the structural unit that the second is, so naturally more unequal settlements and cracking of plaster, brick-work, terrazzo, and tile work can be expected. The third, with its first floor on the ground and its exterior bearing walls lacking the "tie-through" of the second, will have unequal settlements. The fire hazard in the first is much greater than in the other two, and the spending of an additional $2,500 to complete the sprinkler system in it would further reduce the difference in cost between design 1 and design 2.

The figures received indicated that 85 per cent ($58,100) of the economy of design 2 over 3 was in the masonry work. The heating, electrical, and plumbing figures showed an economy for design 2 over 3 of approximately 3 per cent, plus the cost of ventilating ducts of design 2. This was largely due to the fact that the exposed wall area of the former is 8,300 sq.ft. less than in the latter. The saving is slightly offset by the better facilities for piping and conduit work in the attic of design 3.

Although it is not prudent to draw definite conclusions from isolated cases, yet the economy of a reinforced-concrete skeleton for school buildings is so positive that it should appeal to the structural engineer.



DESIGN 1 DESIGN 2 DESIGN 3

COMPARATIVE DESIGNS OF SCHOOL BUILDINGS FOR ROCHESTER, N. Y.
Typical plan and cross-section of three buildings differing only in structural details.

The 8-M.G.D. Sioux Falls Iron-Removal Plant

One of the Largest Iron-Removal Plants, Built at Low Cost, Has Small Hand-Operated Units and False Bottom Underdrains

By F. G. Gordon
Principal Assistant Engineer, with Dabney H. Maury, Consulting Engineer, Chicago

Strict economy dictated the use of several of the more unusual features in the new 8-m.g.d. iron-removal plant at Sioux Falls, So. Dak., built at a cost of \$11,125 per million gallon capacity. Small filter units permitted hand operation of the valves. Recording water-level gages on the filter effluent line replace the ordinary integrating loss-of-head gages. A spent wash-water storage sump spreads out the discharge so that a smaller drain answers. The underdrains consist of a steel plate false bottom, into which nozzles are screwed.

Before preparing final plans an experimental plant was operated to determine whether aeration, followed by sedimentation and filtration but without the use of chemicals, would remove the iron satisfactorily. As the results with the experimental plant indicated a 96 per cent removal, it was decided to employ this process in the contemplated plant.

The water supply is obtained from large shallow wells sunk in an excellent gravel stratum located in the Big Sioux River valley. From these wells the water is lifted by motor-driven centrifugal pumps to the aerator in the iron-removal plant. The aerator is of the weir-step type, in which the water cascades down concrete steps on which removable 1½-in. pipe are placed to break up the stream. From the aerator the water flows into one end of the sedimentation basin and is collected at the other end by an overflow weir, from which point it passes to the filters.

There are sixteen filter units, each having a capacity of 500,000 gal. per day when operating at a rate of 125 m.g.d. per acre. The use of units of this size was influenced by operating conditions and by structural reasons. It was expected that, from the standpoint of hand operation which had been decided upon, it would be easier to operate the valves for the plant as designed than to operate the fewer but larger valves of a plant having larger units. The iron-removal plant was built directly over an existing reservoir, in which the column spacing and design combined to make advantageous the construction of filter units of the size used. Certain iron-removal plants in the past have experienced difficulty with a growth of crenothrix in the sand. It was thought that the use of the smaller units would enable the handling of such difficulties (if they occurred) more easily than in units of larger size.

FIG. 1—STEEL PLATE FALSE FILTER BOTTOMS
Cast-iron umbrella-shaped nozzles are screwed onto brass nipples screwed into the steel plate. The plate is supported 20 in. above the floor by U-shaped cast-iron posts with a 1½-in. holding-down bolt in the U.

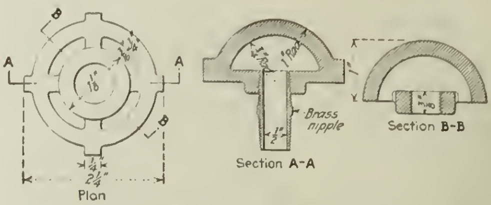


FIG. 2—DETAIL OF FILTER NOZZLE

Each filter unit has 30 in. of sand and 15 in. of gravel, the gravel resting on a ½-in. steel plate which is supported by short cast-iron columns. The gravel was screened to size and deposited in the filter in the following layers:

Thickness of Layer	Size of Gravel
5 in.	2 in. to 1 in.
3 in.	1 in. to ⅝ in.
3 in.	⅝ in. to ⅜ in.
2 in.	⅜ in. to $\frac{5}{16}$ in.
2 in.	$\frac{5}{16}$ in. to size passing No. 10 sieve

Specifications called for a sand having an effective size of from 0.35 to 0.50 mm., and as low a uniformity coefficient as possible. The steel plate which serves as a false filter bottom is drilled and tapped on 6-in. centers to receive ⅜-in. brass nipples, to which cast-iron umbrella-shaped nozzles are screwed. The design of these nozzles was based on those used by the American Water Works and Electric Co. in its East St. Louis plant. The area of the openings through the brass nipples is 0.53 per cent of the total area of the filter bed. The area of the openings through the nozzles is in excess of the area of nipple openings. The distribution of wash-water is apparently very uniform.

A new type of rate controller manufactured by the International Filter Co. was used in this installation. This controller is of the Venturi type, with a butterfly valve operated by a diaphragm. Tests, in which the head on the inlet side was varied from 2.5 to 5 lb. in an interval of one minute, showed a variation in discharge of less than 5 per cent.

Recording water-level gages were used for loss-of-head gages. The gages for adjoining filters were mounted back to back on 1-in. gage boards located on the operating floor. Although this type of gage is not differential in its action, it gives a satisfactory record because the water level in the filters is carried within a few inches of the same elevation at all times.

Since a single wash-water pump is provided, for emergency use a connection is made to one of the high service mains leading from the pumping station to the distribution system. The friction loss through this connection was carefully calculated, and the size of the pipe selected so that the wash-water pressure when delivering a sufficient quantity for washing purposes would not be excessive.

A sump having a capacity of 40,000 gal. was con-

structed to receive the wash-water from the filters. The construction of this sump permitted the use of a 10-in. cast-iron drain from the sump to the nearest city sewer instead of the 16-in. drain which would have been required if the sump had not been built. The saving due to the use of the smaller drain amounted to $5,887, while the cost of the sump was only $1,617. Cast-iron construction for the drain was necessary because of its proximity to the gravel stratum from which the water supply is obtained. The Champaign and Urbana Water Co. has had a similar arrangement in service for a number of years, but its sump is used with the idea of reclaiming a large part of the wash-water.

The office, laboratory and pump room are located at the front of the filter plant building. The pumping equipment, which is all motor-driven, consists of a wash-water pump, three auxiliary low-lift pumps, which can be used as boosters to assist the well pumps during the periods of low ground water, and one high-service pump.

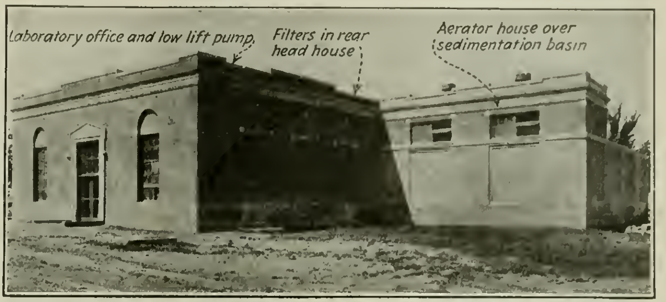


FIG. 3—BRICK SUPERSTRUCTURE OF SIOUX FALLS 8-M.G.D. IRON-REMOVAL PLANT

Aerator house surmounts concrete sedimentation basins at left. Filters are in rear of the brick head house (at right) in which are located a laboratory, office and the low-lift pumps.

FIG. 4 — INTERIOR OF FILTER ROOM WITH OPERATING GALLERY IN REAR

Struts, acting as walkways over filters, cut in half effective length of beams at tops of filter walls. Depth recording gages are mounted back to back on pipe supports. Since valves are hand operated no operating tables are needed.

The concrete used in the filter tanks and in the walls of the sedimentation basin consisted of one part of cement to five parts of coarse and fine aggregate. In determining the proportion of fine to coarse aggregate, sieve analyses were made of both classes of material. The theoretical proportions first adopted were those which would give a smooth curve of parabolic form when the quantity of material passing the various sieves was platted. It was found, however, that a more plastic concrete could be obtained by the use of slightly more fine aggregate and less coarse aggregate than the theoretical curve indicated. The slump test was used to control the amount of water in the concrete. Concrete was mixed for 1½ min. after all ingredients had entered the mixer and was placed with two-wheel carts. As the concrete for the walls of the sedimentation basin was deposited during the winter, the materials and water were heated and the concrete placed in forms which were protected by heavy straw mats on the weather side. Salamanders were used on the interior.

No trouble was experienced in putting the plant in operation, and operating results up to the present time have been entirely satisfactory. The raw water has an iron content of 4 to 5 p.p.m., while the filtered water shows 0.15 p.p.m. A greater reduction in the iron content of the filtered water will probably be obtained when the most desirable rate of wash, quantity of wash-water and time for washing have been determined. At the present time the amount of wash-water used is about 2 per cent of the amount of water filtered. The filters are washed at a rate which gives a 24-in. vertical rise per minute.

John Mundt, the commissioner in charge of the Sioux Falls Water Department, through persistent advocacy of the plant over a period of years, was largely responsible for its construction. The plant was designed in the office of Dabney H. Maury, consulting engineer, Chicago. The resident engineer was Paul G. Windt.

Minnesota Drainage Work Is Slack

Land drainage activities in Minnesota during the year ending June 30, 1923, were at a low ebb. According to a statement by E. V. Willard, commissioner of the State Department of Drainage and Waters, this slackening in the reclamation of wet and overflow lands was due to three years of abnormally low precipitation combined with the poor economic situation among the farmers. Revival of drainage work in the past few months indicates that prosperity is returning, particularly in the southern part of the state, but it will take a year of heavy rainfall to restore normal activity.

Studies in Highway Traffic and Finance

Abstracts of Committee Reports to the Advisory Board on Highway Research of the National Research Council, Presented at Meeting in Washington, Nov. 8-9, 1923

Sources and Expenditure of Highway Funds

By J. G. McKay
Bureau of Public Roads, Washington, D. C.

BEFORE decision as to the justice or expediency of methods of highway financing, it is necessary to make a complete study of the sources of highway revenue, local, county, and state, in typical states. Most previous investigations have been limited to a study of the sources of *state* revenue for highway purposes and have disregarded the *county* and *local* expenditures. The following results are based on an analysis of *all sources* of revenue and expenditures in four Wisconsin counties from 1915 to 1921. Wisconsin was selected as a state whose system of highway financing represents a fair average of methods of raising highway revenues in other states. The counties were selected as representing the highway development in different sections of the state.

Dane County is a well populated, rich agricultural county, with no highway bond issues. Madison, the capital city of the state, is located in the center of this county.

Outagamie County is a good agricultural county. It has financed a large portion of the construction of its highway system through bond issues since 1916.

Rusk County is located in the newer section of the state. It is a purely agricultural county with soil of average fertility but as yet largely undeveloped. No highway bond issues have been made and its highways are, with the exception of the state trunk highways, largely unimproved.

Waukesha County lies west of the city of Milwaukee and is a rich dairying and manufacturing country. It has floated large bond issues during the past three years.

Table I shows the total expenditures for highways in each county. It is evident that the proportion of the burden of all highway expenditures which rests upon real property varies from 55 per cent to 70 per cent. The highest proportion is found in Rusk County, relatively undeveloped, while the lowest proportion is found in Waukesha County, a very rich section both agriculturally and industrially. This variation is due largely to differences in revenue derived from the income tax. In the richer counties the income tax furnishes a larger portion of the total revenue, and as a result, insofar as funds for highway expenditures are taken from general revenues, the income tax furnishes a larger portion of revenue for highway expenditures. It will be noticed that real property taxation and "other revenue" taken together furnish almost the same proportion of revenue for highway expenditures in all counties. The figures are as follows:

	Per Cent
Dane County	76 82
Outagamie County	79 86
Rusk County	81 35
Waukesha County	78 68

A comparison of the proportions furnished by each source of revenue in any one county for the different years substantiates the conclusion that the contribution of real property varies inversely as the contribution of other revenue. Other revenue as the name indicates is made up of all sources of revenue except the sources listed separately in Table I, but the principal part of it is made up of revenue derived from the income tax. The other sources of revenue included under this head such as fees, fines, etc., form a very small proportion of the total in this class. The annual expenditures by counties from each source of revenue show that in the years 1917 and 1918, when the receipts from the income tax were highest, the proportions of revenue derived from real property taxation were smaller than in the years when the receipts from the income tax were smaller.

TABLE I—PERCENTAGES OF EXPENDITURE FOR HIGHWAYS IN FOUR WISCONSIN COUNTIES

	Total	Local	County	State	Federal
Dane County					
Total	100 00	100 00	100 00	100 00	100.00
Real property taxation	60.29	74 06	66 99	37 73	.
Personal property taxation	11 20	12 06	13 51	8 71	...
Other revenue	16.53	9.47	19 26	4 50	100.00
Automobile license fees	10 08	.	. .	49.06	.....
Special assessments	1 82	4.41	.	....	...
Miscellaneous contributions	0.08	.	0 24	....	.....
Outagamie County					
Total	100 00	100 00	100 00	100.00	100.00
Real property taxation	63.27	66.57	71 82	36.67	...
Personal property taxation	13.54	11.52	17 14	8.41	
Other revenue	16.59	20.53	11.04	3.95	100 00
Automobile license fees	6 12	.	.	50.97	. .
Special assessments	0.48	1.38	. .	....	.
Rusk County					
Total	100.00	100 00	100 00	100 00	100.00
Real property taxation	69 83	82 04	81 68	35.70	.
Personal property taxation	10.23	10 17	13 48	8.07	.
Other revenue	11.52	7 46	4 84	2 47	100.00
Automobile license fees	8 26			53.76	.
Special assessments	0.16	0 33	.	. .	....
Waukesha County					
Total	100 00	100 00	100 00	100 00	100.00
Real property taxation	55 29	64 18	72 88	38 45	.
Personal property taxation	10.19	10 59	13 90	8 70	. . .
Other revenue	23 39	24 66	13 22	2.73	100 00
Automobile license fees	10 90	.	.	50.12	.....
Special assessments	0.23	0.57	.....	.....	.....

TABLE II—PERCENTAGE OF TOTAL REVENUES FOR HIGHWAY EXPENDITURES RAISED BY VARIOUS GOVERMENTAL UNITS

County	Local Funds	County Funds	State Funds	Federal Funds
Dane	41.27	32.81	20.54	5.38
Outagamie	34.88	49.63	12.01	3.48
Rusk	48 20	30 37	15.36	6.07
Waukesha	39.56	29.55	21.76	9 13
Average	40 98	35 59	17.42	6.02

Table II indicates the importance of funds raised by the local units (townships and villages) for highway purposes, as compared with state and federal funds. The funds raised by the local units and counties furnish from 69 per cent to 84 per cent of the total highway expenditures. While this analysis is based on only four counties it is safe to assume that these proportions are reasonably correct for the state of Wisconsin as the counties studied were selected as representative of the various counties within the state. In other states the proportion raised by the various governmental units may vary to a considerable extent from those shown in Table II, but in those states which are organized on the township basis the funds raised by the local units and counties will approximate the percentages shown in Table II. The percentages shown in Table II are derived from the total expenditures within the different counties for the period 1915 to 1921 inclusive. It should be noted that this period includes a few years before the period of federal aid, and also that the activity of the state in the highway field has increased greatly during the later years so that had the period been made to include only the years 1918 to 1921, the percentages derived from state and federal funds would probably have been larger.

The proportions of highway expenditures contributed by local, county, state and federal units, as indicated in Table

TABLE III—PERCENTAGE OF TOTAL REVENUE FOR HIGHWAY EXPENDITURES FROM REAL PROPERTY TAXATION LEVIED BY VARIOUS GOVERNMENTAL UNITS

County	Local Taxation	County Taxation	State Taxation	Federal Government	Total
Dane	30.56	21.98	7 75	.	60.29
Outagamie	23.22	35.64	4 41	. .	63.27
Rusk	39.54	74 81	5.48	.	69.83
Waukesha	25.39	21.54	8 36	....	55.29
Average	29.68	25.99	6 5		62.17

II, may vary to a considerable extent in different localities, nevertheless the figures are conclusive evidence that any discussion of highway finance which treats exclusively of state and federal expenditures, omits local and county expenditures which constitute the major portion of the total highway expenditures. While it would be advantageous to have more of our highways entirely financed and constructed by the state, *the fact remains that at the present time local and county highway expenditures absorb the major portion* of funds raised from all sources for highway improvement.

While the general property tax is the most important single source of revenue for highway expenditures in all units—the townships, the county and the state—its importance as a source of highway revenue is much greater in the township and county than in the state. As will be noted from Table III real property taxation by the local units furnishes from 23 per cent to 39 per cent of all highway expenditures, and county real property taxation provides

TABLE IV—PERCENTAGE OF REAL PROPERTY REVENUE FOR HIGHWAY EXPENDITURES LEVIED BY GOVERNMENTAL UNITS

County	Local	County	State
Dane	50.70	36.45	12.85
Outagamie	36.70	56.33	6.97
Rusk	56.62	35.52	7.86
Waukesha	45.93	38.95	15.12
Average	47.49	41.81	10.70

from 21 per cent to 35 per cent of the total highway expenditures, while state real property taxation provides only from 4 per cent to 8 per cent of the total highway expenditures.

Table IV shows the proportion of real property taxation revenues for highway expenditures raised in each county by the various units. An average of 47.49 per cent is raised by the local units, 41.81 per cent by county units and 10.70 per cent by the state. *The real property revenue for highway expenditures raised by the state in comparison with local and county real property revenues is but a small share of the total real property revenue raised for highway improvement.*

It is to be noted that real property taxation produces seven times as much of the total highway revenue as that derived from motor vehicle license fees, while the taxation of incomes (other revenue) produces approximately double the amount raised by vehicle license fees. Since local funds are expended on purely local roads, it is fair to compare the amount of county and state real property tax funds produced for expenditures on state and county highways with the amount raised by vehicle license fees used on the same highways. County and state real property taxation produce 32.49 per cent of total highway revenue, vehicle license fees 8.84 per cent. Real property which contributes 62 per cent of all highway expenditures produces for county and state highways four times as much of the total expenditures as that produced from vehicle license fees.

The conclusions based on this analysis of the sources and expenditure of highway funds in four representative Wisconsin counties are as follows:

1. The major portion of the total of highway funds in Wisconsin during the seven-year period from 1915 to 1921 was raised by township and county units rather than by the state.

2. Real property taxation was the chief source of highway revenue producing an average of 62.17 per cent of the total local county and state highway expenditures.

3. Vehicle license fees produce 8.84 per cent of the total highway expenditures.

4. Real property taxation for highway purposes bears too large a portion of the burden of highway expenditures, producing from 55 per cent to 70 per cent of the total highway revenue.

5. The major portion of the burden on real property is due to local and county taxation of real property for highway purposes. The local units produce 47.49 per cent, county units 41.81 per cent and the state 10.70 per cent of the real property revenue for highway expenditures.

6. Real property contributes a larger share of highway revenue during periods of depression, when the revenue from

TABLE V—SOURCES OF HIGHWAY REVENUE FOR TOTAL HIGHWAY EXPENDITURES

Source	Average Percentage
Real property taxation	62 17
Other revenue (largely income tax funds)	17 01
Personal property taxation	11 29
Vehicle license fees	8 84
Miscellaneous	0 69

other sources decreases. This results in an excessive levy on real property owners since the tax levy on real property is paid from income derived from the property and in periods of low prices this income is reduced at least as much as income from other sources.

7. When income tax funds increase within a county, real property taxation for highway purposes decreases.

8. As a county develops and grows richer the relative burden on real property for highway purposes decreases. When a county or state is in the developmental stage the cost of the permanent features of highway improvements can be economically financed by issuing a limited amount of deferred serial highway bonds. By this method the burden on property is lightened during the early years of the improvement, increasing with the ability of property to produce more revenue as a result of the highway improvements.

9. A reduction or elimination of state taxation of real property for highway purposes in Wisconsin would not materially reduce the total of real property taxation for all highway purposes.

10. Reduction of real property taxation for highway purposes in Wisconsin would result largely in a reduction of local and county taxation of real property for towns'hy and highway expenditures.

* * *

Highway Traffic Analysis

By G. E. Hamlin
Connecticut Highway Commission, Hartford, Conn.

IT IS necessary to differentiate between a highway traffic census and a highway transport survey. The traffic census will give information pertaining to the traffic using the highway at the time the census is taken and the purpose of the highway transport survey is to determine the probable amount and character of the future traffic which will use a given highway during the lives of its several component parts. Up to the present time, the information collected by the various states has given traffic census information and no state has extensively taken up the highway transport survey.

A highway traffic census is of value only for determining conditions which exist at the time the census is taken. It may be that by the construction of a new section of road the general trend of traffic may be radically changed in any particular locality. After an extended highway traffic census, it is recommended that additional counts be taken at critical periods of the year in succeeding years from which, after a number of counts have been taken, curves of natural increase can be plotted from which can be roughly determined an estimate of increased traffic for a reasonable period of years. This estimate should also include the curve of increase of motor vehicle registration which can be determined at the present time in every state. It is questionable if such a curve can be applied to other than the locality in which it is developed. In fact, even in a state of small area, different curves will have to be developed for different sections of the state, rather than to utilize a general curve for all of the main highways. Up to the present time it has been found impracticable with the data available, to develop a formula of this character.

The value of an extended traffic survey in determining the allocation of construction and maintenance funds in the development of a highway system is unquestioned. Such traffic survey, however, should be utilized for type and strength of surface, rather than for location of expenditures inasmuch as the development of new territory within a state is as much a demand upon the expenditure of highway funds as the taking care of traffic already developed. This

point cannot be stressed too strongly, for, if the allocation of funds depends wholly upon the volume of traffic, only a few of the roads in any particular state would ever receive a construction allotment. This is where the decision of the engineer in charge is valuable and this decision must be based on potential as well as present traffic conditions. In other words, he must minimize any particular locality to consider the value of transportation in the whole state and each construction unit must be based on his vision of the value of such unit.

To carry out a traffic survey successfully much planning must be done preliminary to the actual field work. Stations must be chosen which will give the average condition along each highway and these must be located at a sufficient distance from the congested centers to eliminate as far as possible the strictly local traffic which will not enter into the construction program. Care should also be taken to establish stations where traffic is divided so that the value of each section as well as each road may be determined. Each station should be occupied at least one day each month, for an eight- to twelve-hour period. This should be arranged so that the same station will be occupied successively on different days of the week and on a different hourly basis to determine daily as well as seasonal variation of traffic. Blank forms where check marks may be used will reduce the time required for gaining information and names of cities, character of loading and make of truck or car may be coded, thus simplifying actual compilation of office records.

In the state of Connecticut the cost of three parties operating over a year's period with varying numbers, including necessary automobile transportation, board allowance, etc., has been about $27,000.

* * *

Motor Truck Transportation in New England

By J. G. McKay
Bureau of Public Roads, Washington, D. C.

THREE groups of agencies in New England are engaged in the transportation of people and commodities: steam and electric rail lines, boat lines, and highway transportation companies.

From September to December, 1922, over a million net tons of freight were transported by motor trucks over the Connecticut highway system. Rail service during this period was below par due to labor difficulties, and naturally this situation increased the volume of highway transportation above the normal level. The largest portion of motor truck net tonnage movement was limited to the short haul zone: 69.4 per cent was hauled less than 30 miles, 18.4 per cent from 30 to 69 miles, and 14.2 per cent over 70 miles.

Two factors are in general responsible for the highway transporting of commodities over 20 miles: (1) The lack of rapid and efficient rail service enabling shippers to obtain fast rail transportation of l.c.l. freight. (2) A limited number of commodities which are especially adapted to motor truck shipment and will probably continue to be shipped by truck for distances beyond the short haul zone. The total ton volume of these commodities is not very significant.

Since January, 1923, the per cent of the total net tonnage transported by motor truck beyond 30 miles has decreased, indicating that with efficient rail and boat service the motor truck is not a major transportation factor in the middle distance and long haul zone.

The commodities transported by motor trucks on the Connecticut highways reflect the industrial production of New England. Of the total net tonnage 73.6 per cent are manufactured goods, 8.5 per cent products of agriculture, 7.1 per cent of animals, 6.7 per cent products of mines and 4.1 per cent products of forests. The large per cent of manufactured goods is partly explained by the fact that more profit can be made in motor truck transportation of these goods than by moving bulky goods of lower value.

In general manufacturers ship their commodities by motor trucks for two reasons: (1) Prompt and reliable service and (2) Trade demands. Railroad freight congestion and rail embargoes force manufacturers to ship their products by motor trucks in both the short and the long haul zone.

A combination of motor truck and rail and motor truck and boat service is a modern development. This service has developed largely in response to the demands of shippers for a rapid pick-up and delivery service of freight. The motor trucking company assembles the commodities and loads the freight cars which are forwarded daily regardless of whether they are loaded to capacity or not. The cars are shipped by rail to destination and the trucking company unloads and delivers the freight.

The second type of joint service is a combination motor truck and boat service which has developed very rapidly in the past few years. In most cases this service is limited to over-night delivery from New England points to New York City. The Starrin-New Haven line operating between New Haven and New York City is the best illustration of this type of service. This company maintains a sidewalk pick-up and delivery from Derby, Shelton, Ansonia, Seymour, Beacon Falls, Naugatuck, Waterbury, New Britain, Meriden, Wallingford, Middletown and Hartford, Connecticut, to New Haven, Connecticut, and ships by boat from New Haven to all points.

Highway transportation of freight and passengers is increasing in volume each year. Its development has been so rapid and the information as to its movement is so meager that it is extremely difficult to lay down any definite principles as to the economic sphere of motor trucking companies engaged in the highway transportation of freight. The following is a tentative outline of the economic fields of motor truck transportation as a correlated part of our transportation system:

1. Organized urban motor truck transportation in congested terminal areas consisting of motor truck terminal to terminal freight transfers as well as pick-up to delivery service. This can be illustrated by the operation of the U. S. Trucking Co. in New York City in co-operation with the Erie R.R. in the transfer of freight from the Erie-New Jersey terminal to New York City for delivery. Carefully organized and efficiently operated motor trucking companies, assured of rail and steamship co-operation, will materially speed-up terminal freight movement, decrease the volume of freight warehoused, reduce the cost of moving freight through terminals and expedite the rail delivery time of l.c.l. freight.

2. The organization of motor truck freight service to supplement and extend existing rail and water transportation agencies. The development of motor transportation companies in areas inadequately served with rail or water transportation offers an enormous possibility for the economic extension of highway transportation. This type of service is especially desirable in the development of new areas or localities with insufficient transportation facilities and will make available additional tonnage for movement by rail or water. This is a non-competitive service extending and supplementing existing rail and water agencies.

3. The short haul transportation of freight probably not to exceed 30 miles. The freight transported by motor trucks in the short haul zone is largely a non-competitive assembly and distribution of commodities. The differences in the density of population in different areas, the distance between cities and areas of production and distribution, the prevailing type of production and the type of rail or water transportation available may decrease or increase the above zone of the short haul.

4. Motor truck transportation of a limited number of special commodities in the long haul zone in which delivery time, the character of the goods transported or the demands of the industry or trade, indicate the desirability of motor truck transportation. This type of freight is but a small percentage of the total net tonnage transported over the highways.

Through the Reclamation Country

By F. E. Schmitt
Associate Editor, *Engineering News-Record*

THIS is the ninth of the series of letters written by Mr. Schmitt during a journey recently made through the West in which he visited irrigation projects, studied developments, and interviewed builders, operators and settlers, in order to present to our readers the actualities of reclamation as revealed to an unprejudiced investigator.

The series of letters began in the issue of October 4.

Phoenix, Ariz.

MANY special views of reclamation are afloat in this great West. They appear peculiar to the visitor. Some of them are connected with past reclamation policy and some with future policy; many are related to what is often called the repudiation sentiment of the project farmers. A general appraisal of present reclamation difficulties is bound to encounter them and take them into consideration. And if they are important in their bearing on project operation they are very much more important with respect to future expenditure of national funds for reclamation.

National Duty—Stated in most general form, one Western sentiment is that it is the nation's simple duty to irrigate Western lands. Homestead lands in the Mississippi valley have a natural water supply, and Western lands should be turned over to the homesteader in equivalent condition. Suppose the hardfisted early irrigators did build their own ditch systems—that is no reason why under modern conditions the government should fail to recognize its duty to put water on the land for the farmer.

A slightly different view is that the Reclamation Fund does not belong to the United States but belongs to the West, and more specifically to the individual states, since it was raised by the sale of national lands situated in these states and wrongfully withheld by the nation from these states. One prominent citizen in particular argued this view to me vehemently and with a refreshing disregard of the customary amenities.

A third view, or rather an attitude (perhaps unconscious), of many reclamation farmers is that reclamation is not designed primarily to help the farmer or land owner, but is designed to help the United States as a whole. The entire business of reclamation, under this view, is essentially Uncle Sam's own private game, which he started for his personal purposes and which he is morally bound to see through. In less extreme cases, this view takes the form that Uncle Sam was not entirely selfish in the matter but that he does occupy the position of a sort of parent or guardian, and that, having also the biggest stake in the project, it is his plain duty to make the farmers prosperous and happy without regard to account-book questions. This has been called the Santa Claus idea of the government's part in reclamation.

Repudiation—Woven all through the fabric of thought on the projects is a widespread and definite element of repudiation sentiment. No one likes to admit it in terms; it is quite intangible; but it unmistakably colors the reclamation sky. One way of describing the sentiment is to say that those who hold it would be pleased if Congress passed a law or if some other thing happened to relieve them of the necessity of paying for the cost of the irrigation works. Another way is to say that the active repudiationist directs all his agitation and scheming and arguing toward proving that he never promised to pay, that he can't pay, that the engineers lied about the cost of the work and executed it incompetently, that costs have been negligently and fraudulently piled up, that waterlogging and the further expense for drainage resulted from the negligence of the engineers or even from the vengeful spirit of the director, that the Reclamation Service is responsible for exorbitant freight rates, and that the country at large has already put many times the alleged debt of the project farmers into its pocket in the shape of taxes and assessment rolls due to the growth of the project.

The ordinary man may find it hard to understand how the farmers, or any considerable number of them, can knowingly try to evade an obligation that they willingly assumed. But the matter of the obligation is not quite so simple. It would be simple if concerned with *homestead lands taken up after completion* of the works and announcement of their cost, which condition almost never occurs, however. Under the usual circumstances, the private owner or the early homesteader was not told what the works would cost, and such advance guesses as were made were often inadequate, so that in the end he found himself in for much more than he expected, a condition which everybody dislikes. Moreover, the law requires the farmer to pay the "estimated cost," and he thinks this refers to the advance guesses (often referred to as promises) rather than to the final estimates. He knows that the law does not create an inherent obligation anyway, but represents only a formal requirement on the part of Congress, which requirement has already been modified more than once by that body and which may be modified further if Congress is sufficiently urged. The contract that he may have signed was not really a free undertaking, but one that he, singly, could not well have kept out of. He believes also that the nation never intended to place upon him a burden greater than his ability to bear; and actual practice shows that his land, being located far from markets and being farmed inefficiently, does not produce enough to enable him to bear the burden conveniently on top of his other debts. So, believing that the government can better afford to lose the money than he can, he is inclined to welcome cancellation of his government debt, and he forms organizations to ask as a preliminary for forty-year extension or some equivalent postponement of payment. More correctly stated, his office-holding local representatives do this, not the farmer himself.

Another point bears on the same bit of psychology. Various people have circulated the idea that the whole reclamation business was a money-losing affair from the start and was known to be such. Perhaps some soft-headed government representatives have at times preached doctrines that helped build up this impression; but most of it is due to the efforts of out-and-out agitators. Such agitators say, for example, that interest payment was remitted in the original Reclamation Act because it was known that irrigation was an unprofitable adventure; that all the good projects were developed by private capital, and even most of these

are not able to pay interest on the construction money; and that the government, in return for its loss of interest, gains tremendous amounts of income in taxing the wealth which it creates. By such ingenious bits of reasoning, these people try to yoke together in the general Western consciousness (1) the belief that reclamation cannot pay interest and perhaps not more than a small fraction of the principal, because it is unprofitable; and (2) the conviction that the nation should hand out great additional sums for further construction, because reclamation is profitable. It is going to be difficult to graft these views upon the thought of the country generally, or to get wide support for the development policies which they suggest.

But this is only another case of how the agitators have hurt reclamation. The reclamation farmer's financial credit has already been impaired by agitators, as expressed very definitely by Land Bank officials, and now the same agitators are creating doubt of the wisdom of doing more reclamation. Some day the farmers are going to wake up to how ill they have been served by the agitators.

The Pork Barrel—Following another line of thought, many men in the arid states feel that it is time the government did something handsome for them, after having lavished federal funds on rivers and harbors to the benefit of Eastern communities for these many years. Doesn't Congress take large sums of money out of the public treasury to benefit New York and Philadelphia by building them harbors and dredging channels? Doesn't it subsidize the Ohio River cities by canalizing the river at tremendous cost, and the farmers of the Mississippi River bottoms by leveeing the banks? Well, then, with equal justice the Western states may ask for government expenditures for the public good! And this means Treasury money, not Reclamation Fund money, because that belongs to the West, not to the United States, having been raised from Western lands and duly consecrated to the West by Congress in the Reclamation Act.

It needs no special imagination to picture the development of reclamation if the spirit of this school of thought comes to prevail. The long odorous pork-barrel system when extended to irrigation and drainage would furnish new and interesting possibilities. Senate votes for power grants on the Colorado might be traded in legitimate legislative manner for cessation of a filibuster on a deficiency appropriation for the Columbia Basin work (assuming that project to have been started by then).

State Apportionment—Definite convictions are entertained in most parts of the West concerning claims of the several states to reclamation money. The provision of the Reclamation Act which requires money to be expended according to geography rather than efficiency is partly responsible, no doubt. But even aside from this there is enough local rivalry, or jealousy, to keep these convictions alive. Their importance lies in the fact that such matters as water supply, soil, topography and settlement make reclamation difficult enough, without the intermixture of ward politics. The general citizen presumably believes that, if national expenditure for irrigation should rest on the basic consideration of efficient use of the money, the most productive and profitable projects should be undertaken. The believer in state apportionment may grant the premise but he denies the conclusion.

Alum Shortens Drying Period of Imhoff Tank Sludge

Laboratory and Operating Tests Lead to Adoption of Alum at Joint Sewage-Works of Plainfield, N. J.

Paper No. 130 of the Journal Series, New Jersey Agricultural Experiment Stations and New Jersey State Department of Health, Substation, Sewage Investigations, by Willem Rudolfs, John R. Downes and F. Leslie Campbell, respectively, Chief, Sewage Investigations, New Brunswick, N. J.; Superintendent, Plainfield Joint Sewage-Works and Member Research Committee, New Jersey Sewage Works Association, Green Brook Park, Bound Brook, N. J.; and Research Chemist, Sewage Investigations.

LABORATORY experiments on the effect of certain chemicals upon the rate of suction filtration of ripe Imhoff sludge made by Van der Meulen and Smith showed that aluminum sulphate gave the best results and suggested the addition of alum to the sludge to increase the rate of gravity filtration and evaporation on sludge-drying beds. (See *Jour. Ind. Eng. Chem.*, XV, 281, 1923.) The experiments were carried out at the Plainfield, N. J., joint sewage-works. Some of the drying beds used were located about 60 yd. from the Imhoff tanks. The sludge flows from the tanks along a trough into a mixing pit and is then pumped out upon the beds.

Van der Meulen and Smith used 6.7 lb. of aluminum sulphate per cubic yard of sludge. We used from 2.7 to 3.5 lb. per cubic yard. For gravity filtration it is desirable to have a quickly formed porous mat of gas-permeated solids floating on clear liquid, and it is this condition that we strove to approach in our work.

Investigators have stated that rapid and uniform mixture of the colloidal material with the elctrolyte is necessary to insure maximum flocculation. At first glance it seemed in our practical experience necessary to obtain a thorough mixture of the alum and sludge by stirring; accordingly, a motor-driven stirring apparatus was devised, consisting of the blades of a small boat propeller fastened to a long iron rod. This apparatus, put in operation at the Plainfield plant, showed at once that the stirring affected the appearance of the sludge materially. Upon examination it was found that the comparatively porous material—sludge aggregates interspaced by gas bubbles—became finely divided, leaving the finely dispersed material devoid of gas bubbles with a liquid film on top. It is desirable to have large flocs interspaced with fairly large gas bubbles in order that the liquid movement may be downward and thereby facilitate the draining off of the transparent liquid. The violent stirring of the propeller apparently beat out the CO_2 formed by the acid alum acting on the carbonates of the sludge, whereby the porosity of the solids was destroyed causing them to sink to the bottom. Further tests, in which the time of stirring ranged from one-half minute to ten minutes, were made but in no case were the results as satisfactory as those secured by gentle mixing in the following manner: The calculated amount of alum solution was siphoned into the sludge as it flowed slowly by in the sludge channel at a point where the stream of sludge turns at right angles to itself to pass through a shear gate to the bed. The right-angle turn folds the sludge over on itself, which motion, together with the drop into the bed, gives adequate mixing and the reaction is completed in quiescence so that the floc is not again broken up. Consequently the stirring apparatus was discarded in subsequent work. Tests were made in January, April and May of 1923 in the latter manner, and several treatments were made by the superintendent without checks to relieve the overload condition of his tanks.

The day after the January experiments were made a

heavy snowstorm accompanied by frost and resulting in a thick layer of snow, prevented us from making daily observations. The initial amount of sludge in the beds had shrunken considerably in the course of nine days. When the material was taken off the treated sludge consisted of a fluffy, spongy mass while the untreated sludge was stiff and hard.

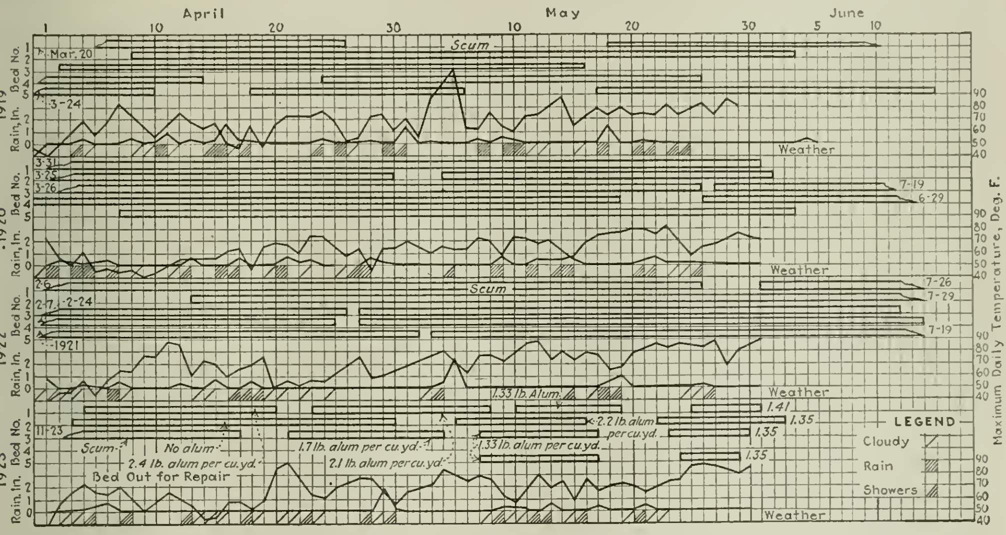
The amount of moisture present in the samples taken from the April experiments does not give a fair representation of the consistency of the drying sludge. The first few per cents of moisture are rapidly drained off but as drying proceeds the release of water becomes increasingly difficult and the sludge remains gelatinous for several days. This is very apparent when the moisture contents are compared with the time when the treated sludge was ready for forking.

make a few trials at their own plants to determine the exact amount of alum necessary for rapid dewatering.

The alum used was bought in large quantities at $1.75 per 100 lb., so the cost of treatment is well within practical limits. The total cost, for instance, is so small that variations over the range indicated in the chart would mean a variation between $28 and $51 a year for each m.g.d. of plant capacity.

In addition to the rapid drying, the sludge has a better texture for removal from the bed. Rain, even during the first few hours, has little effect on the drying as compared with untreated sludge.

There are no odors from the treated sludge. Local sludge gives some odor when untreated, during the first and second evenings after drawing. The treated sludge, when dry, is less voluminous than the untreated. The treated sludge



RATE OF DRYING OF IMHOFF TANK SLUDGE WITHOUT AND WITH ALUM ADDED TO SLUDGE

No alum used in 1919, 1920 and 1922. Alum used in 1923, at rates stated. Long bars indicate time one dose of sludge remained on bed to dry, each square being a day. Results for each of five beds shown separately. Rainfall and temperature plotted because of their relation to drying period; also, for each day, whether cloudy during daylight, rain or showers—a shower being a rainfall of less than 0.1 in. "Scum" indicates that bed in question was used to dry grease skimmed from tank instead of to dry sludge; results not comparable in such cases.

The May experiments were conducted with slightly different amounts of alum. Again the moisture content after ten days did not differ greatly but the appearance of the treated and untreated sludge was marked. Circumstances interfering with the securing of proper check experiments made it impracticable to carry on more controls. The superintendent, however, was so impressed with the advantages of this dewatering that he has applied the results of the experiments to the regular routine operation of the Plainfield sewage-works.

In the accompanying diagram the results obtained by drying alum-treated sludge during April, May and part of June, 1923, are compared with the results of drying untreated sludge during the same months of 1919, 1920 and 1922 (1921 is omitted because repairs to the concrete of the sludge channel in that year interefered with drying during this period). The treated sludge dried in approximately half the time required for untreated sludge. Alum to the amount of 3 lb. per cubic yard of sludge increased the acidity to pH 5.4 to 5.7, the original pH values being 7.4 to 7.6. Larger amounts of alum will give still shorter drying periods, but in view of the fact that with even the smallest amounts rapid drying is secured, we feel that no great advantage is gained by shortening the drying periods by one or two days at a much higher cost. It is apparent that the dose is not very critical within a wide range and operators could readily

cracks within five hours. As with untreated sludge, best drying results are obtained by keeping the original thickness on the bed down to 9 or 10 inches.

The improved results of treatment since May 22 are due to a more thorough appreciation of the fact that the agitation should be kept down to a minimum and the dose applied as close to the drying bed as possible.

Laboratory work at the sewage substation, which will be extended and reported separately, later has furnished some explanation of the favorable results obtained by minimum agitation and has indicated that this minimum is so low that it has apparently escaped the notice of other observers. A second optimum condition of flocculation can be obtained, but only with an unwarranted excess of energy and alum.

Progress in Development of Non-Corrosive Steels

Great strides in the development of non-corrosive steels may be expected during the next few years in the opinion of Dr. G. K. Burgess, director of the Bureau of Standards. The waste represented by the corrosion of steel is so great that its prevention by the development of these special steels constitutes, in his opinion, one of the most important present-day trends in the steel industry.

Federal Land Reclamation: A National Problem

6. Difficulties and Complaints of the Farmer

The Sixth of a Series of Articles on the History and Performance of the Great Government Adventure in Irrigation of the Arid Lands of the West.

By H. H. BROOK
President, Elephant Butte Irrigation District, Las Cruces, N. M.

THE SUCCESS of the federal reclamation projects does not depend primarily upon perfect engineering, or upon rules of farming, or terms and regulations laid down in Washington. Success will depend upon the ability of the average settler to overcome the trials of creating wealth and making a home where nature never intended there should be one.

The building of a dam or a canal is a comparatively easy problem, rules for which can be found in scores of handbooks, but there is no formula for welding thousands of diverse human factors into a prosperous happy community.

Considering that the settler is the one who will pay the bills, his voice is relatively small and weak in the battle of words that is now taking place. Possibly there would be less complaint and more success if his advice and counsel were solicited. By training and habit he is not a speaker or a propagandist. He has, however, great powers of resistance. The great majority are united in the belief that they cannot meet payments twice what they expected when they signed their contracts, without disaster to at least three-fourths of the present settlers. Assuming that the doubled costs are perfectly legitimate and necessary, the settler should not be called upon to pay them in the same time he agreed to pay one-half as much. If it was not wrong for the Reclamation Service to have underestimated by one-half the work necessary, it is not wrong for the settler to ask for a longer time to pay this increased cost. The settlers as a whole do not want to avoid or repudiate payment.

Private and Federal Irrigation Contrasted—Business men and corporations weigh their possible earnings very cautiously before making large expenditures for fixed investments. Every promoter of private or corporate irrigation enterprises realizes every minute that the success of his project depends on the ability of the farmer to make enough money for the living of his family and the upbuilding of his farm. Consequently, every cent is expended *with a view to the ability of the farmer to pay.* The contrast of the reclamation project procedure is striking. Here the spending is done without any direct connection or relation between the earning capacity or the success of the enterprise as a whole. Well constructed engineering works do not insure success. The financial caution that animates every private enterprise is very remote.

While the Service contains a splendid body of loyal conscientious employees, and in most instances we are proud of their work, nevertheless it cannot be asserted that they are not fully conscious of this irresponsibility for the ultimate success of their work, and the mighty power of the government that protects them, and cloaks their mistakes. Generally speaking, they have no farm experience and no sympathetic understanding of the farmer's problems. Most of the criticism of their work comes from the farmers. Unless extreme precautions are taken a spirit of bitter enmity and disrespect for the farmers arises and influences their work. They are only human and the system of government work encourages these conditions.

A concrete example of the results of this lack of relation between the earning and the spending agencies is in the Rincon Valley of the Rio Grande project. The Rio Grande project cost has been announced as \$90 per acre for all lands. In the Rincon Valley over \$100 has already been spent, and \$35 more per acre must be spent before the lands can be farmed, making a total cost of \$135 per acre. This is \$45 more than each acre will pay—the deficit being assessed against all other lands of the project. Much of the land in this valley will never be worth \$135 per acre and it will be many, many years before any substantial part of the lands are worth that amount. It is a long narrow valley requiring many expensive river crossings and the works are menaced by arroyos in many places. There is no reason why the engineering difficulties and costs could not have been as well estimated ten years ago, before the work started, as today. With advance knowledge of these costs, the landowners certainly would never have approved the work on the present plan. Trusting in the government, they did not know what the cost would be until it was too late to stop.

Reclamation Service Secretive—This cause of ill feeling is further aggravated by a lack of frankness and free exchange of information between the Service and the farmer. Due perhaps to much unjust criticism in the past the Service has become pretty much of a close corporation. The system of accounting is not such as inspires any degree of confidence. Unnecessarily intricate and confusing, the farmer looks upon it as an instrument for his undoing. In general the farmer is only given such information as is considered good for him. Of course, any information specifically called for is always furnished but only so much and no more. Very often information is gathered at the farmer's expense for the specific purpose of refuting and bringing confusion upon him when he attempts to complain. Rightly or wrongly the farmer very soon reaches the conclusion that the power and resources of the department are leagued against him. There is not, as a general rule, that friendly feeling of co-operation, good will and sincere desire to help, that should rightly prevail between parties whose interests should be mutual, if not paternal.

These conditions—avoiding responsibility, lack of candor and secretiveness—which have caused so much trouble, have been relieved on the Rio Grande project in recent years by a policy of greater co-operation and mutual understanding between the project manager and the official representatives of the farmers. The project manager refers all major policies and construction fea-

tures to the farmer's representatives, who are allowed to discuss and pass upon them, thus dividing responsibility for the success or failure of this particular matter. In earlier days, and even yet on many projects, the farmers are allowed no voice in the manner and policy of the work after the contract is signed. Often the farmer's advice is found valuable, his experience prevents mistakes, and his backing changes to approval what would otherwise be resented and condemned. Long experience with project farmers proves that the majority are generally fair, reasonable and sound. If taken into confidence by a studied policy of consistent project publicity, telling them fully the whys, wherefores and costs of each thing, admitting the mistakes and calling attention to successes in a simple, clear, frank and open manner, they would be found on the right side in practically every instance. The theory that silence reduces the amount of trouble stirred up is a fallacy. The farmer is an extremely suspicious individual but a staunch friend when once his confidence is won.

Farmers Not Incompetent—From articles and discussions of various reclamation enthusiasts, concurred in to considerable extent by the bureau heads, the average person would gather the impression that the greatest part of the financial difficulties on reclamation projects was due to *incompetent* settlers. Not only is this fundamentally untrue but it is such a specious line of reasoning, so constantly reiterated, and so harmful to the splendid work of reclamation that something must be said about it from the farmer's viewpoint. Our reclamation theorist, with naïve ingenuousness, loudly proclaims that the reason his theory hasn't worked is, forsooth, because the settler isn't competent. Wonderfully convenient idea, and so simple and plausible! But have any facts been produced to prove it? None that we have ever seen in many years on the projects.

The accepted axiom that it has taken three failures to make one success on the reclamation projects does not *ipso facto* prove that the three failures were incompetents. It might as easily prove, what nearly all the actual settlers contend, that the building of a modern community out of the desert in defiance of nature, and the payment in twenty years of vast irrigation works beyond the scope of private capital, is a burden beyond the ability of the average good farmer to carry.

It is true that there are incompetents and drifters on all our projects, but in no greater proportion than in any other western occupation. Even the Reclamation Service has its incompetents, and probably in as great proportion. As a class, the men that go upon our western projects are not incompetent. They are of the same pioneer stock that has made our western country great—the class that in a few decades has built the country of which we are wont to boast.

It is urged that the settlers on federal reclamation projects be selected for their fitness. If the law of averages must be eliminated, is it not a confession that the terms are too severe? Are we to have an example of the "law of the survival of the fittest" administered by some bureaucrat instead of by nature?

Drainage Losses—A dilatory policy with regard to drainage has been the source of an inconceivable amount of financial difficulty on many of the projects. Losses from seepage were allowed to occur, often aggregating more than the total cost of the project. Many farmers lost their holdings and the savings of a lifetime. All of them have been so crippled financially that it will take many years of fair returns to recover any large ability to pay. The excuse offered by the Reclamation Service is that the farmers would not vote to approve the cost of drainage. This is true, but, while on the face it seems a valid excuse, upon analysis it is found superficial and unsound.

It cannot be denied that the engineers of the Service were charged with all the responsibility of laying out and estimating the needs of a project and its cost. Theirs was the technical knowledge, and their recommendations were final. The impression was given that a fatherly government would call in its wisest men, devise the best system and the farmer need have no fear or suspicion. The farmer was allowed no voice in planning and, admitting his ignorance, relied upon the federal engineers' assurance of an adequate system and a properly estimated cost. Very soon it became apparent that the irrigation works were going to exceed the estimated cost. The farmer saw evidences of mistakes, experimentation, and what appeared to be lavishness, that shook his faith and confidence. Few of the farmers realized the danger of seepage, and before this danger was fully apparent he was asked to sign a new contract for a greatly increased cost to cover drainage. True to every natural and human instinct, and not realizing perhaps that he was trapped, he rebelled and refused to sign.

In the first place, there is no possible excuse for the government engineers not knowing the necessity for, and providing for, drainage in the original estimates. It was discussed but no allowance was made, because (it is weakly contended) it could not be determined whether it would be needed or not. On the Rio Grande project, at least, the noted English engineer, Sir William Willcox, warned the government of its error in unmistakable terms before the project was even begun. In the second place, having for one reason or another overlooked this obvious duty and responsibility, a more aggressive policy should have been pursued to remedy the pending tragedy. What was actually done was to sit back and say in effect, "Sign on our terms or drown, your sins are on your own heads." The Service has often exercised arbitrary power in less important matters and having, as they contended, a contract for the payment of the actual cost no matter what it might be, why couldn't they have arbitrarily insisted upon drainage?

Furthermore, realizing full well the pending tragedy, and if the signing of a new contract was an absolute necessity, what was there to prevent an intensive publicity and educational campaign early in the development? The government could well have afforded to spend thousands of dollars in such educational work. A few formal warnings were issued, but it remained for the farmers to organize such an educational campaign after the damage was done.

The Government Benefits—As to benefits: bearing in mind that no agricultural development is possible in the arid states without irrigation, and that such development is vital to public progress, which is recognized in the extraordinary powers granted to irrigation districts, is it not clear that the chief and primary beneficiaries of irrigation development are the nation, state, county and cities? These institutions are perpetual, the individual is transitory. The individual

hopes to make a profit, and occasionally does, but the nation, state, county and city inevitably profit in perpetuity both on the improvements and production. The nation's meat supply, the vast cattle and sheep breeding ranges, are protected from the scourge of periodic drouths. The cities and towns in most instances in the arid section are largely dependent for their prosperity upon the production of the irrigated lands.

The original plan of the Reclamation Act was to finance those projects which are beyond the scope of private interest-bearing capital. The avowed purpose was the establishment of contented rural homes, but this idea is first predicated upon national welfare in the recognized advantages of a home-owning agrarian population and the increase of taxable wealth.

Federal aid alone, as given by the reclamation law, does not accomplish this aim. It requires the extremely hazardous co-operation of some venturesome individual with an abundance of brains, money and energy. It is an axiom of the irrigated West that every success is built upon the cumulated efforts of three failures. To successfully create a prosperous farm from the desert, even with federal aid, is a vastly more hazardous job and requires a higher and more able type of citizen than it took to develop the free homestead lands of the Middle West.

Pioneering Unprofitable—The up-building of the country, as recited, is a necessary adjunct to profitable farming and must be done during or before the farmer can be expected to pay for irrigation works. In the meantime, he must house, feed, clothe and educate himself, his wife and children. Does it seem reasonable or feasible? Can anyone assert that the pioneer farmer has even an infinitesimal chance of profiting in proportion to the government? The farmer takes all the risk and experience shows that a very large majority of the pioneers lose. Except for gross mistakes, the government takes no risk and can't lose.

Since the benefits of increasing farm homes and national wealth are unquestionable, and the works are not private, but public, to be enjoyed by the nation for all time, what sound reason is there for not extending the time or repayment to a point where the purpose of contented homes and increasing national wealth can be accomplished without a trail of discontent, hardships, failure and tragedy?

The conclusion should not be drawn from this article that reclamation is a failure—far from it. The development of our natural resources through reclamation is the best and most profitable investment the government has made or can make. Every dollar invested has already returned manyfold in national wealth. These facts need not be repeated.

The Reclamation Service has unquestionably been one of the best administered bureaus of the government with no taint of politics, graft or intentional wrong. Compared with the public management of our roads, schools, counties, municipalities and other corporate large scale irrigation systems, the Reclamation Service has done fully as well as, if not better than, the people would have done under their own management. In fact, it is vital in some instances to have an organization in charge that is not influenced in the least by local prejudices, habits or politics. This article attempts to give the farmer's close intimate views of some of the causes of the complaint and criticism arising on the projects

Protecting Highway Bridges From Colliding Vehicles

Destruction of Bridges by Collisions Becoming More Frequent—Skid Beams, High Curbs and Traffic Guides Advised

BY E. F. KELLEY

Senior Highway Bridge Engineer, Bureau of Public Roads, Washington, D. C.

IN LESS than two years *Engineering News-Record* has published accounts of the destruction of four steel truss bridges by motor vehicles which collided with the truss members. The last three of these accidents occurred within eight months. Doubtless other accidents of a similar nature have occurred which have not been reported in the technical press, and the writer knows of one such case in which the end post of a truss was wrecked by a truck, although the complete failure of the structure did not ensue.

The situation is grave, as has been pointed out editorially, and it promises to become more serious as time goes on. With ever-increasing speed and density of traffic, such accidents will doubtless occur in ever-increasing number. Therefore the problem of the adequate protection of bridge structures, particularly steel trusses, from injury or total destruction by motor vehicles merits the careful consideration of every engineer interested in the construction or maintenance of highway bridges. The problem is not a simple one, involving as it does not only development of suitable structural details but also the important item of additional expense.

DAMAGED HIP VERTICAL
Showing absence of adequate protection.

From the reports of accidents it is evident that not only the end posts but also the entire web system must be afforded protection. End posts may be adequately protected from vehicles approaching the bridge by massive masonry posts, but protection of either end posts or web system from vehicles on the structure or leaving it is not so simple.

Skid Beams—In a letter published in *Engineering News-Record* of Jan. 18, 1923, p. 131, is found the suggestion that the trusses be protected by skid-beams such as are in use on railway bridges. Undoubtedly this would be a step in the right direction. Such members, if of sufficient strength and properly placed, would give much better insurance against accident than is now usually afforded. However, their appearance and cost might cause some objection to their use, and they would also involve some rather difficult details.

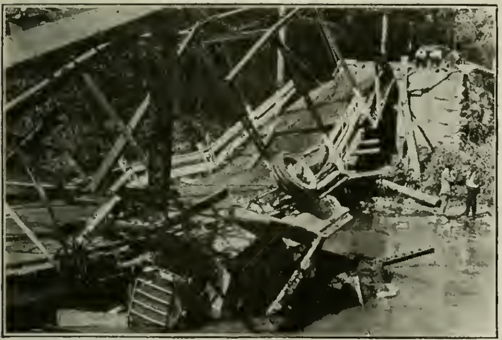
For the most effective protection, the beam supports should be independent of the truss members. Several lines would be necessary, for the truss must be protected not only from fenders and hubs but also from overhanging bodies, and this would necessitate that the

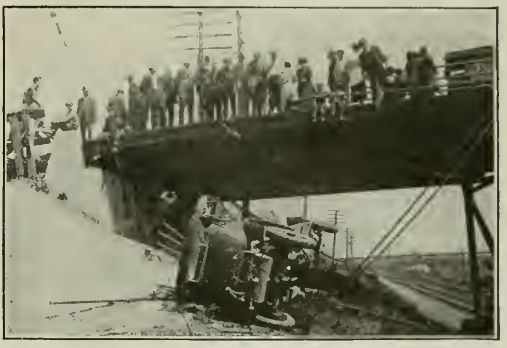
top beams be placed at some considerable distance above the bridge floor, which might mar the appearance of the structure. Also the beams would necessarily be of greater strength in proportion to the weight of the traffic units than in the case of railway bridges; for, on a highway bridge wide enough for two lines of traffic it is entirely possible that a vehicle may strike the rail almost head-on. The cost of providing steel rails that would stop a charging truck would seem to be prohibitive.

Protection by Curbs—The suggestion that the necessary protection be afforded by adequate curbs seems to offer the most satisfactory solution which has been advanced. But here again we are confronted with questions of appearance and cost, as well as with the fact that the necessary curb construction will scarcely be feasible on bridges not floored with concrete.

Curbs which will stop a car must be at least as high as the center of the wheels. This means a minimum curb height of 15 in. with 18, 20 and even 24 in. required for the larger vehicles; a curb 18 to 20 in. high will provide for the greater portion of traffic. From the standpoint of cost the curb width, or the distance from the face of curb to the clearance line of truss, is more important than is the curb height. The lack of standardization of truck bodies leads to a great variation in the amount of overhang, which may be as much as 30 in., possibly more in extreme cases. However, it is not practical, nor is it necessary, to provide for such extreme conditions. Based on information supplied by truck manufacturers, the conclusion is reached that a minimum distance of 12 in. from face of curb to clearance line of truss will be sufficient to provide for at least 95 per cent of motor vehicle traffic. This conclusion is given some added weight by the regulatory state laws governing widths of truck bodies, although too great dependence cannot be placed on legal requirements, as frequently they are not enforced and in any case they may be revised or repealed at any time.

Such curb heights as are suggested here may be a shock to our conventional ideas of appearance. Again, the extra curb width will add to the cost of the structure by requiring that the trusses be placed farther apart to give the same width of roadway between curbs.





TWO TYPICAL BRIDGE ACCIDENTS DUE TO MOTOR VEHICLES NOT HOLDING THE ROAD

At left: Wreck of bridge over Little Patuxent River near Savage, Md., two years ago; in spite of signs warning that the roadway was too narrow for two vehicles, a passenger car and a truck tried to cross at the same time, with the result that the web system of the trusses was knocked out.

At right: A recent accident near Alexandria, Va. The car was going at high speed, the approach to the bridge is a sharp curve, and the car failed to make the curve. As the structure is of deck type, the car merely went overside; a through truss bridge would have been wrecked.

It is to be noted that by flaring the ends of such curbs and extending them out onto the approach fill or pavement at the end of the bridge, the end posts of the bridge may be protected from approaching vehicles.

Traffic Guides—In addition to the positive protection of the structure by mechanical means much may be accomplished by means of traffic guides, especially those which are effective at night. Marking traffic lanes by lines painted on the roadway surface has proven most effective on pavements, and it should be equally effective on bridges. Painting the handrails a light color, which is practiced in some localities, also adds to the insurance against collision.

Public Safety—Of equal or greater importance than the protection of the structure from injury or destruction is the protection of the traveling public. For a number of years the Iowa Highway Commission has kept a record of accidents of all kinds which occur on the highways of the state. The commission's *Service Bulletin* reports that 58 automobiles went through bridge railings in 1921, while 64 similar accidents occurred in 1922, with a total of 130 persons injured in the two years. This is the record for one state of the forty-eight. Does not the situation demand a remedy? On through truss bridges the protection which will safeguard the structure will also safeguard traffic. On other structures substantial curbs or railings are necessary.

In some states it is the practice to insure an adequate width of approach fill at the end of the bridge by building flaring abutment wing walls with horizontal tops for a portion of their length. On this horizontal portion is constructed a substantial rail of concrete or other material in keeping with the structure, and the fill is maintained at roadway level to the end of the rail. The wing rail and the added width of approach fill increase the safety of vehicles by affording actual protection from accident, while the rail increases the visibility of the bridge and gives it an improved and finished appearance.

The above discussion is presented to emphasize the facts and opinions which have already been published, in the hope of arousing engineers to the need for a most serious consideration of the situation, to the end that our bridge investment may be safeguarded.

Present-Day Street and Pavement Practice for Cities

A.S.M.I. Discussion Recommends Increase of Radius and Widening of Curves—New Penetration Requirements

Abstract of Report of Committee on Street and Highway Design, presented at convention of the American Society of Municipal Improvements, November, 1923: E. R. Conant, chairman, P. L. Brockway, S. Q. Cannon, H. E. Barnes; together with papers on details of street and highway design.

Report of Committee on Street and Highway Design

THAT municipal and other engineers are recognizing the advantage of long radius corners is shown by the replies received to our questionnaire sent to many cities. Hartford, Conn., reports changing from 6 ft. to 12 and 15 ft. and states that a great improvement is noticeable with this change. Waterloo, Iowa, which formerly used 10 ft., changed a few years ago to 15 ft., and this year changed some dozen street intersections to 30 ft. Toronto, Canada, had originally 12 ft., then changed to 18 ft. and now has adopted 25 ft. Los Angeles reports that it uses a radius at curb returns equal to the width between the curb and property line, except where the distance on both streets is 15 ft. or more. In such cases the radius is made 5 ft. greater than this distance.

At Muskogee, Okla., the narrower streets are given the greater radii: 24- to 30-ft. streets have radii at corners of 12 to 15 ft., while for 30 ft. or over, a 10-ft. radius is used. Pawtucket, R. I., is increasing the radius from 15 to 25 ft. and Davenport, Iowa, 10 to 15 ft., Cheyenne, Wyo., new pavements are 18 ft. Other cities report adopting radii of from 10 to 225 ft.

Elimination of Catch Basins—There is a decided tendency towards eliminating catch basins and connecting the inlets direct to sewers or storm-water conduits and especially is this done where there are adequate-sized storm sewers with good slopes.

An unusual method of disposing of storm-water drainage is reported from Phoenix, Ariz. No storm-water sewers have been constructed. Walls of 6 ft. internal diameter are sunk to water bearing sand, usually 20 and sometimes 30 ft. below the surface. Brick is used for lining, laid open 6 ft. down from the top. With proper inlets into the wells, it is reported that satisfactory results are attained, the water-bearing sand taking away the discharge. Each well serves about 45,000 sq.ft.

Special Curb and Gutter Construction—An innovation in curb cross-section is being introduced which appears practical and beneficial. We all know that automobile and truck tires are often injured by grinding against the vertical rough stone curb. A few cities are adopting a curb with a batter on the gutter side and again this batter is sometimes merged with the gutter and the gutter and curb formed with a curved face. Jacksonville, Fla.; Shreveport, La.; Salt Lake City; Phoenix, Ariz.; Sacramento and Hartford are introducing this method to a greater or less extent. Quite a number of cities having bituminous pavements are introducing a gutter 4½ to 6 ft. wide, built of concrete brick or hard surface, which will not be affected by gasoline or oil drippings from automobiles or trucks. Boisé, Idaho; Muskogee, Okla.; Sacramento and St. Louis report this improvement.

Changes in Penetration Pavement Construction—The penetration limits for asphalt used in asphaltic pavements are being decidedly reduced, according to information received from a large number of cities. Also quite a few report using additional amount of dust. The changes bring about a harder mixture preventing pushing under traffic.

Information received from many engineers shows that they are increasing the concrete base thickness and, in some instances, increasing the thickness of the wearing surface. Peoria, Wichita, Davenport, Oak Park, St. Louis, Tulsa, Sioux City, Pontiac, Oklahoma City and New Orleans report increase of depth of base of about 1 in. The average adopted for heavy traffic is from 7 to 9 in.; medium, 8 to 7 in.; light, 5 to 6 inches.

Cost-Plus—George A. Carpenter, city engineer of Pawtucket, R. I., reports a rather unusual method of making payment, under the cost-plus basis. The paving done amounts to about $300,000 per year and is contracted for and paid on the cost-plus basis. Before the contract is made, a fair estimate of the cost per square yard is agreed upon and the contractor is to be paid the actual cost, plus 15 per cent upon the estimated cost, if the final cost does not exceed this sum. If the final cost does exceed this sum, he is to pay all such excess cost, until his percentage of profit is reduced to 10 per cent, as figured upon the estimated cost per square yard. Beyond this point of reduction, the city will pay the extra cost. Should the contractor succeed in laying this pavement for less than the estimated cost, he will receive 15 per cent upon such estimated cost and one-half of the saving he will have made to the city.

* * *

Curve Widening

By G. A. Crayton
Springfield, Ill.

HIGHWAY curves, if sufficiently sharp, should be widened. There appears to be very little agreement in the practice of the several states in this country; which is shown graphically in Fig. 1. One state will widen a maximum of 8 ft. and others no more than 3 ft. The greatest

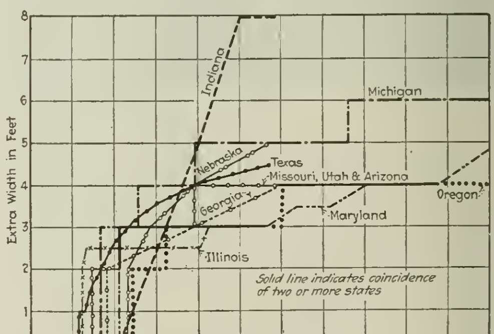


FIG. 1—HIGHWAY CURVE WIDENING PRACTICE

variation of opinion seems to be on curves of from 6 to 12 deg. It is the purpose of this paper to develop a method of widening that will be sufficiently flexible to meet all reasonable conditions.

It is a well-known fact that, when traversing a curve, the rear wheels of a vehicle will track inside of the leading wheels. Except in case of trailers built to track, each pair of wheels in a train will continue to track inside of those ahead of them. This, in the judgment of the writer, is the only logical reason for the practice of widening curves.

To develop a method for determining the necessary amount, it is first essential to determine the kind, general dimensions and construction of the motor truck and its trailers. As a rule, the longer trains will use "tracking" trailers. Our formula should, however, take account of the worst possible case, that of a motor truck of long wheel-base drawing a train of ordinary farm wagons. To make a few assumptions: (1) that there will be no side slip of the wheels; (2) that the path described by each pair of wheels

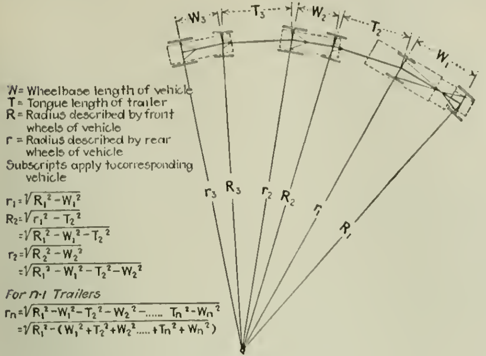


FIG. 2—CONDITIONS AFFECTING FORMULA FOR WIDENING CURVES

is an arc of a circle, after equilibrium has been established; (3) that the center of the curve will be the common center of all paths; (4) that the front axle of each trailer is at right angles to its tongue; (5) that each rear axle is at right angles to its reach. While all of these are not strictly true, it is believed that the approximation is sufficiently accurate. The conditions as outlined will result in the formula as shown in Fig. 2.

To secure some specific figures, assume a truck with a wheel-base of 144 in. and from one to five trailers, each being an ordinary farm wagon having a wheel-base of 7 ft. and a tongue length of 13 ft. Working out values on this basis, values of difference of track are obtained as shown in Fig. 3.

At last year's convention of this society, it was recommended by the Sub-Committee on Sidewalks and Street Design that in general the width of the roadway should be based upon a certain number of lanes of traffic and that a definite width should be allowed for each base. We will apply this principle to the case in hand, and assume that track difference constitutes the reason for widening. Highways of sufficient importance to warrant widening should be designed for a minimum of two traffic lanes. Each of these lanes should have applied the track difference as its extra width or a two-lane road should be widened double the tracking difference.

A better method of application is on a percentage basis.

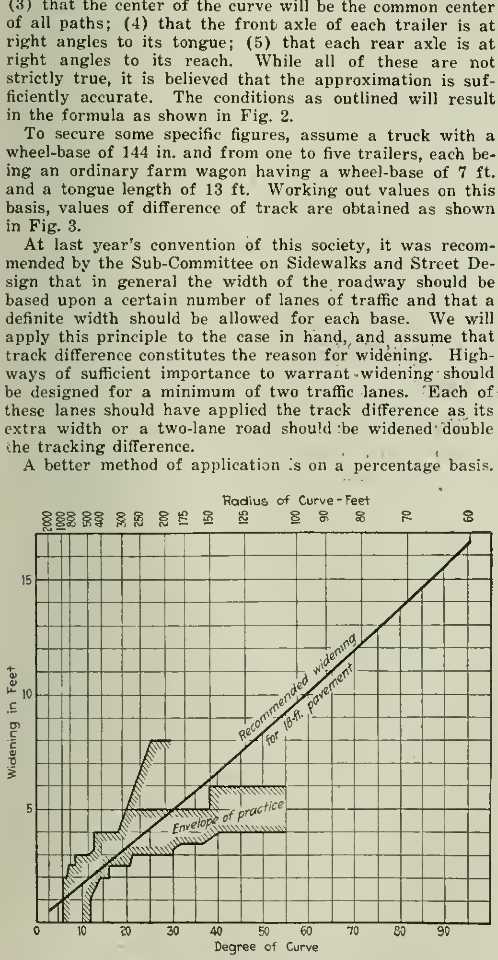


FIG. 3—RECOMMENDED WIDENING FOR 18-FT. PAVEMENT COMPARED WITH PRACTICE SHOWN IN FIG. 1

The usual over-all width of a vehicle is 5½ ft., which requires in usual practice a 9-ft. traffic lane; then if a given set of conditions of a curve and vehicles cause a track difference of 1 ft., the "effective" width of the vehicle and train together is 6½ ft., and the width necessary for its traffic lane will be expressed by (9 × 6.5) ÷ 5.5, in feet, or since two traffic lanes are under consideration, the total width of the curve would be (2 × 9 × 6.5) ÷ 5.5, or 21.27 ft., in which case the widening is 3.27 ft. This allows the same proportion of extra width in the strip between the vehicles as required by the vehicles themselves.

That we may compare the results by this method with current practice, Fig. 3 shows by curve the extra width required on the basis of a truck with two trailers on an 18-ft. pavement, the shaded area representing the "envelope" of practice shown in Fig. 1. It will be noted that in general the state requires more width than necessary on flat curves and less than required on the sharp ones. Or, expressed differently, the recommended curve is nearly a straight line, while nearly all of the practice curves are decidedly concave downward.

* * *

Some Details in Street Design

By P. L. Brockway
Wichita, Kan.

SOME engineers have thought that it should be possible to retain the very excellent qualities of the standard sheet asphalt wearing surface, and yet increase its resistance to internal flow, by adding larger, angular aggregate up to material passing a ⅜-in. screen without any other modification of the mixture. A surface was constructed along these lines four years ago, on a brick surface which had been practically destroyed by the concentrated heavy traffic leading to two ice and cold storage plants, a large planing mill and a freight depot. Asphaltic cement having a penetration of about 45 was used. It had to be made specially for this contract at that time but it is now a standard product of the company from which it was purchased. There was used about half as much material over the ¼-in. and through the ⅜-in. screen as would ordinarily be specified in the fine aggregate asphaltic concrete mixtures. Street temperatures ranging from about 0 to 125 deg. F. have been observed with standardized thermomoters many times, the maximum being 137 deg.

Traffic counts indicate an average of 600 trucks daily or about 200 tons per foot width. In addition heavy reconstruction of some of the plants has caused some very heavy loads of machinery to pass over it and heavy, vibrating construction machinery to stand in one place for weeks at a time. The pavement marks up some in extreme hot weather but has not yet developed any waves or general unevenness of surface. The same mixture has since been used on several other of our heavier traffic business streets having traffic counts up to 10,000 vehicles per day and only one serious wave was developed. That where a 4-in. wearing surface had been laid to even up over the old pavement.

Another point in the construction of soft top pavement which is more pertinent than formerly is the degree of roughness of the base course on which the surface is laid. Many old pavements which were laid with rock aggregate so coarse that it was practically impossible to get an even contour, to say nothing of a smooth surface, are holding their own pretty well even under the punishment of greatly increased traffic. Other base laid with greater care in later years, and especially base laid without coarse aggregate having fairly smooth surface texture, has not fared so well. Examination shows that spots which give the greatest trouble from shoving of the wearing surface are above unusually smooth places on the concrete base. There was, therefore, developed a plan of artificially roughening the surface by marking across the base at intervals of about 18 in. by striking it with an inch rope when the concrete is still soft enough to be readily cut by the rough rope. The marks are made about ½-in. deep. This method has not been in use long enough to prove its merit but there is no ques-

tion that roughening of some kind will be an advantage.

A very troublesome kind of traffic to handle in cities in the agricultural territory is tractors loaded up to 15 tons and having deep lugs or cleats on the driving wheels. Concrete, brick and standard asphalt surfaces all fail alike under such abuse. Many places cannot afford granite blocks. Most cities, of course, try to concentrate this traffic on one or two streets.

It had been surfaced with penetration macadam some years earlier and, while it was not worn through, the surface was very badly pitted. The remaining patches of the surface were loosened and spread over the well compacted sand fill macadam. The new wearing surface was what might be called a plant mixed macadam. It was composed of limestone from 1 in. down, with all the dust and screenings retained. Screen analysis showed that it contained from 5 to 8 per cent of 200-mesh clean limestone dust. The specifications required that sufficient asphaltic cement having a penetration of 90 to 100 be added to thoroughly coat all particles and then about 0.5 per cent more be used and that it be mixed hot in a standard pug mixer. About 6½ per cent asphalt concrete was used rolled hot to a thickness of about 2 in. The texture of the rolled surface was quite porous because of the excess of large aggregate. On this was placed a squeegee coat of the same hot mix, running about 4 lb. per square yard. Hot, coarse sand was immediately spread over the whole surface and thoroughly rolled.

The objective was to obtain a mixture with an excess of plastic asphalt concrete which would rebond the surface material as often as it was displaced by the chopping action of tractor lugs. Over 20 lb. per yard was used. This surface has now been in use two years and, while there was some dissatisfaction the first year because some of the material would occasionally stick to an especially heavy wheel, it has proven so satisfactory the second season and is holding its contour and surface so well, that the tractor operators recently held an indignation meeting because the same material was not used on a main thoroughfare which they must occasionally use.

Another detail in pavement design which has proven very successful is the use of creosoted wood of 2-in. commercial thickness set with the grain vertical in transverse contraction or expansion joints in concrete pavement. Such joints have been in use twelve years without a single failure without costing anything for maintenance and without the objectionable lump which so often develops.

* * *

Modern Construction of Brick Pavements

By Will P. Blair
Vice-President, National Paving Brick Manufacturers' Association, Cleveland, Ohio

The manufacturers of vitrified brick, through the Western Paving Brick Manufacturers' Association, now advocate an asphalt in place of the portland cement filler for joints previously urged. This filler is a certain refined asphalt, which has the quality of maintaining its place in the brick joints, under extreme high temperature and does not become rigid and fragile under the influences of low temperature. The new filler affords such flexibility that the forces operating with an upward thrust against the brick surface [due to expansion of subgrade due to saturation or other causes] have little injurious effect. This filler protects the edges of the brick equally as well as the cement filler.

Important details subject to neglect and oversight are: (1) The stabilization of the subgrade by reducing to a minimum the possible moisture content, (2) the smoothness of the artificial base, (3) the uniform compression of the sand bed upon which the brick are placed. Unless compressed, the brick wearing surface will ultimately conform to any unevenness of the base surface. This requirement can only be accomplished by using a hand roller and filling the depressions noticed after each rolling. Three to four repetitions are necessary to accomplish the desired result.

Forecast of Railroad Situation in 1933

In order to check its estimates of the probable traffic increase in the next ten years and also to establish a practical basis for estimating the increase in railway facilities and the additional investment in railroads that would be needed in order to handle the increased business, the U. S. Chamber of Commerce Committee on Governmental Relations to Railroad Transportation sent a questionnaire to each of the Class 1 railroads asking them to check its estimates of the increase in traffic, and to state what physical facilities they would require to handle this new business. Sixty-two railway companies operating 166,810 miles of line, or 64.6 per cent of the total mileage in the United States, sent in replies which agree substantially with the committee's estimate that there will be an increase in passenger traffic of about 25 per cent and that there will be an increase of 33⅓ per cent in the ton-miles of freight. The results of these computations indicate that the railways of the country as a whole, in order to handle the increased traffic, will need to make the following increases in their physical facilities within the next ten years:

	Miles
First main track	5,950
Other main track	11,400
Yard and sidetracks	21,000
Total, all tracks	38,350
Locomotives	13,200
Freight cars	725,000
Passenger cars	12,300

Using present prices as a basis for estimating the cost of this new work and additional equipment, the capital requirements will be as follows:

Additions	$5,339,874,000
Improvements	2,533,103,000
	$7,872,977,000

This figure takes no account of the capital required for grade crossing elimination, automatic train control, and other safety provisions which will be, or already are, mandatory.

Westinghouse Brake for European Railways

The adoption of the Westinghouse brake by the railways of continental Europe has been recommended by the International Railway Commission (see *Engineering News-Record*, May 17, 1923, p. 871) and also by a commission which met recently at Paris as representative of the allied powers. The treaty of Versailles provided that Germany should equip its railway rolling stock with appliances facilitating the interchange of cars with the railways of the allied countries and these powers were to select a type of uniform continuous brake within ten years. The only other compressed-air brake considered was the Bozic which is used to some extent in Serbia. Choice of the Westinghouse does not involve its exclusive adoption, since any other system of compressed-air brake that can be coupled with and operated with the Westinghouse will be admitted in international traffic. Financial conditions may delay rapid introduction of the uniform brake, especially as Germany has made extensive use of the Kunze-Knorr brake since the war. The Paris correspondent of the *Railway Gazette*, London, ends a dispatch on the recent decision as follows: "In France we are not likely to see freight trains equipped with the continuous brake for many years, apart from those which were handed over by the American army and which have been the best advertisement of the Westinghouse brake that could have been desired."

South and West Unite to Promote Extension of Reclamation

Forestry, Reclamation and Home-Making Conference at New Orleans Discusses Reclamation Problems of the South

Engineering News-Record Staff Report

TWO HUNDRED men, largely from the South and Southwest, but with a goodly number from Utah, Idaho, Arizona, and California, met at New Orleans, Nov. 19-22 in answer to a call made by C. S. Ucker of Savannah, Ga., A. G. T. Moore and Walter Parker of New Orleans, F. H. Newell of Washington and others, to attend a Forestry, Reclamation and Home-Making Conference, under the auspices of the Southern Pine Association, the Florida and Mississippi Development Board and the New Orleans Association of Commerce.

Perhaps the most notable feature of the meeting was the spirit of co-operation shown between the South and the West, as evidenced by the remarks on the convention floor, corridor talks and a telegraphic exchange of resolutions between the Western Reclamation Association and the conference, all bearing on extension of reclamation to include cut-over, swamp and overflowed lands, chiefly in the South. Land colonization, the problems of the settlers, the revision of the present Reclamation Act and a variety of other topics were considered. A number of resolutions on future reclamation policy were adopted.

Permanent Organization—The conference appointed an executive committee with power to formulate a plan for permanent organization. Among its members are: Chairman, Clement S. Ucker, president, Southern Settlement and Development Organization; F. H. Newell, consulting engineer, U. S. Reclamation Service; and U. S. Senator William B. Bankhead of Alabama. It was voted to request the delegates to hold conferences in each state, Virginia to Texas. It was announced that the committee would take steps to form a Southern Reclamation Association and that the permanent organization would act as a clearing house for the association just named and others as well.

Co-operation Between West and South—All through the conference, stress was laid on co-operation between the West and South in furthering reclamation. Repeatedly it was asserted that the Reclamation Act of 1902 owed its passage to Southern votes, under the leadership of Senator Underwood and Congressman (now Senator) Bankhead of Alabama. This was attested to by men at the conference from both West and South, who said that it was the understanding, in 1902, that when the South called for federal aid in reclaiming swamp and cut-over lands the West would respond. Mr. Ucker of Savannah added that all the southern States, except the two Carolinas, Virginia and Georgia, had had public land and that such still exists in Florida, Alabama and Louisana, where federal land offices are maintained. As representing the viewpoint of a westerner, it may be noted that in an interview during the conference, Congressman Addison T. Smith, of Idaho, chairman of the House committee on Irrigation and author of the Smith-Fletcher and the Smith-McNary bills, stated that there is no reason why the South cannot benefit in the same way as the West through federal aid, *"to be repaid of course, by the communities assisted."* The swamp and marsh lands of the South he added, will be highly productive when placed under cultivation, and the South is entitled to assistance in solving this big problem.

Interest on Reclamation—The italicized quotation reflects on the desire in some Western quarters to get rid of the obligation to pay for the cost of irrigation works incurred by settlers when they took up land on the reclamation projects. The revolving fund which was to be formed by these payments has "stopped revolving," as Mr. Ucker said. Significant, also, in view of the absence of interest charges against Reclamation Service settlers was Senator Bankhead's statement that in the future no federal aid to reclamation ought to be given without interest charges to the beneficiary equal to what the government itself has to pay. George H. Maxwell and others also urged payment of interest on future reclamation loans.

Claims of the South—Speaking of the Western promises of 1902 to aid the South when called on, Col. Joseph Hyde Pratt, of North Carolina, said that only within the past two years has the South begun to be interested in reclamation, and that now this term needs a broader definition than that which has been understood in connection with the 1902 Reclamation Act. But aside from former promises, present-day conditions were urged in support of the southern claims. Thus, Senator Bankhead said that there are today ten acres of reclaimable land in South to one in the West, and that nowhere but in the South is there land available to meet the agricultural needs of the population a few decades hence.

Nation-Wide Policy Needed—A nation-wide reclamation policy, formulated by a well-rounded commission, was advocated by Col. Joseph Hyde Pratt of the North Carolina Geological and Economic Survey, Chapel Hill, N. C. Land classification according to adaptability for various purposes is needed. Lands subject to overflow that have been reclaimed are generally in use, due to their being located in settled communities. The case with swamp lands is different; it will take years to get them under cultivation. Of the idle worn-out lands, some should be planted to trees and some restored to cultivation. The cost of Western reclamation by irrigation has increased from $30 to $100 per acre. No $100 projects should be put through. It is no longer true, said Mr. Pratt, that the West affords cheap lands. That promise has shifted to the South. Two great aids to reclamation would be topographic maps and improved highways.

Co-ordination in Water Control—A plea for co-ordination of many efforts having to do with utilization of water and protection of land from the evil effects of water when uncontrolled was made by Walter Parker, secretary of the New Orleans Association of Commerce. This co-operation should include federal, state, county, city, and rural agencies, and particularly the many federal departments and bureaus that work as if unaware of the others having to do with water. The late Senator Newlands, who took great interest in the matter, said Mr. Parker, was nearly defeated at the time of his last election to office because it was urged against him that his interests were too broad and that he should devote himself to the needs of Nevada. In 1917, Senator Newlands secured the passage of his Waterways Commission Bill. In 1919, he having died

meanwhile, the bill was repealed. The bill was again introduced last year and will be re-introduced in the next congress. The Waterways Commission Act, provided for the sort of federal study that must precede the formation and execution of a broad policy of water utilization and control.

Home-Making and Citizen Development—Throughout the conference it was repeatedly urged that home-making opportunities for persons of moderate means should be provided.

Improved Reclamation Methods—George H. Maxwell, of California, long well known for his advocacy of western irrigation, addressed the conference on Western Methods as Applied to the Southern Conditions. He laid down five principles of future reclamation development; (1) Reclamation must accord with a national policy; (2) Federal loans must be repaid; (3) Interest must be paid on loans; (4) the federal government must not serve as collector of principal and interest; (5) reclamation projects must be set in motion by the formation of districts having the power to levy taxes, issue bonds and make contracts.

Cut-over Lands—The vast areas of cut-over lands in this country, said John H. Kirby, president, Southern Pine Association, must be reforested if at all by public funds. Timber is the best all-round crop for the cut-over lands, in the opinion of E. A. Sherman, of the U. S. Forest Service. Col. Joseph H. Pratt, Chapel Hill, N. C., was not quite so sweeping as Mr. Sherman, perhaps because he had North Carolina conditions more particularly in mind, but he did say that for at least two or three generations a large majority of the cut-over lands should be reforested.

The Everglades and Other Florida Reclamation—Jules M. Burguieres outlined the Florida Everglades problem, prefacing his remarks with the statement that these lands did not pass from federal to state ownership until 1903. The state now has title to about 1,800,000 acres of the Everglades, through which some of the needed drainage canals have been cut. In addition, there is an equal area needing drainage. The cut-over lands of Florida are increasing at the rate of 400,000 acres a year. The federal government should look into the economic need for reclamation in Florida and elsewhere.

Wet and Swamp Lands—Perhaps the easiest way to bring more land under cultivation, said S. H. McCrory, chief of the division of Agricultural engineering, U. S. Bureau of Public Roads, is the reclamation of wet and swamp lands. Of these there are in the United States about 100,000,000 acres, a large part of which require both reclamation and colonization.

Resolutions on Reclamation Policy—Of the resolutions adopted by the conference, the following two are of special inte.est as defining views on reclamation policy:

That we request Congress to consider the recasting of the entire reclamation law, making it applicable to all parts of the United States, eliminating the conditions which make speculation easy and which have encouraged tenantry and promoted soil deterioration, and at the same time extending the good features of the law so as to be applicable to the reclamation and best use of lands in whatever part of the country they may exist, such development to take place in time and manner best to promote the creation of opportunities for self-supporting and self-owned farm homes; also that the organization of a Reclamation Service be provided for by law and be placed on a permanent basis.

That full publicity and discussion be had of better methods of land settlement and provision be made under state laws for the organization of suitable semi-public bodies for taking option on desirable farm lands, appraising these, providing for favorable and easy prices and terms, preferably under some form of amortization, and that the condition of sale require actual settlement and cultivation under a system of agriculture found to be adapted to the locality.

Street Retaining Wall Founded on Fill of Large Boulders

Construction of Hillside Street in New York City Complicated by Riprap Fill at Site of Retaining Wall

By Harry W. Levy
Engineer in Charge, Division of Design, Department of Public Works, Borough of Manhattan, New York City

North of Washington Bridge, which crosses the Harlem River in the northern part of New York City, the easterly slope of Manhattan Island orginally descended precipitously toward the river. Amsterdam Ave., a few hundred feet west of the top of the slope, and part of the side streets east of it are well built up. In order that property lying 200 ft. east of Amsterdam Ave. might be provided with better street facilities, Laurel Hill Terrace, a new north-and-south street, was laid out, interposing a street between this property and the public park lands lying to the east along the Harlem

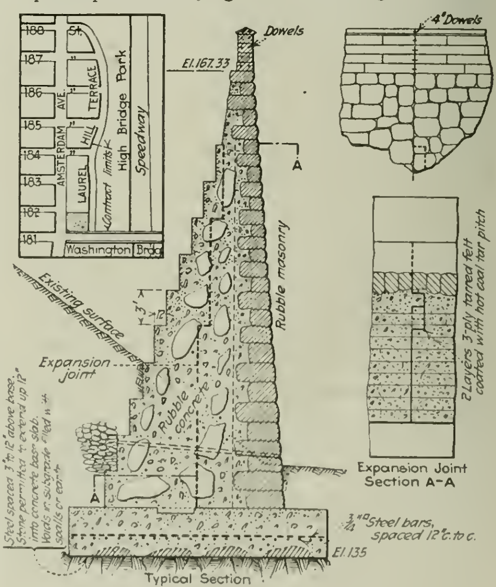


FIG. 1—LOCATION AND SECTION OF WALL
Greatest height of wall, 32 ft. 4 in.

River speedway. Existing street grades made it necessary to fix its elevation considerably above the original surface, and thus required the construction of a high retaining wall.

Before the grading of the street was taken up, large quantities of heavy rock fill and ashes had been dumped on the street site, filling the west part of it practically to grade, and sloping off into the park lands. To re-

move this mass of loose rock fill to the original surface, in order to construct retaining walls, would have necessitated excavations 50 ft. in depth through heavy riprap material of a sliding nature which could not readily be supported by sheeting on account of the steep slope of adjacent lands. The rock fill extended to a considerable depth, and consisted mainly of large, rugged pieces of stone, several cubic yards in volume, such as are taken out in cellar excavations in gneiss. Exploration showed that large open voids existed throughout the mass, but the fill as a whole was stable, observation and levels indicating that there had been no appreciable settlement over a period of years. In view of this, it was concluded that by spreading the load over a considerable area of this fill by means of a reinforced-concrete mat foundation the retaining wall could be constructed thereon without any danger of settlement.

The retaining wall varies in height from 10 to 30 feet. Its foundation was so designed that in case of settlement the mat would support the wall over any void up to 20 ft. span. It was placed after filling voids in the subsoil with stone or earth to hold the wet concrete mix; the specifications allowed large stones to project 12 in. above the bottom of the mat. The effective depth of the mat is 28 in. and the reinforcing consists of $\frac{3}{4}$-in. square bars 12 in. on center both ways.

FIGS. 2 TO 5—LAUREL HILL TERRACE RETAINING WALL, A CONCRETE WALL BUILT ON OLD ROCK FILL

Upper left—Original condition of hillside; men standing on line of wall. Lower left—Rubble-faced wall on spread footing built directly on rock fill. Upper right—Finished wall, seen looking southward from park at 184th St. Lower right—Ornamental stair tower and park approach built at 184th St.

No expansion joints are provided in the mat but the wall above has expansion joints of two layers of three-ply tarred felt every 40 ft. The retaining wall is of rubble concrete faced with rubble. The parapet wall and coping consist of a portion of the old Central Park wall which formerly was in front of the Metropolitan Museum of Art, seated on a new granite wall cap.

Provision has been made for regrading the fill within the park area so that in future a park path may be constructed and the intervening slope between this path and the wall graded and sodded without exposing the retaining-wall footings. An ornamental double stairway approach to the park, of rubble stone and cut granite, is constructed at the northerly end of the wall.

The work was constructed by S. Rosoff and Clemente Contracting Co. at an estimated cost of $85,717.25.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

State Engineer on Apishapa Dam Failure

Sir—The Apishapa dam failure, described and discussed in *Engineering News-Record*, Aug. 30, p. 357, Sept. 6, p. 373 and Sept. 13, p. 447, which involved the total loss of the earth embankment primarily constituting the dam, again directs the attention of engineers to certain vital questions incident to the employment and maintenance of such structures which call for the most careful deliberation. Since the reports and comments thus far printed are more or less conflicting and indicate a somewhat confused impression of the situation, and since the writer has occupied the position of state engineer of Colorado and, consequently, ex-officio, that of consulting engineer for the structure, during its entire construction and operation period, being properly chargeable with responsibility for the plans and specifications adopted, and is, moreover, thoroughly familiar with the history, construction and operation, including repairs, of the dam, all such data being filed in his office, he feels that it is incumbent upon him to furnish to the engineering profession all essential information, to the end that correct conclusions regarding the causes of the failure may be arrived at and similar catastrophes be averted hereafter, so far as this is humanly possible. With this end in view it seems desirable to review, as concisely as possible, the more pertinent facts already published, adding such further detailed information in his possession as appears to be essential for a clear understanding of the problems involved.

Unfortunately, but perhaps unavoidably, the real issues have been considerably befogged heretofore by the publication of much that is extraneous to the vital questions, both in the reports that have appeared and in the comments thereon, and it seems best to eliminate from this discussion those features that have no direct bearing upon the failure of the dam.

It is conceded by all who have personally studied the situation and reported thereon that neither the matters referred to in the "protest and warning printed on the official record plans," mentioned in *Engineering News-Record*, Aug. 30, 1923, p. 357, and again, editorially, Sept. 6, 1923, p. 373, nor any of the appurtenances of the dam, such as riprap, cutoff walls, piling, spillway, freeboard, outlet tunnel, gates, drains, toes, etc., already sufficiently described in the earlier articles can be properly charged with any responsibility for the disaster; but the opinion that weaknesses of some kind or kinds existed in the earth embankment as constructed, and that these were primarily responsible for its failure, appears to be unanimously held. Therefore the writer will not discuss, at this time, any of these features not contributing to the failure, but will confine himself to those details which, in his opinion, bear some important relationship to what has happened. These details are as follows:

Nature of Dam—The dam was fundamentally an earth embankment having incorporated in it such appurtenances as were deemed necessary for the impounding and regulation of flood water for irrigation use, none of the appurtenances, however, being suspected of having contributed to the failure.

Construction—The embankment was constructed, so far as methods were concerned, in accordance with what were considered to be standard plans generally adopted among hydraulic engineers. The facts that three separate sets of specifications, all quite similar with respect to methods of construction, contemplating three distinct dams proposed for the site, each not to exceed 115 ft. in height, were prepared at different times by different engineers or firms of engineers; that these three sets of plans were separately approved by three different state engineers; and, further, that the first specifications regarding the points now at issue are said by one of the members of the firm that prepared them to have been in substantial conformity with the then more or less standardized specifications of the U. S. Reclamation Service, are worthy of note. It is true that the different sets varied somewhat in their requirements concerning the amounts of water to be used in moistening the earth and in some other minor particulars, but they were all practically identical in leaving to the engineer in charge the final decisions as to the requirements for spreading, sprinkling and rolling. The embankment was considered practically completed by Sept. 20, 1920.

Material—Two distinct varieties of earth, described in considerable detail in the earlier articles and to be referred to again later herein, were used in the construction of the embankment. The suitability of the earth is questioned, especially by J. E. Field. (Sept. 13, 1923, pp. 418 and 420.)

Storage of Water—The reservoir was filled gradually to gage height 65 ft. on Aug. 3, the surface being then lowered gradually until the gage height was 47.3 ft. on Dec. 28.

1922: The surface remained at approximately 46 ft. until about May 10. Little water was available for storage that year and the surface gradually lowered until about Dec. 15 when the reservoir was practically empty, remaining at that stage for some months thereafter.

1923: No water was stored until after June 1. Between that date and Aug. 2 the water rose gradually from 14 to 48 ft. on the gage. The significant gage heights from Aug. 2 till the failure of the dam on Aug. 22 were as follows:

Date	Hour	Gage, Ft.
August 2	....	47.6
August 12	....	60.0
August 14	....	71.0
August 17	2 a.m.	71.3
August 17	7 p.m.	74.1
August 18	5 p.m.	75.7
August 19	9 p.m.	74.3
August 21	8 p.m.	75.1
August 22	3 p.m.	82.9

The water reached a gage height of 65 ft. on Aug. 3, 1921, after which it was drawn off gradually until it stood at about the 46-ft. level at the end of the year, where it remained until about May 10, 1922, then lowered to practically nothing at the end of that year, the reservoir remaining nearly empty until after June 1, 1923. It again reached the 1921 high-water stage of 65 ft. about Aug. 13, a little more than two years after it first reached that point. After Aug. 13 the water rose rather rapidly until, while still, according to the engineer in charge, about 11 ft. below the crest of the dam, the embankment failed at 3:00 p.m., Aug. 22, 1923.

Settlement and Cracking—The following details are abstracted from two letters dated respectively Sept. 14 and 16, 1923, from the engineer personally in direct charge of the project, A. N. Dallimore:

Following the time of maximum storage in 1921 two cross-sectional cracks developed, these being at distances of from 80 to 90 ft. from both the east and the west end of the dam respectively, each crack running from the water surface to the top of the dam, and the west one extending down on the back slope. These cracks were over the shoulders of the rock cliffs at points where the fills were much less than they were nearer the center of the dam and where the settlement might naturally be expected to be much less toward the ends of the dam than toward the center.

Another crack, running lengthwise of the dam and a little above the high-water mark, appeared also at the same time. Mr. Dallimore says that this crack was "probably caused by the fact that there was more settlement where the water covered the slope than on the slope above," and also that he considered it logical to expect such settlement cracks and did not consider them serious. He did not try to seal them up for some time, until he was sure they were not opening up any more. He then pumped water and

washed earth into them until they appeared to be entirely sealed. He reported that the maximum settlement of the dam up to May 10, 1922, "was about 2.5 ft., and about 3.5 ft. vertically on the slope at the water surface."

As the water rose above the 60-ft. gage height in August, 1923, there was some tendency to settlement on the front (water) slope at the west end of the dam, following the old crack there, and two very fine cracks showed on that end of the dam. These were the only cracks that appeared until just as the dam failed, when the diagonal crack described in the earlier articles opened up. The water entered the dam about 100 ft. from the east end and broke through the lower side at a point about 150 ft. from the west end.

the principal owners of the project and himself a graduate engineer, is quoted as being both pertinent and just:

"Regarding the care of the Apishapa dam by Mr. Dallimore, engineer in charge, will say that ever since he assumed charge of the company's system he has been at the reservoir frequently, and I know from conversations held with him that he was constantly on the lookout for settlement cracks in the dyke and fully appreciated that any such cracks which might occur would be possible sources of danger to the dam and should be given careful attention. I have asked him to report fully to you regarding what settlement cracks had occurred prior to the one which suddenly appeared and which caused the failure of the dam within a few minutes of its first appearance. I know of my own knowledge that three hours prior to the failure there were no cracks showing along the line where failure occurred and Mr. Dallimore and the caretaker both told me afterward that they had inspected the whole dam looking for cracks after I did and within a short time prior to the break and that nothing showed at that time.

"After considerable water was in storage this summer Mr. Dallimore greatly increased the time and attention given to the reservoir and was always there to personally superintend the work when the weather gave indications that a flood might occur; and during the ten days prior to the break, during which time the water was being held at a level about 10 ft. lower than the spillway, he was at the dam practically all the time, day and night, and several nights did not even have his clothes off to sleep as he made frequent inspections of the dam during the night. He did this even though nothing had occurred to cause any real uneasiness regarding the safety of the dam. There was about 2 sec.-ft. of water seeping through the rock around the east end of the dam and coming out of the hillside in the form of clear water springs which did not touch the lower slope of the dyke, being carried away by ditches on the side hill. From two personal inspections of the dam made within two weeks prior to the break I know that the lower slope of the dam was entirely dry and that not to exceed 1 sec.-ft. of clear water was coming out of the drain pipe at the bottom."

All the evidence in this case leads to the conclusion that

APISHAPA DAM FAILURE: WATER JUST BEGINNING TO TRICKLE THROUGH NEAR THE WEST END

The water entered the dam near the surface about 100 ft. from the east end and immediately began to trickle out near the west end. The dotted line shows that the water traveled along that course until nearly 2,000 sec.-ft. was running through before the dam began to slough off. This would indicate a heavy crack along that course.

Leakage—Mr. Dallimore makes these statements in his letter of Sept. 11:

"The quotation from *Engineering News-Record* of Aug. 30, as follows, 'Leaks attributed to settlement cracks had been observed a year ago. . . . These leaks were at each end of the dam and about 25 ft. below the crest,' is not correct, as at no time, until just as the dam failed, has there been any leak through the dam. Some seepage developed through the rock cliffs in July, 1921, and occurred again this year when the water got up in the reservoir. On the west cliff this seepage was very slight and through the east cliff was about 2 sec.-ft. This seepage came through seams in the rock and was at all times entirely clear, carrying no sediment. It was carried off in ditches and did not get into the earth fill. [There had been no water at any elevation like 25 ft. below the crest between August, 1921, and August, 1923—A. J. McC.]

"At no time had there been any seepage at the toe of the dam, except through the drainage pipe in the old channel bed. At the time of the failure there was not to exceed 1 sec.-ft. coming through this pipe.

"The tunnel has shown no signs of soft spots or of seams washing out, at least up to the last few weeks, during which time we have had some large heads discharging. Eighty feet of the tunnel is lined below the gate chamber and I doubt if it will ever be necessary to line any more."

Supervision of the Dam—The following extract from a letter dated Sept. 14, 1923, from H. H. Knowlton, one of

the vital trouble was in the embankment alone and that 5 ft. more added to the height of the dam, or changes in the construction of the toes, would not have averted the disaster. It appears to be certain, also, that there had been no leaks through the body of the dam prior to the time of the break that would have given warning of impending danger. Nor does there seem to have been any upward pressure of any importance under the dam as suggested by Mr. Godfrey. (*Engineering News-Record*, Sept. 13, 1923, p. 447.) Indeed, Mr. Godfrey's premises with respect to the Apishapa dam being incorrect, his conclusions in this particular case have no bearing on the questions at issue.

Conclusions—In the light of the evidence and studies now given to the case, several items attract particular attention. These are: (1) The character of the earth used in making the fill; (2) the efficiency of the compacting that it received through sprinkling and rolling; (3) the interval of more than two years that elapsed between the times when the water reached the 65-ft. level; (4) the apparently very considerable settlement that took place after the water reached that level in 1921, and the development of cracks that appeared at that time; (5) the apparently unhampered flow of water into the dam soon after it rose above the same level and its practically immediate discharge at a somewhat lower level on the lower side of the dam nearly at the opposite end, both inlet and outlet being nearly enough on line with the bluffs to arouse a strong suspicion that settlement cracks and, possibly, cleavage planes along those lines in combination with an internal longitudinal crack, were largely responsible for the failure.

Compacting—Reviewing the situation, it now appears to the writer that the earth of which the embankment was composed should have been thoroughly compacted by means of a pool of water along the center line of the embankment, or, at least, by the utilization of optimum amounts of water, determined by trial. It appears to him to be reasonably clear that there was internal settlement and cracking when the reservoir was first filled to the 65-ft. level, caves forming inside the dam, the upper 50 ft. of which had been just sufficiently solidified by sprinkling and rolling to hold together without external cracking, possibly somewhat in an arch form. It seems probable that the water did not stand long enough at the higher levels in 1921 to saturate the entire body of the dam below the 65-ft. level, so there may have been a slight cantilever action in the upper portion of the embankment. The company, believing that there would be no further settlement below that level after the cracks had apparently been sealed, proceeded to add more material to the surfaces to compensate for the settlement, not suspecting the serious condition inside the structure.

These conclusions are presented, not with a view to fixing the blame upon any one connected with the work, but solely for the purpose of determining the nature of the fault in construction that was responsible for the failure. The state engineer will be blamed by some on the ground that the supervision was inadequate or incompetent. It must be remembered, however, that there are over 900 earth dams in Colorado that are under the supervision of the state engineer; that a number are usually being constructed at the same time; and that superintendents or inspectors appointed by the state engineer cannot, legally, be paid more than $5 per day—hardly laborers' wages. Consequently much must be left to the owners and their engineers in direct charge. The state engineer's office can devote no more money or time to such work than it is now giving. In this particular case it was believed that those in charge of construction were more than usually competent, as, indeed, they were. The fact is that in forty years' experience as an irrigation engineer, more than ten years of that time as state engineer of Colorado, the writer has never before known of a failure like this one. He sincerely hopes that this may furnish such an object lesson to the engineering profession that there will never be another failure like it.

This discussion would not be complete without a word regarding the gates. It has been suggested by some that they should have had a greater discharge capacity. The writer does not believe this to be true. It is granted, of course, that the embankment should have been so constructed that there would have been no danger of failure short of actual overtopping by some totally unprecedented flood. Granting this, it is to be remembered that the spillway capacity is practically unlimited and that the reservoir was intended to be a stream-bed reservoir for the conservation of flood waters. The gates were sufficiently large to furnish water for all prior rights along the stream below the reservoir, with an unusually large margin of safety. Under the existing circumstances, and assuming the dam to be properly constructed, there would seem to be no good reason for any larger outlet capacity. In short, the responsibility for the failure must be charged to the faults, whatever they may have been, in the embankment alone.

A. J. McCune,
Denver, Colo., Oct. 1. State Engineer.

Politics Not an Element in Opposition to Dr. Work

Sir—The following statement attributed in your issue of October 18, in an article "Work's Friends Justify Davis' Removal," to friends of Dr. Work, has just come to the attention of William Dudley Foulke, the president of the National Civil Service Reform League:

"The activities of the National Civil Service Reform League smack of first aid for the Democratic party. All its representatives who have called on Dr. Work have admitted affiliation with that party."

In reply to this statement, Mr. Foulke, who, as you probably know, was a close friend of Colonel Roosevelt, and who served as a member of the United States Civil Service Commission during the Roosevelt administration, has asked me to send you this statement:

"This statement is false. I was one of these representatives and no such affiliation was admitted by me, nor did it exist. I called on Dr. Work with two other members of the League. He asked me the question, 'What are your politics?' I told him I was an Independent. He said, 'That means you are a Democrat.' I answered that it did not, that I had been strongly opposed to the administration of Woodrow Wilson, to which he rejoined, 'Oh, that was a mere personal objection.' In fact, I have never voted the Democratic ticket since the administration of Grover Cleveland, but always either the Republican or the Progressive ticket. Dr. Work must be in hard straits if he finds it necessary to defend himself by the statement of an affiliation which he well knew did not exist."

I hope you may find Mr. Foulke's statement worthy of use in your publication. Richard Boeckel,
Washington, D. C., Washington Representative,
Nov. 23, 1923. National Civil Service Reform League.

Stanton's Expedition Down The Colorado

Sir—I note in your issue of Nov. 15, 1923, p. 787, under the heading "Engineering Plus Adventure" it is stated, "When it is remembered that the trip itself, devoid of any of the surveying accessories, has been made only two or three times and, with the exception of the pioneer Powell trip, *only as an adventure*, the Birdseye expedition becomes a notable addition to the annals of engineering."

The writer is evidently unaware of the notable expedition under the direction of the late Robert B. Stanton, M.Am.Soc.C.E., who made a most thorough and exhaustive survey and examination of the Colorado River and its canyons in the years 1889 and 1890, for the purpose of locating a low-grade railroad line to the Pacific Coast.

See *Transactions*, Am.Soc.C.E., Vol. 26, p. 283, also *Engineering News*, Oct. 18 and 25, 1890.

Port Chester, N. Y. F. S. Odell,
Nov. 20, 1923. Civil Engineer.

[The writing of Powell instead of Stanton in the editorial noted was a slip of the pen. Major Powell's famous exploratory trip down the canyon in 1869 was in no way a survey, but Mr. Stanton made a most thorough survey in 1889-90 for a possible railway. In the numbers of *Engineering News* referred to there are some excellent views of places in the canyon which have since become quite noted in engineering discussions.—Editor.]

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Construction of a Concrete Power house and earth dam to develop a head of 62 ft. on the Manistee River near Cadillac, Mich., is contemplated by the Consumers Power Co. of Jackson, Mich.

Oregon City, Ore., Has Adopted the city manager plan and the city will elect a mayor and a treasurer Jan. 1 1924. The mayor will appoint a city manager, who will name other city employees.

One of the Longest Ferro-Concrete bridges in England has been opened at Reading. The bridge crosses the Thames at a point which connects Reading with lower Caversham on the Oxfordshire side of the river.

To Keep Connecticut River Flood water back from the sewers in streets, covering an area of 328 acres, the Springfield, Mass., city council on Nov. 12 voted to appropriate $79,000 for a pumping system and accompanying equipment. The system adopted was recommended by Metcalf & Eddy, engineers, Boston, Mass.

Several Weeks Probably Must Elapse before it will be possible for the State Department to call the proposed conference on oil pollution. The assembling of necessary data and reports is not yet complete. It is believed, however, that the situation has resolved itself largely into a matter of prescribing the mechanical devices necessary to make proper oil disposal comparatively easy.

An Important Civic Project at Dallas, Tex., is the extension and widening of Field St. from Main St. to Orange St. and Cedar Springs Ave., in order to provide a new cross-town route in the shipping and banking district. At present there is no continuous opening along this route and much of the property is occupied by barns and sheds which would be replaced by modern business buildings. This improvement was recommended by the late George E. Kessler, landscape architect, and it is now being urged upon the city by the Dallas Property Owners Association, of which E. N. Noyes is engineer.

In the Case of George W. Clark against the Green Briar Drainage District of Jasper and Crawford County, Ill. Mr. Clark has been awarded $25,000 damages by a jury in the U. S. District Court at East St. Louis, Ill. He constructed a levee for the district several years ago and the district claimed that the levee was unsatisfactory and declined to pay the full amount due under the contract. Two years ago Mr. Clark obtained a judgment for $30,000 but the Federal Court of Appeals remanded the case for a new trial. Counsel for the levee district has now filed a motion for retrial.

Chicago Rapid Transit Extension

A 5½-mile surface line extension of the Chicago elevated railway system is to be built in Evanston and Niles Center, under the name of the Chicago, North Shore & Northern Ry. From the present Howard St. station on the elevated system the new line will descend on an incline and run west to Niles Center, where it will turn north to a terminal at Dempster St. A site of about 55 acres has been secured for car shops for the elevated lines and the interurban line of the Chicago, North Shore & Milwaukee Electric Ry. An extension to Waukegan is projected, giving the latter railway an alternative route for its limited trains between Milwaukee and Chicago. Application has been made to the Illinois Commerce Commission for the necessary authority. The work will be under the direction of B. J. Fallon, general manager of the Chicago Elevated Railways.

Power Commission Grants More Licenses

A license to develop 29,000 hp. on Cascade Creek, 22 miles from Petersburg in Alaska, has been granted to Hutton, McNear & Dougherty of New York City and San Francisco. The license is conditioned upon a contract with the U. S. Forest Service for the purchase of timber as the power is to be used for the manufacture of pulp and paper. The project will consist of a dam, reservoir, a conduit 14,250 ft. long, and a power house and pulp mill.

A preliminary permit has been granted to the West Virginia Power Co., of Charleston, covering a project on New River, five miles above Hinton, W. Va. The erection of a dam 140 ft. high and 750 ft. long is contemplated.

Another preliminary permit has been granted to Mary I. Crocker and J. W. Preston, Jr., of San Francisco, Calif., for a power project on the Mokelumne River and Sutter Creek within the Stanislaus National Forest, consisting of three reservoirs and three water conduits. The first conduit is approximately 22 miles in length with a capacity of 400 sec.-ft., the second approximately 7 miles in length with a capacity of 750 sec.-ft., and the third approximately 9 miles in length with a capacity of 350 sec.-ft. Three power houses will be built, the first to utilize a head of approximately 1,175 ft., the second 632 ft., and the third, 565 ft. The estimated total ultimate installation for the three is 48,000 hp.

To facilitate the handling of minor power projects the Federal Power Commission has authorized its executive secretary to issue licenses for ten years covering projects with a capacity of less than 100 hp., and field offices to issue licenses for ten-year periods covering projects of 40 hp. or less. If there is a possibility of the smaller projects conflicting in any way with larger projects the license is to be limited for five years.

Highway Officials Puzzled by Federal Reorganization Plan

Washington Correspondence

State highway officials apparently are in a quandary, judging from letters being received in Washington, as to the attitude they will take toward the proposal to transfer the Bureau of Public Roads from the Department of Agriculture to the Department of the Interior. They are inquiring as to whether their work will be simplified under the arrangement being sponsored by the administration, whereby they will have to maintain contacts with two Cabinet members instead of one. In addition to this proposed transfer the reorganization sets up a Bureau of Transportation in the Department of Commerce, which is to deal with railroads, waterways and highways.

Due to the large volume of business which must be transacted with the federal government in carrying out the multitudinous activities surrounding construction projects of the magnitude of those provided in the program for the federal-aid highway system, very close co-operation must be maintained by state officials with those of the federal government. For this reason, state highway officials are showing very active interest in the reorganization plan.

In some states the rural population already has importuned the state highway commissions not to agree to the transfer of the Bureau c Public Roads from the Department of Agriculture. In those cases the attitude has been that the highway is a more important factor in the conduct of farming operations than it is to any other activity. The contention is that the Secretary of Agriculture could be relied upon more than any other cabinet officer to champion policies which would give farmers good highway facilities without saddling on them a disproportionate amount of the cost.

Richmond, Va., Seeks Aid for Its Port Development

The city of Richmond, Va., acting through its council committee on dock, river and harbor, has retained the Technical Advisory Corp. of New York to make a port and industrial survey of Richmond and its environs.

The investigation is aimed at two purposes: (1) To secure the aid of the federal government in improving the James River; and (2) to formulate a plan for the industrial development of the city.

As a result of the survey, which was started in September Richmond hopes to convince the board of army engineers and Congress that a substantial appropriation for the improvement of the James River will be warranted. It will be the purpose of the city, if the desired river improvements are made, to provide an adequate modern terminal.

Construction Under Way on Pit No. 3 Project

Half of Railroad Complete—Work on Tunnel Being Advanced — Drilling at Dam Site

Construction is going forward rapidly on tunnel and preliminary work for the Pit River plant No. 3 in northern California. This plant is fourth in the Pit River series which is being built by the Pacific Gas & Electric Co. as power demands on the system require. The location and features of the proposed development as a whole were outlined in *Engineering News-Record*, Oct. 13, 1921, p. 604 and the Pit No. 1 plant was described in the issue of Oct. 5, 1922, p. 570.

The first half of the 10-mile railroad necessary to reach the Pit 3 power house was completed Sept. 1, bringing rail head to headquarters camp at the diversion dam site, which is also the upper end of the four-mile tunnel. The remaining five miles of railroad which involves heavy construction through the Pit River Canyon is to be completed by Jan. 1.

Work on the tunnel is now being advanced from the intake portal, from two portals at Rock Creek, 1¾ miles below, and at the adit about a mile below Rock Creek. Work at the lower end will not be begun until the railroad reaches that point. On Oct. 20 the intake heading was in about 600 ft. The tunnel is being excavated to a 21x21-ft. horseshoe section; it will be lined with concrete and will probably require timbering for most of its length. The first 600 ft. was largely through volcanic tuff and diamond drilling indicates that the same material will be encountered for another 600 ft. after which lava and basalt are expected.

Contractor Furnished Equipment

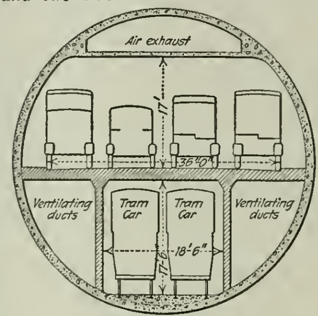
In order to insure having equipment on the job suitable for the several tunnels contemplated in this vicinity the power company decided to furnish the contractor on this tunnel with all heavy equipment, such as compressor plant, steam shovels, muck cars, etc. and to build such camp structures, roads, railroads, inclines, etc. as may be required. Small tools, drill steel, power, etc., are to be furnished by the contractor. Under this plan of operation it will not be necessary to let the work in such large blocks. Contract for a total of 2,000 ft. of tunnel at Rock Creek and the adit now under way is held by the Bates & Borland Co. The power company is driving the intake heading with its own crews.

Diamond drilling at the dam site indicates that foundations will go about 25 ft. below stream bed. A gravity-type concrete dam 125 ft. high is contemplated. While foundations are being placed the stream is to be carried in a flume about 12x30 ft. in section and 1,200 ft. long of which the upper 800 ft. at the dam site probably will be made of concrete as a safeguard against interruptions during the short low-water season. The capacity of the flume will be 3,000 sec.-ft., this capacity being about 20 per cent in excess of the normal low-water flow. Half of the heavy rock cribs for the temporary diversion dam are now in place; the remaining cribs will be placed in April or May of next year.

Pit River No. 3 power house is to contain three 27,000 kva. generators driven by vertical reaction wheels operating under a static head of 313 ft. and is to be in service Oct., 1925. Construction work on the project is under the direction of O. W. Peterson.

Mersey River Tunnel Proposed

A project for a highway tunnel under the River Mersey to connect the cities of Liverpool and Birkenhead, England, provides for a single bore 44 ft. inside diameter. It would be located a little downstream from the Mersey Ry. tunnel, and would have a river length of about 4,000 ft., with long approaches or grades of 5 per cent for light traffic and street cars and 3 per cent for a lateral approach carrying heavy traffic of the docks district. At the centerline of the tunnel section would be a 36-ft. deck wide enough for four lines of vehicles and two narrow sidewalks. Two supporting walls for this deck would form a central section for street cars and two side sections for ventilating



PROPOSED MERSEY RIVER TUBE

ducts. About 17 ft. above the upper deck would be a flat roof or ceiling forming an air exhaust duct along the top of the tunnel.

It is proposed to have a cast-iron shell with interior concrete lining and with grout pumped to fill all exterior voids. The total cost is estimated at $32,000,000. The consulting engineers are Sir Maurice Fitzmaurice, Basil Mott and John Brodie.

Legal Obstacles Removed in Extending Minidoka Project

Extension of the Minidoka reclamation project in Idaho to overflow part of the present site of the town of American Falls may proceed, legal obstacles having been removed by the decision of the Supreme Court Nov. 12 in the suit of DeWitt Garrison Brown and Rosa C. Brown against the United States.

Because extension of the project would inundate part of American Falls, a town of 1,500 inhabitants, Congress passed a special act authorizing the Reclamation Service to condemn land adjoining the town to which land three-fourths of the town would be removed. Proceedings were begun to condemn a farm owned by the Browns. The jury awarded them $6,250 and, under Idaho law, $328 for interest. The Browns resisted and filed suit to resist the condemnation on the ground that the proposed use of their land did not constitute public interest. This contention the Supreme Court held to be wholly erroneous.

Non-Partisan Board Selects New New York Roads

Approximately 1,000 miles of new state highways will be added to the New York State system of good roads during the next eight years if the program approved by a non-partisan committee, named by Col. Frederick S. Greene, superintendent of public works, of New York State, be approved by the legislature. The committee named is as follows: H. Eltinge Breed, representing American Society of Civil Engineers; W. F. Wilson, representing County Highway Superintendents Association; C. W. Hawes, representing Dairymen's League; C. O. Kramer, representing Motor Truck Association of America; Charles W. Leavitt, Jr., representing New York State Association of Real Estate Boards; Frank M. Baucus, representing New York State Automobile Association; F. J. Riley, secretary, New York State Grange; B. W. Miller, representing Federation of Farm Bureaus; and T. H. Bennet, representing Motor Federation.

The committee met at Albany on Nov. 20 and approved a majority of the proposed development, cost of which is estimated at from $45,000 to $50,000 per mile. About 400 miles of additional roads are still to be approved and will be considered by the committee at a meeting Dec. 11.

Colonel Greene, in opening the meeting, told the committee that it was to have the entire say in the selection of the roads proposed by his department, county superintendents of highways and division engineers.

"The highway department will not have a vote in the matter" said he. "What we aim to do is to stop building roads to placate those who have political power and to end the construction of deadhead highways."

To bring about a consummation of the plans for the additional roads, legislative enactment will be necessary including a change of the map of the ultimate system of state and county highways and an amendment to the highway law inserting therein the new routes proposed.

Railroad Denied Right-of-Way in Salt Creek Oil Fields

The Department of the Interior has denied a right-of-way across the Salt Creek oil fields in Wyoming to the North & South Railroad Co., a new railroad 332 miles long now building from near Casper, Wyo., in Miles City in Montana. The reason for the denial of the right-of-way across 20 miles of the Salt Creek field is based on the fact that the public lands in the Salt Creek field have been reserved and that, because of this reservation, the law does not sanction the building of a railroad across it. Another ground for the refusal to approve the map as submitted by the North & South Railroad Co. is the fact that the railroad would interfere seriously with the development of oil in the fields and the rights of the oil lessees, according to the Department of the Interior. As one of the chief objects in building this railroad was to provide the oil fields of the Salt Creek area with an outlet, it is probable that a way will be found to circumvent the technicalities now standing in the way of this construction.

Federal Employees Protest Personnel Classification

Washington Correspondence

A storm has been precipitated by the action of the Personnel Classification Board in reversing its attitude toward tentative reclassification of civilian employees of the federal government outside the District of Columbia. Following a mass meeting in Washington, a committee representing the National Federation of Federal Employees sent a formal protest to the board and asked President Coolidge to order an investigation, declaring that the reclassification act was being disregarded. The change in policy by the board affects only federal employees outside the District of Columbia. In preparing a report for Congress regarding reclassification of these employees, the field division of the board, under the board's instructions, prepared specifications for the various kinds of work and called for allocations by heads of divisions under these specifications, whereby the same rates of pay would be given for comparable work and responsibility regardless of the department or place where this work is performed. With about 60 per cent of the reports at hand, the division sent a tentative report to the Budget Bureau for its information in formulating departmental and bureau budgets for 1925. The District of Columbia Division proceeded differently, classifying employees by departments and bureaus according to present duties and pay, leaving for the future the specifications for comparable work by which inequalities will be removed. The District schedule is to go into effect July 1, next, while the law called for a report, only, as to the field forces.

On Nov. 13, the Board, by a vote of two to one, directed that estimates be prepared for the field forces on the same basis as was used in the District of Columbia Division in order that more complete estimates of cost might be at hand in the event Congress did not provide a bonus for field workers.

Levees and Drainage for the Arkansas River

Reclamation of the overflowed lands along the Arkansas River in Kansas is of increasing importance to the industrial development of cities along the river as well as to agricultural development, and a co-operative movement for such work has been taken by the organization of the Arkansas Valley Improvement Association to co-ordinate the various interests and communities and to assist in organizing a number of drainage districts to carry out the works. Levees and bank protection are needed, and ditches and levees to take care of the runoff from hill streams whose natural channels are of insufficient capacity. One most perplexing problem is the reconstruction of bridges in and adjacent to the larger cities, such as Wichita, Larned, Hutchinson and Arkansas City, since the majority of these bridges are inadequate to pass flood discharges. R. H. Rhoads, Arkansas City, Kan., is secretary of the Association and the Clark E. Jacoby Engineering Co., Kansas City, Mo., acts as consulting engineer. This company has already submitted plans for flood control at Wichita, Kan., and for levee works at Larned.

Ford Bid for Muscle Shoals Gains in Favor

With the chairman of the Appropriations Committee of the House of Representatives actively advocating the acceptance of the Ford offer for the government's properties at Muscle Shoals, the prospect of the acceptance of that offer by Congress is increased. Entirely apart from the importance of his position, Chairman Madden possesses powerful influence among the conservative Republicans, the portion of the House membership relied upon to defeat the Ford bill.

In conversation with the Washington correspondent of *Engineering News-Record*, Mr. Madden admitted that he is not informed as to the important offers for Muscle Shoals which are said to be in prospect but he reiterated his belief that Mr. Ford is in a better position than anyone else to develop that property. Mr. Madden confirmed the statement carried recently by the Associated Press, to the effect that he is backing the Ford offer principally because of its fertilizer feature, under which Mr. Ford would be required to make an immediate investment of some $50,000,000. The government can afford, Mr. Madden believes, to write off its expenditures at Muscle Shoals if it assures the farmers adequate supplies of fertilizers at low cost.

Southern Pacific to Complete Double Track Over Sierras

The Southern Pacific Co. is now completing the double tracking of its main line over the Sierra Nevada Mountains. This involves the building of a new second track from Blue Canyon to Truckee, a distance of about 41 miles. Portions of this new work, from Blue Canyon to Emigrant Gap and from Andover to Truckee, totaling 12.7 miles, have recently been completed at a cost of about $1,200,000. The final section from Emigrant Gap to Andover, a distance of 28.7 miles, will cost about $10,800,000, or an average cost for the 41 miles of about $290,000 per mile. Double tracking on this section of the line has been left until the last because it involves the heaviest construction in the mountains. The completion of this project, which is expected in about two years, will give a continuous double track from San Francisco to Sparks, Nev.

Throughout this double-track work improvements have been introduced in the form of reduced curvatures and decreased lengths of snow sheds. About two miles of the second track at the summit will be on a newly located line in tunnel under Donner Peak. This new location which will be used by eastbound traffic will lower the summit by 135 ft. The existing main line over the tunnel will continue to be used by westbound trains. Several short tunnels will also be driven for the second track, the one between Donner Lake and Cold Stream being 877 ft. long.

Other features of the work are three steel viaducts as follows: Across Butte Canyon 410 ft., across Lower Cascade 403 ft. and across Upper Cascade 298 ft.

Grading and tunneling on the new work will be done by contract; viaduct and track work will be done by the railroad under the direction of G. W. Boschke, chief engineer, and W. H. Kirkbride, engineer maintenance-of-way.

China Relief Commission to Construct Utilities

American Engineer to Be in Charge of River Control and Highway Work

Oliver J. Todd, a member of the American Society of Civil Engineers, has been appointed by the executive committee of the China International Famine Relief Commission to take charge of the engineering work of the commission in North and Central China. This commission was organized in the fall of 1921 to take over the work of six or eight organizations which have been handling famine relief work during and after the great famine of 1920-21. It took over the funds of these several commissions and is now using the unexpended balance as a revolving fund for river-control work and for highway construction throughout the provinces of North and Central China, where the menace of flood and the lack of highways are the contributing causes to famine.

The new program contemplates immediate investigations and surveys of various public utility projects, such as river control for the Yellow River and other large streams, irrigation projects, and an extensive network of highways. This will necessitate the establishing of local engineering bureaus in each of the provinces where the commission will carry on its work. In these local bureaus Chinese engineers will be employed and their work directed by the Peking headquarters. The Peking office will be in charge of Mr. Todd and he will have two or three American engineers as assistants and also several Chinese engineers who have been working with him in China during the past four years. It is expected that some of the river-control work will be started in the spring as famine-prevention measures and other work such as highway extensions will be undertaken only as relief measures in districts where subnormal crops make some relief desirable. The commission expects to continue its policy of employing famine sufferers on this work and paying them in grain.

Additional funds for the prosecution of this work will be raised in two ways: First, by annual contributions from Chinese provincial relief societies, and, second, by having a portion of the new customs increase of the Chinese Government allotted to the work of the commission when the increase is approved. It is estimated that about $750,000 a year will be available.

Belle Isle Bridge Opened

Detroit's new $3,000,000 Belle Isle bridge connecting the main land with Belle Isle was formally opened to traffic on Nov. 1, following ceremonies and a parade across the bridge, which marked the close of 27 months in building and 25 years' agitation for a new structure. At the conclusion of the ceremonies, a procession estimated at 10,000 people crossed the bridge on foot.

H. H. Esselstyn, engineer in charge of the construction of the bridge presented the bridge to John W. Reid, commissioner of public works. Tribute was paid to Greiling Bros., builders of the bridge.

Reclamation Advisers Believe Settlers' Relief Necessary

Washington Correspondence

Witnesses appearing before the Special Advisers on Reclamation apparently have convinced that body that prompt relief must be found for some of the projects. Governor Campbell, chairman of the advisers, suggests that some type of moratorium may have to be arranged. At the initial conference with the press last week, Governor Campbell pointed out that the work of the advisers thus far largely has been along the lines of research. Enough testimony has been heard, however, to convince Gov. Campbell that something must be done promptly to reorganize the fiscal principles under which the reclamation projects are being operated. Despite the rather hopeless situation in which many of the settlers find themselves, Gov. Campbell declared the demand for repudiation is negligible.

One of the points brought out by witnesses before the advisers is the matter of the efficiency of the individual farmer. Under the law no selective process can be employed in the choice of settlers. Apparently there is a new realization that the success of a farming enterprise on a reclamation project depends to a greater extent than on the average farm on the ability of the individual farmer. Inclusion of land of doubtful value is a source of weakness in some projects, the evidence presented by witnesses would indicate. Other witnesses contend that construction costs are excessive. All agree, however, Chairman Campbell stated, that the work is well done, but some contend that it is done too well.

Formulate Principles to Underlie Building Trade Apprenticeships

General principles which it was agreed should underlie apprenticeship training in the building trades were formulated at a conference in Washington Nov. 15 between the Federal Board for Vocational Education and representatives of employers and employees and material supply manufacturers.

Eight general principles were laid down. They are:

1—That a local representative committee composed of all interests in the industry is essential to determine the needs and supervise the training.

2—That part time or evening schools should be provided to supplement job training.

3—That all-around training is more desirable than specialized training.

4—That the national associations should set up fundamental training standards for apprentice training and make the information thereon available for instructional purposes.

5—That co-operation with the public schools is essential to the promotion of apprentice education.

6—That incentives should be set up to induce boys to enter apprenticeship.

7—That pre-employment training for employed apprentices or boys under contract is recommended.

8—That emphasis should be placed on dull-season training to follow up the initial training given in the pre-employment period.

A number of those attending the conference, which was called for discussion of the apprenticeship problem rather than for immediate definite action, recited plans which have been followed in various trades at specific localities to induce more young men to enter apprenticeship, or which have been devised to be put into operation soon.

N. Y. Central Offers Plan To Solve West Side Problem

The New York Central R.R. has offered a plan to the Transit Commission of New York City whereby solution of its so-called West Side trackage problems is to be accomplished through elimination of tracks from city streets, increase in freight transportation facilities and abandonment of certain terminal structures and track. Principal features of the proposed reconstruction, which, with grade crossing elimination it is estimated will cost $75,000,000, are a two-track elevated line from the new terminal at West and Spring Sts. to the 30th St. yards (which are to be double-decked); a four-track elevated line from 30th St. to 59th St., and from there widening of the right-of-way to allow installation of five tracks to another elevated structure at 116th St.

City Managers Hold Convention

Discussion of literally scores of problems which confront city managers constituted the feature of the tenth annual convention of the City Managers' Association, held recently in Washington, D. C. The discussion was divided into three parts, dealing with problems common to communities of 15,000 population, of 10,000 population and of 5,000 population. Particular interest was shown in markets, trees, lights, zoning, disposition of refuse, and water supply. Parks, bridges, schools, hospitals, reformatories and the various city departments were visited. A considerable portion of the time of those in attendance at the convention was spent on inspection trips.

Joint sessions were held with the National Municipal League and the Government Research Conference.

To Seek Aid for Government Barge Lines

Washington Correspondence

An effort will be made at the forthcoming session of Congress to secure legislation which will provide a new basis for the operation of Government barge lines. The Secretary of War now is considering the draft of the bill which would provide the Mississippi-Warrior services with a larger amount of working capital. It also provides that while the management still is to be vested in the War Department, it will be freed from departmental restrictions so as to be able to exercise a control similar to that employed in private enterprise. If the management can be arranged so that it may have the advantage of more direct control, it is believed a much better showing can be made.

A determined effort will be made at this session of Congress, it is understood, to set up a policy which will permit the War Department to do pioneering in inland waterway transportation on other streams. An argument which will be advanced in support of the plan is that this provides a cheaper way of expanding transportation facilities than would the construction of additional rail facilities to handle an equivalent tonnage.

Random Lines

Brothers Under Their Skins

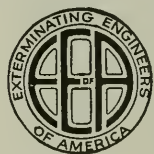
"There is a demand in the church for a new type of worker—the '*socio-religious engineer*,' D. J. Beebe, dean of the school of theology, Boston University, declared today at the annual meeting of the board of home missions of the Methodist Episcopal Church. The '*socio-religious engineer*,' the speaker said, has special skill in relating the church to the whole life of the community and can deal with community problems from the religious point of view."—From the Boston *Herald*.

Now if he could only fix up a partnership with our old friend the "*hymn book engineer*," they ought to get most of the business in their line.

* * *

A Live Profession

The propaganda of our brothers the exterminating engineers might well be emulated by some of the older branches of the profession. They have one virtue, certainly; they get publicity. All over the country the newspapers are carrying their advertisments, but more than that they are getting free advertising—such as this column gives, for instance. And we find a department editor of the Duluth *Herald* rather timorously assuring a correspondent that "it would be stretching the term to call this kind of a job a 'profession' ". Profession or not, it has a nice new seal, which is shown in the accompanying reproduction.



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The Triumph of the Concrete Ship

The 3000-ton concrete ship "Sapona," built at Wilmington during the war, has achieved a notable end. She has been bought by a Florida hotel keeper and will be located on Ajax Reef, 24 miles south of Miami Beach. The owner is going to fit her out with a "reasonable amount of furniture and equipment and use her as a fisherman's club house." And Bimini only 50 miles away.

* * *

Every Man To His Job

NOTE: An attempt by an engineering society to get its members to write an engineering short story or novel by offering substantial prizes has met with disappointing results.

The engineers, they have no fears,
They wear thick leather panties.
They spend their time in tropic clime
And live in wooden shanties.
Meanwhile just look, on screen, in book
Is told their tale romantic
By scribblers gay so dumb that they
Drive engineers near frantic.
But why in hell cannot they tell
These tales like any other?
The fact remains, they lack the brains
Or find it too much bother.

Boa.

To Build New Power Plant at Montreal

As the result of an agreement between the city of Montreal and the Bank River Power Co. whereby the power company will provide the necessary protection for sewer outlets on the Riviere des Prairies as well as the streets abutting on the river, the power company will now be able to proceed with the construction of a dam below Cedar Island, at which is planned to develop 50,000 hp. An order-in-council was passed by the legislature during its last session authorizing the company to undertake this work as soon as it had reached an agreement with the city of Montreal and had satisfied the Provincial Board of Health that the diversion of the stream would have no injurious effects on public health.

The construction work will include numerous dikes and a dam 1,300 ft. long containing ten 40-ft. sluices for use at times of flood. A 300-ft. channel will be provided on the Montreal island side of the river.

Engineering Societies

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS. Washington, D. C.: Annual Convention, New Orleans, La., Dec 3-6, 1923.

FEDERATED AMERICAN ENGINEERING SOCIETIES. Washington, D. C.; Annual Meeting. Washington, D. C., Jan. 10-11, 1924.

AMERICAN ROADBUILDERS' ASSOCIATION. New York City; Annual Convention, Chicago, Jan. 14-18, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS. New York City; Annual Meeting, New York, Jan. 16-18, 1924.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Chicago, Ill., Jan. 21-24, 1924.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich. Annual Meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

The Engineers' Club of Philadelphia, on Nov. 20 tendered a dinner to Charles M. Schwab, recently elected an honorary member of the club. The speakers were Dr. Robert H. Fernald, Alba B. Johnson, J. Hampton Moore, Mayor of Philadelphia, Admiral A. H. Scales, Julian Kennedy, and Mr. Schwab. The dinner was made the occasion for presenting Mr. Schwab with the certificate of honorary membership in the club. The o her living honorary members are Thomas A. Edison, General George W. Goethals, Edgar F. Smith, Herbert Hoover, and Lewis H. Haupt.

The San Francisco Section, Am. Soc. C. E. held a special meeting on Nov. 14 for Secretary Dunlap, who spent one d:y in San Francisco in the course of his tour visiting western sections. Mr. Dunlap spoke vigorously and enthusiastically about the formation of technical divisions of the society, closer relations with new chapters and local sections, the quarterly meetings and special committees on such subjects as engineering education, and finally the duties of the individual engineer as a citizen. Representatives of the student chapters at Leland Stanford, Jr. University and the University of California asked for the aid of the society and the local section in giving undergraduates a practical view of engineering activities in general. C. D. Marx and C. E. Grunsky supplemented Mr. Dunlap's remarks, referring to past and future activities and endeavors of the society.

Personal Notes

W. Z. BETTS, maintenance bridge engineer for the North Carolina State Highway Commission, has been appointed purchasing agent of the commission to succeed H. V. Joslin.

J. R. WENDT, district maintenance superintendent for maintenance district 8 for the State Highway Commission of Louisiana, has been transferred to Ruston, La., as maintenance superintendent for districts 8 and 9, relieving Fred D. King of district 9, resigned.

C. C. HEZMALHALCH has been appointed deputy state engineer for Colorado, succeeding R. G. Hosea who resigned to enter the automobile business at Fort Morgan. Mr. Hezmalhalch has been a member of the state engineer's staff since 1911.

C. B. ZORN, who has been with the Iowa State Highway Commission for several years, has been appointed county engineer for Monona County at Onawa, Iowa.

GEORGE J. CALDER, consulting engineer, has opened an office at 1010 Eighth Street, Sacramento, Calif., with M. W. SAHLBERG, designing engineer, in charge.

T. C. CARHART and JOHN G. STUPP, sales manager and chief engineer of the St. Louis Structural Steel Co., have resigned and entered the structural engineering business as Carhart & Stupp, with offices in the International Life Bldg., St. Louis, Mo., to engage in the design of buildings and structures for industrial plants.

THOMAS SHANKS of Ottawa, Ont., has been appointed assistant director-general of surveys, a new position in the Department of the Interior of Canada.

R. HOME SMITH, chairman of the Toronto, Ontario, Harbor Commission, has resigned.

VAN CAMP, recently assistant engineer for Tarrant County at Ft. Worth, Texas, has been appointed resident engineer in charge of construction of roads in the National Forest at Mena, Ark., under the U. S. Bureau of Public Roads.

T. H. WEBB, assistant state highway engineer for Texas, has been appointed county engineer of Callahan County in charge of a $500,000 highway improvement program at Baird, Texas.

J. B. RIEMAN has resigned as county engineer of Red River County, Texas, and has been appointed county engineer of Hopkins County.

F. E. DELVIN, consulting engineer, Wichita, Kans., has opened a branch office at Dalhart, Texas, with James Rady as local manager.

A. W. CAMPBELL, chief commissioner of highways of Canada, has gone to England to attend the Public Works, Roads and Transport Congress and exhibition to be held in London this month.

A. P. DAVIS, former director of the U. S. Reclamation Service, has been retained by the City of Los Angeles as consulting engineer in connection with studies of water and power developments which the city has under consideration.

H. V. JOSLIN, purchasing agent of the North Carolina State Highway Commission, has resigned to accept a position as engineer in charge of construction with the Carolina Power & Light Co., Raleigh, N. C.

ERNEST S. MALTICE, formerly managing director of the Phœnix Bridge and Iron Works, Ltd., Montreal, has been appointed chief engineer of Canadian Vickers, Ltd., which recently took over the Phœnix company.

J. L. SIMPSON, British architect and builder, is touring the United States and Canada studying industrial building methods. During his New York visit he was the guest of the John W. Ferguson Co.

GEORGE MCNUTT, construction engineer, North Carolina State Highway Commission, has accepted a position as superintendent of highway construction in North Carolina for the Public Service Corp., of Newark, N. J.

W. R. JOHNSTON, JR., of Maplewood, N. J., has been made terminal engineer of the Lehigh Valley, R.R. He was previously assistant engineer on the Delaware, Lackawanna & Western R.R.

E. PAUL FORD, city engineer of East San Diego, Calif., has resigned, the consolidation of East San Diego with the city of San Diego having been ratified by election on Oct. 23. Mr. Ford will locate in the East.

DENHAM, VAN KEUREN & DENHAM is the new firm name of the consolidation of E. B. Van Keuren & Co., engineers and architects, and William L. Denham and George E. Denham, all of Birmingham, Ala., for the practice of architecture and engineering, with offices in the Herald Bldg., Birmingham.

A. G. MOTT, who has been an assistant engineer in the transportation division of the California State Railroad Commission, has been appointed transportation engineer, succeeding H. G. Weeks, resigned. Mr. Mott is a graduate of Stanford University and for eleven years was employed in various capacities by the Southern Pacific Railway Co.

H. G. WEEKS, transportation engineer of the California State Railroad Commission, has resigned to become assistant to the general manager of the Los Angeles Railway Corp. Mr. Weeks, who has been with the commission since 1913, has dealt with appraisals and rate proceedings, notably

the Los Angeles union terminal and grade crossing elimination cases.

HENRY H. QUIMBY, chief engineer of the department of transit, Philadelphia, Pa., in charge of the planning, construction and equipment of the new municipal high-speed lines, has resigned to engage in private practice.

H. C. FOSTER, formerly associated with the California State Highway Commission, has become affiliated with the Industrial Testing Laboratory of Los Angeles as engineer in charge of road construction.

ANDREW J. O'REILLY, consulting engineer, St. Louis, Mo., has been reappointed a member of the Missouri Public Service Commission. Mr. O'Reilly's new term will expire in 1929; he was originally appointed to fill out the unexpired term of Edward Flad, who resigned from the board about two years ago.

RAYMOND JONES, of the firm of G. W. Jones & Sons, Huntsville, Ala., has been appointed highway engineer for Limestone County, Alabama.

A. C. LINDLEY, engineer of construction work of the Missouri State Highway Commission, has resigned to engage in the road contracting business with LEWIS RICH of Kansas City, Mo.

GEORGE W. DUNCAN, JR., formerly with Leland & Haley, consulting engineers of San Francisco, Calif., has become associated with Albert A. Coddington, consulting mechanical engineer, and they will operate under the firm name of Coddington & Duncan, with offices in the Phelan Bldg., San Francisco.

Obituary

CHARLES A. BIGGER, assistant director of the geodetic survey of Canada since 1905, died suddenly of heart disease at Ottawa Nov. 9 in his 71st year. He was born near Paris, Ont., and for many years practiced as an engineer in Ontario and the West. In 1901 he entered government service and conducted surveys of the international boundary.

LYMAN P. HAPGOOD, former superintendent and since 1922 consulting engineer of the Jamestown, N. Y., water and lighting plants, died Nov. 14 after a long illness. He was 47 years old. Mr. Hapgood was a graduate of the Massachusetts Institute of Technology, class of 1899.

THEODORE C. LINK, architect who designed the St. Louis Union Station, the Washington University medical buildings and several of the buildings at the Louisiana Exposition in St. Louis in 1904, died of pneumonia at Baton Rouge, La., Nov. 12 at the age of 73 years. Mr. Link was supervising the erection of a group of buildings for the new Louisiana University and Greater Agricultural College at Baton Rouge, the projects aggregating $3,-000,000. He maintained an office in the Chemical Building, St. Louis. He was born in Germany and educated at Heidelberg, London and Paris.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Is Time for Preparing Bids Too Short?

In the Nov. 8 issue of "Engineering News-Record," p. 783 a manufacturer of waterworks equipment deplored the insufficiency of time usually allowed for preparing estimates or bids on proposed work. Manufacturers of other products used in the construction field expressed their views in the Nov. 22 issue, p. 866. Additional replies follow.—EDITOR.

Cranes

BY A. H. MCDOUGALL
Whiting Corp., Harvey, Ill.

WE have experienced the same difficulty when bidding on government and municipal work.

With reference to government bids, we have often received notice that bids would be received at a certain time and we would not have time to write to get specifications back and submit a bid. Sometimes there is not time even to receive the specification.

I feel that a great deal of this is due to the time that is taken up in elaborately preparing specifications and drawings for the work. Then the one for whom the work is to be completed gets in a terrible rush over the delay and therefore shortens the time for receiving the bids.

Water Meters

BY J. B. KIRKPATRICK
Neptune Meter Co., New York.

I BEG to advise that the Neptune Meter Co. is not complaining about the shortness of time available for the submission of estimates or bids on proposed contracts.

Cast Iron Pipe

BY D. B. STOKES
U. S. Cast Iron Pipe & Foundry Co., Philadelphia

WE have not experienced any trouble along the lines of insufficient time for preparation of estimates or contract bids. Probably the fact that a larger portion of our product for municipal use is made in accordance with the American Water Works Association specifications explains this. Were the material of more intricate design we might require more time to properly prepare a bid.

Automobile Production

Automobile production during the month of October totaled 360,924 cars and trucks, according to reports made to the National Automobile Chamber of Commerce. The total production of cars and trucks for the first ten months of 1923 has been 3,388,785 as compared with 2,119,111 for the same month of last year.

Gen. Tripp Honored by Japan

The government of Japan has conferred the second degree order of the Sacred Treasurer upon Gen. Guy E. Tripp, chairman of the board of the Westinghouse Electric & Manufacturing Co. This is the highest decoration that can be awarded a civilian foreigner by the Japanese government.


GUY E. TRIPP

General Tripp is in Japan at the present time in connection with reconstruction work following the recent severe earthquake, and his decoration was in recognition of his activities in assisting the Japanese officials in rebuilding the devastated area. During the World War he served as assistant to the Chief of Ordnance with rank of brigadier general. For meritorious service in this position the Distinguished Service Medal was conferred upon him by the President of the United States.

Brick Makers Will Produce Large Stocks for Next Season's Work

Not since the war, according to the monthly statement issued Nov. 1 by the Common Brick Manufacturers' Association, have the brick men gone into the closing months of the year with such determination to pile up stock as is manifested in current reports of 132 manufacturers doing business in 43 states. The situation on the Hudson River, which provides the brick supply for Greater New York operations, is indicative of what is going on in all the large brick-producing centers. By the time Hudson River navigation opens next spring it is anticipated that the plants along the river will have 600,-000,000 brick ready for shipment to their markets. This is 50 per cent greater than the winter stock in any recent year.

Plants are running at full time and will continue until freezing weather stops operations. Those plants equipped for winter running will continue throughout the interim before the coming season. These preparations are going on with the New York manufacturers in spite of the fact that quantities of foreign brick still lie on barges at the docks and many more millions of brick are on their way from Holland and Germany.

Reeves Heads Trade Executives

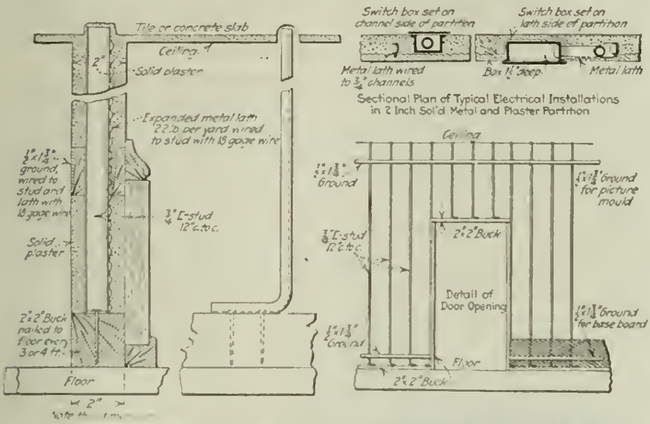
At its convention in Chicago last month the American Association of Trade Executives elected as its president Alfred Reeves, general manager of the National Automobile Chamber of Commerce. This organization consists of the managers or other executive officers of 158 trade associations.

A Space-Saving Office Partition

To save space in office buildings a new type of 2-in. solid plaster metal-lath partition has been designed by the Swetland Co., Cleveland, in co-operation with the Cleveland Association of Building Owners and Managers and the Associated Metal Lath Manufacturers. Economy of erection is one of the advantages claimed for this partition.

The details of its construction are shown in the accompanying drawing. Attention is directed to the fact that the wood grounds may be nailed together by long nails, bent over and clinched. The drawing shows the grounds wired to each side of the stud.

If picture molding or cornice is erected at, instead of below, the ceiling line it may be advisable to have a 2x2-in. buck at the ceiling. The channel studs may be attached to the floor buck by boring holes ⅜ in. in diameter in the buck and inserting the stud in these holes. This method saves bending the atud. It is essential to have a steel channel stud on each side of the door buck.



EASILY REMOVABLE PARTITION FOR OFFICE BUILDINGS

Trailer Association Would Admit Camping Equipment Makers

The membership committee of the Trailer Manufacturers Association, New York, announces that overtures have been made to the manufacturers of camping trailers in regard to joining the association. The association at present is composed exclusively of makers of commercial trailers. While the camp trailer is a very different vehicle and appeals to a different class of purchaser, the truck trailer men believe that they have enough in common with the camp trailer makers to furnish ground for co-operative work.

Construction Equipment Exported

Exports of construction equipment from the United States during September are shown in figures just issued by the Department of Commerce. During the month there were shipped 53 concrete mixers valued at $38,999, eleven of these units going to Japan; 3 power shovels, at $42,195; 185 conveyors, at $30,298; and 373 hoists and derricks at $87,296.

Claim Infringement of Pneumatic Concrete Placing Patent

Suit has been brought in the United States Court in New York for the infringement of the MacMichael patent No. 1,127,660 of Feb. 9, 1915, by the Concrete Mixing & Conveying Co. against the Ulen Contracting Co. on account of the use by the defendant of pneumatic concrete conveying and placing machines in the Shandaken tunnel of New York City's Catskill aqueduct. The development of this system by MacMichael dates back to 1907, when the application for the patent under which suit is brought was filed.

The apparatus involved in the infringement is known as the Webb-Cox placer, and operates in the tunnel to shoot the concrete dumped therein along a conduit by the action of compressed air and place it around the forms for the tunnel lining. Suits against other infringers are expected to follow.

Material-Handling Equipment To Be Shown at Power Show

Material-handling equipment will be a new feature of the second National Exposition of Power and Mechanical Engineering to be held at the Grand Central Palace, New York, Dec. 3-8. The equipment to be exhibited will include conveyors of all kinds, locomotives, industrial trucks, elevators, hoists and large scales. One exhibitor is to install a working model of a complete system of steel-belt conveyors for handling sticky materials, sharp-edge materials or materials at high temperature. Another manufacturer will show a working model of complete coal-handling equipment in a minature power house. The model will show a skip-hoist, bunker, coal weigh larry and cable drag scraper. A program of motion pictures showing the application of equipment will be displayed.

The Power Exhibition, held annually, features the development of apparatus for the economical combustion of fuel and the production and utilization of power. The managers of the exposition are Fred W. Payne and Charles F. Roth with offices in the Grand Central Palace.

Pan-Americans to Inspect U. S. Roads and Transport

Trip for Forty Delegates Arranged by Automotive, Road Machinery, Financial and Government Interests

FORTY delegates will be brought to this country from Pan-American countries to make an intensive study of highways and highway transport under the terms of a plan approved by government, automotive, road machinery, road material and banking representatives at a meeting held in New York, Nov. 22. The proposal as outlined by J. Walter Drake, Assistant Secretary of Commerce; T. H. MacDonald, chief, U. S. Bureau of Public Roads, and Dr. G. Sherwell, secretary-general of the Inter-American High Commission, provides that the men to be invited will be named here, and all of their expenses will be paid by private subscription.

The immediate purpose is to give the delegates a sufficient understanding of developed highway transport to enable them to participate actively in the Pan-American Highway Congress proposed at the last meeting of the Pan-American Union and which will be held as a separate project next year. The ultimate objective is the promotion of closer relations between the United States and the other countries of the Americas.

Roy D. Chapin, Hudson-Essex Co.; W. A. Beatty, Austin Manufacturing Co., and Fred I. Kent, Bankers Trust Co., were named as an executive committee. Details in this country will be handled by the Highway Education Board. S. T. Henry, Allied Machinery Co. of America, will manage the project.

The motor industry was represented at the meeting by Roy D. Chapin, vice-president of the National Automobile Chamber of Commerce; Alfred Swayne (General Motors); A. J. Brosseau (Mack); and Alfred Reeves, George Bauer and Pyke Johnson of the National Automobile Chamber of Commerce.

Cement Industry Worked at 20% Below Capacity in 1921

Cement manufacture during 1921 was at a rate more than 20 per cent less than the capacity of the industry. Had conditions been such as to make maximum output possible, cement to the value of $259,015,207 would have been manufactured during that year. Instead the value of the output of the 125 cement plants of the country was $203,626,929, or 78.6 per cent of the possible output.

These figures have just been made public by the Bureau of the Census. They were compiled as a result of recommendations by the Committee on Census Schedules, created at a conference of trade associations which met in Washington in 1921 at the instance of the National Association of Manufacturers. Nathan B. Williams was chairman of the committee.

Paving materials manufacture was at a rate slightly greater than half the capacity of the industry to produce. Had conditions in that industry been such as to make possible maximum output paving materials to the value of $104,724,458 would have been produced. As it was, the value of products aggre-

gated $61,128,969, or 58.4 per cent of the possible output.

The percentage of possible output among all of the industries of the country was 56.8. This covers 194,194 establishments, with a combined value of products of $42,318,241,453. Had these plants worked at maximum capacity, they would have produced, $74,123,930,736.

Business Notes

National Steel Fabric Co., Pittsburgh, established on Nov. 1 a dealer sales department in charge of W. H. Shaffer, Jr., who for seventeen years had filled a similar position with the Universal Portland Cement Co. The function of the new department is to promote sales of dealers and to expedite deliveries of materials.

National Lime Association, Washington, D. C., announces the appointment of Burton A. Ford as secretary and general manager. For the past three months Mr. Ford has been acting secretary of the association. He is a graduate of the University of Maryland, and until the summer of 1922 was with the Virginia-Carolina Chemical Co. in the capacity of division manager, and was also secretary-treasurer of the Bryant Fertilizer Co. In the summer of 1922 he became assistant to W. R. Phillips, who was then general manager of the National Lime Association.

Harry Meachem, formerly of Dean Bros., Indianapolis, has been appointed vice-president and general manager of the Rider-Ericsson Engine Co., New York.

United States Cast Iron Pipe & Foundry Co., Burlington, N. J., announces the appointment of Thomas P. Anthony as chief engineer, with headquarters at Burlington. P. T. Laws has been chosen as the company's Southern district manager, with headquarters at 1002 American Trust & Savings Bank Building, Birmingham, Ala.

Chain Belt Co., Milwaukee, manufacturer of Rex chain, concrete mixers and conveying equipment, formerly represented on the Pacific Coast by Meese & Gottfried Co., San Francisco, has established direct factory branches and warehouses in Portland and Seattle. Arrangements have also been made with the Washington Machinery Depot, Tacoma, to carry stocks of chain and transmission machinery. Other stocks will be placed in important centers throughout the Pacific Northwest for the prompt handling of local requirements. The Northwest territory, with headquarters at Portland, will be in charge of Allen C. Sullivan, formerly connected with the Allis-Chalmers Co., Milwaukee, and more recently with Smith & Watson Iron Works of Portland. Don B. Catton, formerly with Meese & Gottfried Co. and later engaged in the machinery supply business on his own account will be the special sales representative for the Portland office. The Seattle and British Columbia territory will be handled by William F. Nichols who for the past 11 years has been with the Meese & Gottfried Co.

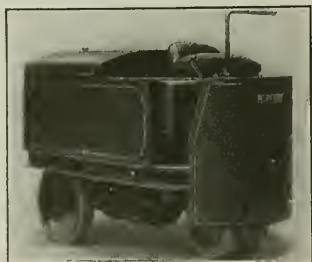
Equipment and Materials

Cork Foundations to Reduce Vibration of Machinery

To minimize the vibration of heavy machinery the Korfund Co., New York, has placed upon the market a cork foundation plate of German origin, made of solid blocks of natural cork bound together into rectangular slabs by iron straps and impregnated by a method which is claimed to prevent decay and at the same time preserve the maximum elasticity of the cork. These insulation plates are in the form of rectangles 4 in. thick and 10 x 12 ft. in plan. This type of insulating foundation, the manufacturer claims, not only increases the life of the machine which it supports but also prevents damage to buildings in which machinery is housed. The cork plates may be obtained to fit any size of machinery and any shape of foundation. The company also manufactures a cork insulating plate to be placed between the tie and the rail of a railway track.

Internal-Gear Industrial Tractor

A new storage-battery tractor brought out by the Mercury Manufacturing Co., Chicago, for industrial service in shops, freighthouses and manufacturing plants, differs from the company's previous designs in having an internal gear in-



stead of a worm-gear drive. An increased work efficiency of 25 to 35 per cent is claimed for this design, increased power being accompanied by a decrease in power consumption. A pinion driven by the motor through a flexible coupling drives a bevel gear in the axle housing and this gear in turn drives the axle pinions for the two rear wheels. Each pinion transmits the power through three idler gears to an internal or ring gear on the inside of the rim of the 20-in. driving wheel. With a gear ratio of 18 to 1 the drawbar pull is 475 lb. normal and 1,800 lb. maximum, while with a ratio of 24 to 1 the figures are 600 lb. and 2,100 lb. respectively.

The power unit, including a high-speed motor, is self-contained and can be detached from the machine by removing two bolts. Heat-treated chrome manganese steel is used for all gears. The steel frame carrying the battery box and control apparatus is carried by semi-elliptic springs and four rubber-tired wheels, but the two 15-in. front wheels are mounted on a short axle to give as short a turning radius as a three-wheel arrangement. This radius is 5 ft. The service brake has shoes bearing on a drum on the motor armature. When the driver dismounts an emergency brake is set automatically by a spring under the seat, the same spring also shutting off the current. A rear coupler is carried by a cast-steel fork attached to the axle housing, so that the pulling strain is taken directly by the axle and not by the frame and springs. At the front end is a combined fender and bumper to protect the driver and to permit of pushing trailers when necessary.

In overall dimensions the machine is 5 ft. 8 in. long, 3 ft. 3 in. wide and 4 ft. high. Its weight is 1,850 lb. without battery and from 2,750 to 3,350 lb. in working order, according to the kind of battery and number of cells. The speed capacity, without load, is 660 and 572 ft. per minute for 18 to 1 and 24 to 1 gear reduction, or 7½ and 6½ m.p.h. respectively.

Publications from the Construction Industry

Metal Lath Data—Truscon Steel Co., Detroit has included in its 48-p. illustrated "Metal Lath Data Book" a mass of information well arranged and clearly expressed, on approved methods and specifications for the use of metal lath in building construction of all types. The information should be particularly valuable to engineers, architects and contractors. The text represents a year's study of the practical uses of metal lath. There are a number of pages of detailed drawings of partitions, walls, floors, roofs, and attached and suspended ceilings. Suggestions also are offered for interior plastering and exterior stucco work. Useful data on loads and properties of Hy-Rib are contained in the form of tables. For all uses of metal lath described and illustrated detailed specifications are given.

Power Shovels—Marion Steam Shovel Co., Marion, Ohio, features its ¾-yd. revolving electric and gasoline-electric shovels in a newly issued 16-p. illustrated bulletin. Data are given showing comparative cost of steam, electric, and gasoline-electric operation, and the various mechanical features of the machine are illustrated and described in detail. A feature of the shovel is the use of separate motors for the three main operations of crowding, hoisting and swinging.

Hydraulic Dredging Machinery—Morris Machine Works, Baldwinsville, N. Y., features its sand and dredging pumps and hydraulic dredging machinery in a 44-p. illustrated booklet just published The text includes a discussion of sizes and capacities of hydraulic dredges, the use of hydraulic dredges for the production of sand and gravel and hydraulic mining operations. Detailed illustrated descriptions are given of the company's standard dredge pumps, including models belt-driven, direct-connected to steam engines and motor operated. Part of the text is devoted to auxiliary equipment, such as cutters, agitators, hoists, sheaves and spuds.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 291 to 303, are the following:

High School, Boston, Mass., Dept. Pub. Wks., $1,200,000.

Hotel, Birmingham, Ala., T. H. Molton, $1,500,000.

Dam, Los Angeles, Calif., Los Angeles Co., $20,000,000.

Large Contracts Let During Week

Among the weeks announcements of contracts awarded in Construction News, pp. 291 to 303, are the following:

Power Plant, Davenport, Ia., United Light and Railways Co., Grand Rapids, Mich., $10,000,000.

Apartment Hotel, Dallas, Tex., to Gilsonite Constr. Co., $1,800,000.

Hotel, San Diego, Calif., to Vukicevick & Bagge, San Francisco, $1,000,000.

Apartment, New York, N. Y., $1,000,000.

Hotel, Louisville, Ky., to Rommel Bros., $2,300,000.

Recent Unit Bids Throughout the Country

The accompanying table gives representative bid prices of various materials and operations, applying on a number of the more important contracts awarded during the last month.

A workable acquaintance with construction cost in outlying districts, may be had by studying the unit bids published weekly in the Construction News section of *Engineering News-Record.*

Common Brick Imports Increase

Receipts For Last Three Months Gain Heavily Over Preceding Quarter —Domestic Output Heavier

Nearly 19,000,000 common brick were imported into this country, through the Port of New York, during the third quarter of the current year as against 10,379 for the preceding quarter. According to the Bureau of Foreign and Domestic Commerce the actual total was 18,953,000 (valued at $155,502), 18,365,000 of which came from Holland.

These brick, with few exceptions, conform to the American standard size, i.e., 8 x 3¾ x 2¼ in., and have not materially affected the domestic common brick quotation, neither have they pene-

UNIT-BID PRICES ON IMPORTANT MATERIALS AND OPERATIONS IN RECENT CONTRACTS AWARDED

Where Located	E.N.R. Issue	Nature and Extent of Job	Unit Bid Price
Calif., Eureka	Oct. 4	12,500 ft. 2 in. standard black pipe, per ft.	$0.1688
Calif., Los Angeles	Oct. 4	700,000 cu.yd. dredging	$94,080.00
Calif., Yuba City	Oct. 11	42,000 cu.yd. suction dredging, per cu.yd.	.50
Calif., Los Angeles	Oct. 11	1 mi. Conc. pavement, per sq.ft.	.23
		Curb, per lin.ft.	.70
		Sidewalk, per sq.ft.	.25
Calif., Los Angeles	Oct. 18	40,000 bbl. cement, sacks 15c. extra, 5c. per bbl., f.o.b. cars Crestmore.	2.55
		40,000 bbl. cement, sacks 15c. extra, 5c. per bbl.	3.112
		40,000 bbl. cement, sacks 15c. extra, 5c. per bbl., f.o.b. cars Colton.	3.115
Calif., Ventura	Nov. 15	6,000 cu.yd. excav., per cu.yd.	.65
		21,765 ft. rolling, per ft.	.20
		348,224 sq.ft. 5 in. asphaltic conc., per sq.ft	.178
Calif., Los Angeles	Nov. 15	180,000 sq.ft. 6 in. bituminous pave., per sq.ft.	.2275
		9,512 ft. curb, per ft.	.65
		44,710 sq.ft. walk, per sq.ft.	.20
		10,800 sq.ft. gutter, per sq.ft.	.30
Ia., Oskaloosa	Oct. 4	7,121 sq.yd. pave., per sq.yd.	2.84
		5,492 lin.ft. conc. curb and gutter, per lin.ft.	.84
		Grading, per cu.yd.	.70
Ia., Cherokee	Oct. 11	98,503 cu.yd. excav. (road grading), per cu.yd.	.27
Ill., Belleville	Oct. 11	12,000 ft. (14 ft. road) rein.-conc. pave	108,391.00
Ky., Frankfort	Oct. 18	77,009 cu.yd. earth excav., per cu.yd.	.38
		58,818 cu.yd. solid rock excav., per cu.yd.	.98
		43,262 cu.yd. loose rock. excav., per cu.yd.	.80
		1,958 ft. 18 in. conc. pipe, per ft.	2.75
		1,268 ft. 24 in. conc. pipe, per ft.	4.00
Mass., Medford	Oct. 18	20,500 sq.yd. bituminous macadam pave.	48,000.00
Mass., Boston	Oct. 25	46,950 sq.yd. 4 in. bituminous conc., per sq.yd.	1.55
		11,320 cu.yd. excav., per cu.yd.	1.50
Miss., Canton	Oct. 4	Excavation, per cu.yd.	.60
		Curb and gutters, per lin.ft.	.90
Mich., Lansing	Oct. 11	17,711 cu.yd. excav., per cu.yd.	.60
		43,352 sq.yd. 7 in. rein.-conc. pave., per sq.yd.	1.25
Mich., Lansing	Oct. 18	9,338 cu.yd. earth excav., per cu.yd.	.50
Minn., St. Paul	Oct. 11	16,700 cu.yd. gravel surfacing	21,790.00
Mo., Sedalia	Oct. 11	11,200 sq.yd. grading and conc. pave., per sq.yd.	2.35
Miss., Albany	Nov. 15	17,625 cu.yd. common excav., per cu.yd.	.35
		11,882 cu.yd. borrow excav., per cu.yd.	.36
		15,998 cu.yd. gravel 1 mi. haul, per cu.yd.	.88
N. J., Bordentown	Oct. 4	1,600 ft. 6 in. c.i. pipe	9,600.00
N. Y., Brooklyn	Oct. 11	300,000 gal. asphaltic cement	15,600.00
		6,000 cu.yd. binder stone	13,860.00
		50,000 asphalt paving blocks	4,780.00
		50,000 grade 1 granite paving blocks	6,900.00
		50,000 wood paving blocks	2,950.00
N. Y., Brooklyn	Oct. 18	1,200 lin.ft. 12 in. vit. sewer pipe, per ft.	3.00
		260 lin.ft. 15 in. vit. sewer pipe, per ft.	4.00
		350 lin.ft. 18 in. vit. sewer pipe, per ft.	5.00
		300 lin.ft. 24 in. vit. sewer pipe, per ft.	7.00
		50 lin.ft. 6 in. water sewer pipe, per ft.	1.50
		200 lin.ft. 8 in. water sewer pipe, per ft.	2.50
O., Akron	Oct. 11	4,960 lin.ft. stone curb, per lin.ft.	1.35
		3,400 sq.yd. brick gutter, per sq.yd.	2.35
		53,600 sq.ft. sidewalk, per sq.ft.	.22
		26,000 sq.yd. earth excav., per sq.yd.	.60
		16,800 sq.yd. Texaco asphalt, per sq.yd.	1.50
		8,360 sq.yd. vitr. brick, per sq.yd.	2.30
O., Columbus	Nov. 15	3,000 ft. 8 in. c.i. pipe	41,783.00
Pa., Waynesburg	Oct. 4	2 mi. conc. road	108,729.00
Pa., Philadelphia	Nov. 15	1,000 ton crushed stone, per ton	2.87
S. C., Dillon	Oct. 4	6.9 mi. sand clay road	36,362.00
S. D., Sioux Falls	Oct. 11	1 mi. conc. pave	35,000.00
Texas, Dallas	Oct. 18	4 in. class B, c.i. pipe, per ton	65.00
		12 in. class B, c.i. pipe, per ton	61.00
Wash., Olympia	Oct. 11	3,520 sq.yd. crushed rock surfacing, per sq.yd.	2.00
		3,800 cu.yd. excav., per cu.yd.	.30
		12,260 cu.yd. excav. loose rock, per cu.yd.	.55
		15,180 cu.yd. excav. solid rock, per cu.yd.	1.50

trated very far inland, most shipments having been consumed in the New York district.

Common brick in the New York market are quoted at $19 per M wholesale, alongside dock, as against $19@20 one month ago. This decline, however, is seasonal and does not reflect the influence of importations.

Brick importations through the Port of New York, during the last quarter, are shown in the following table:

	Number	Value
July:		
Holland	9,443,000	$74,377
August:		
Canada	100,000	1,380
Holland	3,373,000	26,989
September:		
Germany	63,000	411
Holland	5,549,000	48,420
Canada	425,000	3,925
Total	18,953,000	$155,502

Reserve stocks of burned and unburned brick, particularly in the New York distrct, are 50 per cent greater than winter stocks in any recent year. According to the Common Brick Manufacturers' Association of America, brickyards are running at full time and will continue until freezing weather stops operations. Those plants equipped for winter running will continue operations until spring. These preparations are going on with the New York manufacturers despite the quantities of foreign brick on barges at the docks.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Nov. 1; the next, on Dec. 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.25
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.25	5.30	5.00	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.38	3.20	3.45	3.85	3.65	4.10	4.00
Steel pipe, black, 2½ to 6 in. lap, discount	44%	40%	43%	47%	53–5%	36%	33.2@42.2%	35%	47.43
Cast-iron pipe, 6 in. and over, ton	62.10@63.60	54.75	61.00	57.20@60.20	60.50	69.00	—59.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.55@2.65	2.60	2.05	2.10	2.42	2.84	2.61	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	1.85	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	2.00	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	61.00	39.00	54.75	57.50	44.75@45.75	48.00	41.00	29.50	42.00
Lime, finishing, hydrated, ton	18.20	25.00	23.50	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.60	1.85	1.50	1.50	2.70	2.10	2.80	9.50
Common brick, delivered, 1,000	+22.55	11.00	11.60	11.00	16@18	12.00	15.00	15.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	.110	.0724	.075	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1179	.102	.110	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.98	.96	1.03	1.14	+.99	1.07	—1.03	1.15	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.50@.55	.35@.50	.50	.62½	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quanties are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on white pine lumber, free on cars at mill. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tilo per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.91). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in., $119.

Changes Since Last Week

Increased activity in pig-iron buying is possibly the most favorable factor in the current business situation. Sales, though not involving large tonnages, constitute a marked contrast with the recent dullness in this important commodity.

Rise in cotton prices and a recovery of the foreign exchange are also noteworthy features of the weeks' developments.

Car loadings for the last twenty-one weeks have passed the million mark. A total of 1,036,067 cars were loaded during the week ended Nov. 10. These freight movements indicate heavy distribution of materials for this time of the year.

The trend of the lumber movement indicates a falling off in production but at the same time a substantial increase in shipments and new business.

Cement prices declined 8c. in Minneapolis and 10c. per bbl. in Chicago, during the month. Similar recessions occurred in eleven other cities in the Middle West.

The Japanese Embassy on Nov. 14, advised the National Lumber Manufacturers' Association, that contracts for 97,150,000 ft. of lumber had already been awarded. Contracts were also let, during the month, by the Japanese Ambassador, in behalf of the Japanese Government, for 20,000 tons of steel sheets, to the U. S. Steel Corporation; 2,000 tons of wire nails to the Youngstown Sheet and Tube Co. and 1,000 tons of wire nails to the Pittsburgh Steel Company.

Common brick advanced $1 per M., wholesale, alongside dock New York, making the present price $19, against $18@$19 per M., one week ago. The advance was evidently due to a general movement on the part of materials buyers, to cover their requirements against a possible Spring shortage.

A Consolidation of Engineering News and Engineering Record McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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FRANK C. WIGHT, *Managing Editor*

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Pity the Poor Editor

THIS is the time of the year when an editor realizes how elaborate is the mechanism of government. In every mail there comes from Washington some new product of the Government Printing Office. Yesterday it was the special press copy of the annual report of the Corps of Engineers (printed on one side of each sheet only, 6½ in. thick and weighing 8 lb. 2½ oz.); today it is the more modest report of the Shipping Board, the not yet to be released message of the President to Congress, three minor bureau reports and a long abstract of what the Chamber of Commerce of the United States thinks Congress should do in the next month or six weeks. Tomorrow several of the Cabinet officers will submit their annual accountings, accompanied in each case by nicely abstracted digests for press consumption, all signed, if not read, by the member of the cabinet whose ostensible words are so recorded. The mere reader is fortunate. Much of this verbosity finds the waste basket and that which survives suffers a diminution which must pain the official authors. Pity the poor editor, who can not so easily avoid his irksome task of finding out just what the government at Washington does to insure that the republic still lives.

Responsibility

THOUGH investors had paid in $282,000, receivers for the Federal Home Building Corp. of St. Louis found that the organization had only $1.92 in cash, a bank balance of $127.12 and a $50 Liberty bond, as liquid assets. Contract holders for whom not even plans had been drawn, and who had been promised residences at a cost lower than any contractor would quote, had paid $123,608. The receivers' audit showed practically no construction work done for the 400 contract holders. It is not often one can reduce to dollars the value of responsibility in contracting; but each of some 400 persons in St. Louis now place that value at $700.

Force Account Again

IS IT best to do public work by day labor? This question is asked in this issue and answered by three experienced engineers. It has frequently been asked and answered in the past. Indeed the question is perennial. Also the answers this time are no more likely to be accepted as final than have the same answers of years gone by. There is little prospect that the situation will change. So long as contractors prosper by doing public work just so long will engineers aspire to save this profit for the public. And so long as political interference exists in the management of public work so long also will engineers be dubious of the chances for its economic conduct by day labor. To reason thus in a circle gets the argument of contract versus day labor construction to no definite end. Argument anyway is futile. Any argument is futile which starts from assumed conditions which the two sides do not agree on. The conditions essential to successful day labor construction as stated by Mr. Holleran in his article in this issue are in the main part asserted not to exist by Mr. Brown. It serves little purpose under such conditions to wrangle about force account and contract construction as a preferable policy for public work. As they stand the three articles in this issue present the situation about as fairly as can be.

Winter Work Costs Less

AS EXPERIENCE with winter construction increases its disciples multiply. Last week at a luncheon meeting of the New York Building Congress both architects and builders stood up and proclaimed the doctrine that not only was winter building practicable but that it cost less than construction in the normal building season of eight months of spring, summer and fall. Some of the evidence presented by the several speakers is given on another page. The winter reduction in prices and the winter increase in the output of workmen make an astounding record. Indeed one must be cautious in accepting the figures at face value. With winter construction universal the various influences which now tend to lower materials prices and to prompt efficiency of labor would be largely modified. It is the dearth of construction in winter which now makes workmen anxious to hold their jobs by high production and that induces the materials producer to cut prices so as to keep his product moving in the normally dull sales season. It also has to be observed that building work offers a greater possibility for winter operations than do public works and more exposed operations generally. But when all allowances are made the elimination of seasonal operations is bound to reduce the cost level of construction. The task is to convince the building public against all the influences of habit and tradition that there need to be no seasons in building. Records of actual operations in winter such as were presented at the Building Congress meeting will do more to accomplish this task than will volumes of general preachment on the evils of industrial waste. The time indeed has come when less talk and more facts are badly needed in the warfare against seasonal construction.

Timely Business Statistics

BUSINESS statistics are rapidly becoming of more than academic interest. There was a time when mass figures on production, consumption, costs and prices were accumulated only by the census office and published many years after their collection. They thus became merely historical references for the professional economist and were of value mainly in assisting him in telling what really happened in the past. Today such figures have a live interest to every forward looking business man, because he is training himself to use them in the study of the immediate past as some indi-

cation of the immediate future. This requires above all that such statistics should be complete and timely. Both of these qualities mark the new venture of the Department of Commerce, known as the "Commerce Yearbook" which has just been published and which is noted on p. 952 of this issue. The current issue covers 1922 and the first months of 1923 and a new edition covering all of the current year is promised for next spring. No one business man is going to be interested in all the statistics the government has here placed before him but every man can find a section which reports some basic data that should guide him in his business.

Tourist Highways Profitable

TOURIST service is given special consideration in highway development in Wisconsin. Blessed with a wealth of waters and woodland which attract the vacationist, the state has been alert to realize, if these profitable visitors are to come and spend money, that the ways of access must be easy and that in this era of the automobile these ways are the public roads. It has found that well-kept, well-marked roads develop tourists. Recently it has undertaken to determine the number, length of visit and expenditure of these motor tourists. From careful traffic counts it finds, according to J. T. Donaghey, engineer of maintenance, Wisconsin Highway Commission, that there are 7,000 cars in and out of the state each way every day from June 10 to September 10. The average stay in the state of these cars is 10.8 days and the average expenditure per car is $11.72 daily. Without going into the calculations in detail, it is noted that Mr. Donaghey computes the season's expenditure in Wisconsin by out-of-state motor tourists to be $100,000,000. He believes that citizens of the state touring by automobile for pleasure spend twice this sum. But keeping to the out-of-state vacation visitor, it is obvious that a hundred million dollar crop created largely by good roads has high significance to state highway officials. It at least offers a good rejoinder to the complaint often heard from the farmer that improved roads are being built for visitors to wear out. As Mr. Donaghey well says: "Even though the tourist traffic is wearing out our highways and causing large annual expenditures for both construction and maintenance it is leaving profits enough along its trail to repair and build the highways much more rapidly than it wears them out."

A Time for Action

IN 1917 A DEADLOCK between a joint committee of the New York City Board of Estimate and the State Public Service Commission on the one hand and the New York Central R.R. on the other was the climax of six years of negotiations looking toward an improvement of the freight line serving the west side of Manhattan Island. It was particularly unfortunate because it followed so closely upon the tentative agreement which had been reached in 1916, when the railroad and the Board of Estimate were co-operating in the study, by which the railroad was to bear all the expense of the grade separation and electrification in exchange for certain parcels of land needed for its enlarged facilities. The deadlock resulted from an attempt to alter this tentative agreement so that the railroad would get the land under a lease revocable in twenty-five years. Naturally, the railroad company considered that it would not be justified in making the expenditure called for by the improved facilities with the possibility of the lease being canceled a few years after the work was completed, and so rejected the new proposal.

In October, 1917, in commenting on the action of the joint committee *Engineering News-Record* said editorially "In six years possibly the commission, having studied the matter from all angles . . . will make the headway the board did in 1916. . . . But no solution will ever come that is enough better than the 1916 plan to compensate for the delay."

Six years have passed and under the spur of a new law which requires the electrification of all railways in New York City, and with a judicial decision which guarantees the railroad its right-of-way, the New York Central has filed the new set of plans for a west side improvement noted in the news section this week. In its chief features this closely follows the 1916 arrangement, but takes advantage of the state grade-crossing law whereby the state and city will each pay 25 per cent of the cost of the grade-crossing separation. In its minor features, the plan is not so elaborate as the 1916 plan and, in view of the state of the city's finances and the need of keeping down unproductive expenditures by the railroads, it is superior to the earlier plan, though that plan could have been put through in 1917 for a considerably less sum.

Opposition to the plan will come from three classes of people; first, those who are opposed to any proposition which is put forward to continue a railroad along the west side of Manhattan Island; second, from those who think that such a railway line should be a joint one, open to all the railroad companies having terminals in New York, and, finally, from residents of the Riverside Drive section who think that the railroad should be entirely hidden from their sight. The first objection is obviously absurd. The west side line is vital to Manhattan Island. The second objection has some argument in its favor, but is almost impossible of attainment without years of litigation, and even then can just as well be put into effect after the new line is built as before it if such an arrangement is found to be practicable. The last argument is, in our opinion, an unreasonable demand for the expenditure of large sums of money in the elimination of a condition which, when the railroad is electrified, will no longer be a serious detriment to the community. There is no reasonable excuse for asking the railroad company to add that much to the cost of delivering goods to Manhattan Island, for that is what such an expenditure must amount to, and if the city has money to spend for such purposes it might better spend it in creating new park spaces down on the East Side.

The estimated cost of the completed project under the 1916 was $50,000,000. The estimated cost of this lesser project is $70,000,000. That much has already been lost by delay. The loss through delay caused by the present method of surface operation in the warehouse district and from inadequate facilities is enormous and must continue until the new facilities are provided. Further delay is unnecessary and costly. All the arguments pro and con have already been accumulated in the voluminous minutes of hearings held in the six years previous to 1917. There seems to be little reason for repeating them; the time is one for action, not for words.

Getting Metering Across

CONTRARY to the generally held view among politicians, the people may want water meters. At least that is what the recent experience of Chicago's officials would go to show. In analyzing the political psychology of the water-waste situation in Chicago the Western Society of Engineers concluded that the word "metering" was one of the big stumbling blocks in getting meters installed, for always the politician asked what meter company wanted to make a sale. In consequence in none of their recommendations did the society refer to anything but "water-waste prevention" nor did any of the city officials in their appeals to the public stress anything but waste prevention and the equity of paying for a measured service. As a result it looks as though the politician's objections were pretty well answered. In the November bills sent out to certain wards which were supposed to be particularly opposed to meters a letter was enclosed explaining how a flat-rate bill of $5.50 would pay for 88,000 gal., or 242 gal. per day, if billed on the measured-service basis. Prior to this a hurried educational campaign in these districts had been made, consisting of talks before improvement associations. By return mail requests began to come in by the hundred, so fast that the appropriation for meters bids fair to be soon exhausted. Aldermen usually know a good thing politically when they see it and unless all signs fail this response of their constituents is going to make them a bit careful about opposing a universal metering ordinance now under consideration. What the majority of the people want and what the aldermen give them will coincide if only the people have the means of letting their wishes be known.

Define Highway Research

CO-ORDINATION of thought is the first task of highway research engineers. Research now means too many things. One man is thinking of pure research to disclose fundamental scientific principles and another is thinking of investigation which discloses the adaptability of a local material for a local road building purpose. Another man confuses routine test analyses with objective investigation. Again one man is searching to find how he may determine and state precisely the problem to be solved and another is seeking the solution first by working all ways from some outcropping factor which has thrust itself into his immediate planning. At the American Research Council meeting two weeks ago of the Advisory Board on Highway Research each of these thoughts was in evidence at some point in the reports and discussions. The fact in no way justifies censure of the work so far of the Advisory Board. It has had a handful throughout its short life of two years in bringing the various highway research agencies into sufficient co-ordination of activities to prevent constant repetition and duplication of experiments. This it has done, perhaps not completely, but in a noteworthy measure. As a result we are now getting to have in America cumulative experimentation in highway and highway transport engineering. Perhaps co-ordination of research thought is harder to attain. The engineering bent of mind is less toward pure research in the sense that we speak of pure science and more toward determination of facts to be used in solving a specific detail in actual design or construction which occupies immediate attention. There is the further obstacle that funds are not often plentiful for extended research merely to define and state a problem to be solved by further research. The engineer has a hard task to explain expenditures for research that cannot be immediately realized on in the way of usable data. But even accepting these conditions research thought can be made more precise and perhaps the task can well be begun by definition by the Advisory Board.

Co-operative Rail Study Begun

WHAT we have long believed to be the most promising plan for improving the quality of rails, to wit, co-operative study of rail troubles by mill men and railway engineers, has just been put into practice. A joint conference group of representatives of the two interests met at Washington recently, on invitation of the Bureau of Standards, and agreed to enter into such study. Railway and mill men have met before this, many times, but usually for the purpose of quarreling over rail specifications, which proved to be fruitless business; but the same parties that could not agree under those conditions will be able to reach a useful result when they are on the same side of the table.

For the present a single factor of unsatisfactory rail performance, the transverse-fissure type of failure, has been taken up for consideration. The first attack is through a statistical study of fissure breaks; this fact has just been announced by the American Railway Association in calling upon its member lines to compile and forward all pertinent data in their possession. In all probability this study will throw new light on the long-disputed question whether fissure failures exhibit furnace-heat influence or track-service influence more strongly. This question is necessarily the starting-point of discussion, as the difficulty of improving rails has been largely due to the opposition of view between those who hold that excessively severe track service causes fissures and those who hold that some elusive metallurgical defect is responsible. The recent contribution to the subject of James E. Howard has enlivened this opposition of view, the more so as railway engineers are accumulating strong evidence pointing toward the predominating influence of "sick" heats of steel upon fissure failures.

So long as opinion differed sharply on a fundamental point of this kind, the chance for writing better rail specifications was zero or negative. But the co-operative effort now begun—and let us hope it will not become prematurely deceased—is almost certain to develop enough definite knowledge to better this condition. It will serve a very direct need of modern railway engineering, moreover, if it succeeds in showing a way by which the new rails of very heavy section (above 100 lb. per yd.) can be given as high a carbon content as wear and strength demand, without introducing increased liability to fissure formation.

Perhaps even at this early stage of the work it may be serviceable to recall that where a question has two sides each defended by strong argument it is usually found that both sides are right. So in the present matter, the full data may show both excessive track service under certain conditions and defective steel in certain lots of metal. In that event the gain from the newly begun study will be only the greater, since it will have a beneficial reaction on both the railway and the steelmaking art.

Two Reinforced-Concrete Bridges in France

Vesubie River Arch Structure and Bowstring Bridge Over Maudit River at Nantes Are Typical Examples of Recent Long-Span Concrete Bridges

By W. L. Scott
Chief Engineer, Considere Constructions, Ltd., London, England

TWO BRIDGES of considerable span, one across the River Vesubie and one at Nantes, provide excellent examples of the progress of reinforced-concrete bridge construction in France. Both of these bridges have been constructed to Considere designs and while being similar in elevation, are entirely different in type. The former is an arch bridge, thrusting on mass concrete abutments, and the latter is a bowstring bridge in which the horizontal thrust given by the arched ribs is taken through the ties formed at deck level.

FIG. 1—CONCRETE ARCH ACROSS VESUBIE RIVER

Deformation in the arch ribs of any bridge result from: (1) Compression due to the dead weight of the bridge and superimposed loading; (2) inevitable settlement of the abutments during construction and immediately after completion; (3) shrinkage of concrete during setting and hardening; and (4) atmospheric variations of temperature. It is essential that these factors be taken into consideration in the design of big span bridges, in which the main supporting members are of the arch type.

In the case of the bridge over the River Vesubie, the above factors are principally provided for by introducing temporary hinges at each of the springings and at the crown during construction, and, in addition, by completely severing the deck platform in a transverse direction near one end of the bridge.

In the case of the bowstring girder bridge at Nantes, concrete rocker bearings were provided at one end of the bridge and roller bearings at the opposite end thereby permitting angular as well as longitudinal displacement. It will be appreciated that temperature and shrinkage stresses do not require to be taken into account in the design, since the horizontal ties are affected in a similar manner to the arch ribs and approximately to the same extent.

Vesubie Bridge—The bridge over the River Vesubie (Fig. 1) is 344½ ft. long and with a clear span of 315 ft. is among the largest of its type in the world. The deck platform accommodates a roadway 16½ ft. wide and two footpaths, one on either side, giving a total width between parapets of 24 ft. As will be seen from the illustration, the entire deck platform is suspended from the main arch ribs and with this arrangement no interruption is given to the river when it is in flood.

The temporary staging used in the construction of this work was of the ordinary type in which the weight of the structure was carried on transverse trestles, which carried longitudinal timber trusses, so braced that each vertical suspender was strutted to the transverse trestles.

Temporary Hinges Employed—There is no particular novelty in the design of this structure, with the possible exception of the type of temporary hinge employed. Fig. 2 illustrates this hinge, and the thrust being taken by it when the photograph was taken amounted to 400 tons. These temporary hinges are designed and placed so that they neutralize the bending

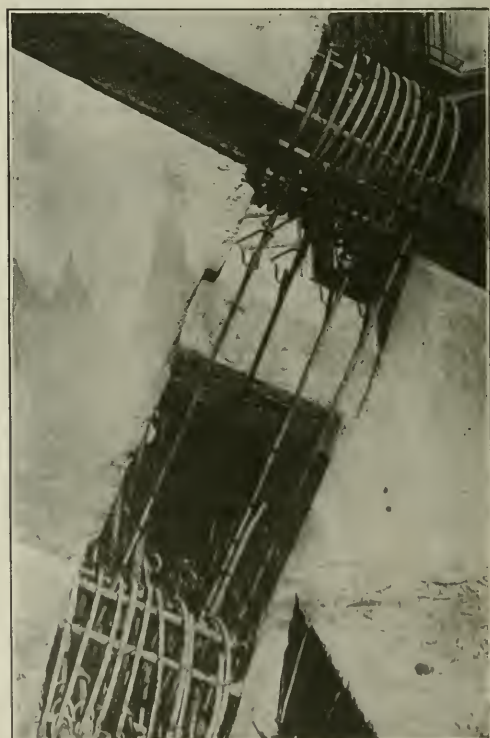


FIG. 2—TEMPORARY HINGE TAKES 400-TON THRUST; VESUBIE RIVER BRIDGE

Hinge is designed to neutralize bending moments due to shrinkage, shortening under load and abutment settlement.

FIG. 3—BOWSTRING GIRDER SPAN AT NANTES

moments due to shrinkage and arch shortening under load, in addition to any elastic settlement of the abutments.

Experience has shown that the stresses due to these latter effects frequently exceed the maximum calculated stresses due to the ordinary arch thrust and moments due to superimposed loading and temperature variations. It would be quite impossible satisfactorily to erect a bridge of this type and span if the flattening of the arches resultant from the above effects were, as is so often the case, ignored.

A certain amount of criticism has been advanced against temporary hinges, to the effect that these cannot properly be regarded as hinges, owing to the resistance given by the main tension reinforcement in the ribs being present and effective in preventing the required distortion. However, such hinges are always designed so as to be sufficiently ductile to compress under load in such a manner that little, if any, tension is ever brought upon the exposed main reinforcement of the rib member. Moreover, the curved main reinforcement is always exposed for a length sufficient to enable it to deform to the very small extent required without distress.

Wind Pressure—The Vesubie bridge is situated in a very exposed position and the question of lateral wind pressure had to be taken into careful consideration. A pressure of 50 lb. per square foot was the figure adopted in the calculations, and this was wholly taken for the central portion of this bridge by the curved ribs, which were suitably provided with lattice bracing so as to enable them to work as a horizontal curved girder. Near both ends of the bridge a heavy frame has been introduced and this transmits the lateral forces to the deck platform, which in turn transmits the total lateral thrust to the abutments in cantilever fashion.

Immediately after completion the bridge was tested by vehicles aggregating 100 tons in weight with a resultant maximum elastic deflection of ¾ in. The bridge has now been open to traffic for about a year and a recent examination of the structure has shown that there are no cracks of any kind in any part of it. In view of this the bridge can be classed as a truly elastic structure and the various assumptions made in the design of the work thereby justified.

Maudit River Bridge—This bridge, at Nantes, beyond the fact that the deck platform is suspended from the arched ribs, requires entirely different treatment in design from the Vesubie bridge, as a brief consideration of the differences in supporting conditions will make clear. The span of the structure in question is 180 ft. and the rise to the arch ribs one-sixth of this amount, which proved to be the economical ratio. (Fig. 3).

The principal advantages of this type of bridge are clear waterway and simplicity of abutment supports, while a disadvantage may be stated to be the limitations of this type of structure to bridges of reasonably narrow width.

Vertical Suspenders—In the case of the Nantes bridge, the footpaths have been cantilevered. With such an arrangement the bowstring girders can be employed for most cases ordinarily met with. Particular regard has been paid to the design of the vertical suspenders, which are made flexible in the plane of the girder so that they do not offer appreciable resistance to the elastic deflection of the curved ribs. These members also require to be made sufficiently rigid in the

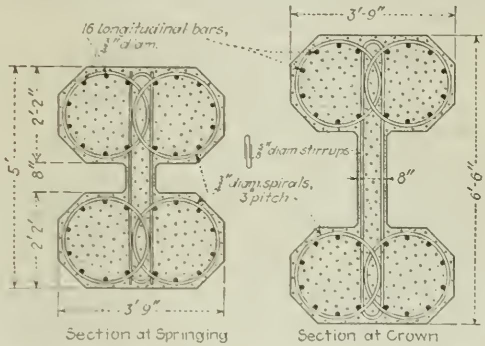


FIG. 4—SECTIONS OF RIB AT SPRINGING AND CROWN, MAUDIT RIVER BRIDGE AT NANTES

transverse direction, so as to transmit the lateral force of the wind coming upon the girders to the deck platform, which acts as a horizontal girder in transmitting the total lateral thrust from the wind to the shore supports.

Until quite recently, some engineers have rigorously opposed the employment of such reinforced-concrete members subjected to pure tension, particularly where these are placed on the inner edge of the pavement, in which position they may be subjected to serious damage from vehicles becoming out of control, but the soundness of design and stability of the structure are borne out by the fact that two or three ties have, at times, been entirely destroyed without any apparent effect on the deck platform.

The curved ribs for the bridge at Nantes are of "H"-section with the upper and lower ribs heavily spiralled. In the design of bowstring girders, the most important point requiring consideration is the connection between the curved ribs and the horizontal ties. It will be appreciated that the entire horizontal thrust from the ribs has to be absorbed into the ties over a relatively short distance and in order that this shall be done satisfactorily, the varying intensities of stress at these connections have been carefully studied and a design formulated whereby these connections can be given the same reserve of strength as obtains in the

remainder of the bridge with the minimum quantities of concrete and reinforcement.

Arch Centering—The temporary staging for the Nantes bridge was built as follows:

An arch truss constructed in two halves was erected and supported on a temporary bracket built on the abutment walls. Suspended from this truss by rods was a horizontal platform at the level of the underside of the horizontal tie. This truss was designed to carry the weight of half of the curved rib and one-half of the horizontal tie. These portions of the girders were then concreted and allowed to take their initial set, after which they were capable of carrying their own weight and the additional weight of the remaining concrete necessary to complete the girder when green. With the girders in position, the deck platform was constructed, the staging for this being supported on the girders themselves.

By this method, the relatively high cost of centering is obviated and the structure is rendered advantageous both from the accommodation and economical standpoints.

Engineering—Profession or Business?

By C. R. Young
Assistant Professor of Structural Engineering, University of Toronto, Toronto, Ont.

Extracts from inaugural address as chairman, Toronto Branch, Engineering Institute of Canada.

There is perhaps no question more frequently asked than the time-worn one as to whether engineering is really a profession or not. It has been the ideal of many leading engineers to place engineering on a purely professional basis and to divest it of the characteristics of a business which it has taken on in recent years. One must frankly admit that the results achieved have not been gratifying and that engineering is, if anything, further from the status of a pure profession than it was a generation ago.

If one were asked to define the essentials of a profession, one might say that properly the professional man should make his services available to such clients as care to consult him, and generally for stipulated fees rather than for a salary. Relations with the client should be on the highest possible ethical basis and no measures should be adopted for the securing of commissions which would not be acceptable in type to those prevailing in the professions of law and medicine. One might enumerate as some specific essentials of an engineering profession, the possession of skill and learning by the practitioner, the maintenance of high ethical relations with the client, and the observance of altruistic motives in his relations with the public.

So basic is the idea of learning in a true profession that one often hears mention of the "learned professions." It is inadmissible for the engineering practitioner to be an ignorant or unlettered man. Although the proprietor of a barber shop or of a shoe shining stand may be operating for the benefit of such customers as may care to patronize him, and for a fixed fee, it cannot be maintained that these callings are in the category of professions, in spite of the recent effort to incorporate barbering in British Columbia as a skilled profession. But on the basis of learning as a requisite, however, one might very properly include in the ranks of the "learned professions," the work of the skilled accountant or auditor, who in his field maintains toward clients relations that are comparable with those maintained by the professional engineer.

A basic essential of professional life is that the relations of the professional man to his client should be those of the most exalted trust and of the most circumspect solicitude for the interests of his employer. Telford, for example, while acting as an engineer for several canal companies declined an appointment as engineer to the Liverpool & Manchester Ry., on the ground that it would prejudicially affect the interests of his existing employers. Sir John Fowler was pre-eminently a shareholder's engineer. He restrained his natural impulse to create great and enduring works for monumental purposes and made sure that the interests of the persons who were furnishing the money were primarily observed. The public very properly expects of a professional man a high attitude with regard to public obligations. It expects him not only to further the interests of the people at large, but to prepare himself for the better performance of such service. The appropriate attitude to his profession might very well be put in the words of Francis Bacon, "I hold every man a debtor to his profession; from the which as men of course do seek to receive countenance and profit, so ought they of duty to endeavor themselves by way of amends to be a help and ornament thereto."

Smeaton's attitude in this regard would have fully satisfied Bacon. He held that "the abilities of the individual were a debt due to the common stock of public well-being." Having this in mind, he limited his professional employment so that he might devote a certain portion of his time to self-improvement and scientific investigation. He systematically resisted tempting offers to attract him from this settled course.

One must admit that the present status of engineering is that of part profession and part business. The methods of solicitation of new work in engineering are by no means in conformity with those observed by the leaders in the professions of law and medicine. Intensive canvassing and lobbying which characterize the conduct of some engineers in the consulting field at the present time do not well comport with the high ethics of Smeaton and Telford. They are of one and the same type as the methods employed to secure orders for bacon or boots.

The competition that is sometimes introduced by engineers with others who have to all intents and purposes secured a given piece of work is not that characteristic of a pure profession. Thus, when the plans of an engineer have been accepted and tenders are called thereupon, it may be questioned as to whether alternative designs are properly tolerable without the full prior knowledge and consent of the client's engineer. It is, of course, a common procedure for engineering contractors to submit their own designs in competition with those of the engineer in charge of the work, and the practice is so firmly established that it is not likely to be given up. In essence it is an embarrassing procedure. It in effect proclaims that the client's engineer has insufficiently studied the situation and that he has overlooked the merits of another scheme which might prove cheaper than the one which he recommended. Anything which lessens the confidence of the client in his engineer's complete mastery of the subject may well be considered as questionable ethically, but so far have we proceeded from pure ethics in the practice of engineering that this procedure often excites no comment.

Under such conditions it becomes very difficult to frame a comprehensive code of ethics for engineers. When they are operating in part as professional men and in part as men of business it does not seem practicable to establish a purely professional code of ethics that will procure uniform observance by the engineers of the country.

New Large Bridge for England

The Great Western Ry. of England has offered to meet half the cost of a great bridge which it is proposed to build across the Severn and the Wye Rivers at Beachley. The offer is made in conjunction with a tentative estimate that the structure will cost $11,000,000. As the bridge is to be used for vehicular as well as rail traffic, the Ministry of Transport and the local authorities are expected to pay the other half of the cost. The increasing volume of rail traffic between England and South Wales has reached such a point that the tunnel under the Severn is inadequate. The bridge scheme is opposed by the city of Bristol on the ground that it will interfere with navigation.

Through the Reclamation Country

By F. E. Schmitt
Associate Editor, *Engineering News-Record*

THIS is the tenth of the series of letters written by Mr. Schmitt during a journey recently made through the West in which he visited irrigation projects, studied developments, and interviewed builders, operators and settlers, in order to present to our readers the actualities of reclamation as revealed to an unprejudiced investigator.
The series of letters began in the issue of October 4.

El Paso

STATE and local responsibilities toward reclamation force themselves on one's notice chiefly because they are wholly ignored; but nearly every phase of project operation contains some reminder of them.

The federal reclamation enterprise seems to be of little interest to the individual states out here. The states were active in getting appropriations for money to be spent on projects within their own boundaries, but then seem to have lost interest. They are and have been wholly apathetic toward the agricultural communities which the nation has worked hard to establish in their midst. They do nothing to assist these communities in working out their troubles, except for the small item of running experiment or demonstration farms on the projects, usually in co-operation with the federal Department of Agriculture, which began the work. In fact, occasionally a state is directly hostile to reclamation, or at least works against its interests, as the state of Washington, whose speculation in school-land prices delayed the development of these lands for years.

State Indifference—One might think that when the national government builds within a state large public-service works which will greatly increase the state's productive wealth and human resource, it would be the state's most interested care to assure the success of the communities served by these works, through helping them develop. But this opportunity and responsibility do not seem to have penetrated to the legislative mind in the state capitals, or, for that matter, to the public consciousness in the West. As suggested in an earlier letter, the attitude toward the federal projects is that they are Uncle Sam's business, and nobody is going to take care of it for him. The great white father in Washington carrying the helpless reclamation farmer in his awkward bureaucratic arms, and hobbled with red tape, may flounder and stumble as much as he pleases, the state will not lift a hand to help. Why?

More personally than the state, the reclamation community itself is concerned in its own success—the community, rather than the individual farmers. Every merchant or banker in the project town is directly touched in his pocket-book by the success or the failure of the smallest farmer on the project; and so long as this farmer's production is held down by lack of proper farming knowledge or lack of money the merchant and the banker, too, will not prosper as fully as they might. The neighboring farmer, too, is affected, for he will have better markets, better transportation facilities and schools, and better human contacts, if all his fellow settlers are doing well. Thus, the whole community, as a unit, has most to gain (or to lose) by proper promotion (or its neglect)—by agricultural stimulation, live-stock development, creation of marketing, and other co-operative facilities, provision of means for financing, in short all the kinds of work involved in rapid upbuilding of the region. But the community, like the state, has done virtually nothing.

Beginnings of Community Effort—With one or two exceptions, the water users' associations, which deal primarily with contract relations between farmers and government, have done no development work at all. To note an exception: Just north of here, at Las Cruces, New Mexico, headquarters of the upper part of the Rio Grande project, the Elephant Butte Irrigation District is going into promotional work with a good bit of zest, and its office, proudly named "Temple of Agriculture," is meant to become the real agricultural headquarters of the valley. If the district keeps up this purpose it will bring the farmers big dividends. Reclamation farmers generally have vaguely expected the Service to do the boosting and nursing for them; once they learn that the Service cannot do this, or will not, and that they themselves are by all odds the best people to do it, the present problems of reclamation will be pretty well out of the way.

And like Elephant Butte, one or two other associations have begun to proceed more aggressively. Progress is making. If it continues, it will in time arouse state governments to an understanding of their duty.

Another development on this Rio Grande project attracts attention: the Gateway Club here in El Paso, a colonization promoting society organized by local business men, which aims to get desirable settlers for the unfarmed lands of the project. Unless this movement stops short of its best possibilities, it is bound to go on into agricultural and financial development work, and so may become a permanent model for the type of organized activity that every project needs. This El Paso development is specially interesting because the city has been slow to wake up to its place in the scheme of reclamation. One reason why the Rio Grande project did not develop any faster than others, though favored by having a large and rich city in its center, is that El Paso at the start took no more interest in the creation of the new agricultural region around it than it would in the addition of a wing to the local post office. Cattle business and other preoccupations were more important—until now, when other interests have slacked off, agricultural production is the thing that puts jam on the city's bread. Today the business men admit that they were wrong, and that well directed promotion work in the earlier years would have meant greater advance for city man as well as farmer.

Water Users Will Not Operate—Local responsibilities are not only slow to be perceived, but even when perceived they seem to be uncomfortable. On nearly all the projects, the water users will not operate their distribution systems. They complain about government operation, and say they could do the work more cheaply; but they won't. That they are able to operate, and operate well, is shown by experience in the three places where the water users are operating: a section of the Strawberry Valley project (Utah), the north side of the Minidoka project (Idaho), and the Salt River project (Arizona). Still the farmers on the other projects are unwilling to take over the work and relieve the government of a function that does not belong to it,

that it never intended to assume, and that was forced on the Service as an unavoidable necessity.

The motives of this unwillingness appear to be a little mixed. The president of a water users' association told me that government operation assures fairness, and he seemed to apprehend politics or other discrimination if the users operated. Several farmers feared the chance of emergency happenings rather than the risk of unfairness. Another man made it evident that he felt it was to the landholders' interest to have the government hold the bag as long as possible. Grounds for any of these views can not be found. If the users took over operation on all the projects, with only such governmental supervision as would protect the equities, more than half the causes of discord between government and farmer would be eliminated.

Reasons For Local Action—Local action has many advantages, among others the ability to deal more fittingly with local questions and with the requests and complaints of individual farmers. Farmer boards, where they are in action, are much more severely impartial than the Reclamation Service people, in spite of the fact that one of the standing charges against the Service is its lack of human feeling. On one project, where relief applications (under last year's Congressional act authorizing deferment of water charges) were referred to the water users' board, this board turned down many more than the Reclamation Service. In another case, claims of many kinds (for rights-of-way, damages, and the like) were passed on by the water users, and their attitude was quite flint-hearted, whereas the Service usually has to go easy rather than hold the individual to strict justice. Dealing with these matters of human relationship is so naturally in the sphere of the local community, made up of neighbors and fellow farmers—a mutual court, as it were—and is so far from being the proper function of the Service, that one wonders why the local people have insisted on sitting back so long.

In discussing how and by whom the vital work of colonizing and developing a reclamation project is to be carried out, a Western engineer said very aptly, "It is impossible to have a strong development policy nationally administered." Settlement and cultivation must be directed from nearer at hand. Except for two factors, it would best be dealt with by the local people themselves, in the opinion of the best informed men out here. These factors are (1) the need for financial strength to support the initial financing of the settlers, and (2) the desirability of adequate breadth of view and adequate resources back of the movement to guarantee progressive development and maintain the value of the enterprise. Half a dozen settlers on a newly opened project are not a sufficiently large community to do any development work except in their own half-dozen backyards; and, as a former irrigation manager said, "The irrigation district system is not applicable to the reclamation of raw desert. Every successful district that we have was preceded by some other attempt at irrigation."

Greater Productivity Needed—Breadth of view and sufficient resources of men and property are required also as a protection against various mischances of development. Irrigation farming, because it is expensive, must be operated for high productivity, and this productivity must be maintained. The present condition (on the authority of agricultural observers on the projects) is that the reclamation projects in particular and irrigation farming in general are not producing as much per acre as they should, by a large margin. It may suit the individual farmer to raise less than half a bale of cotton per acre, but it may be all wrong from the standpoint of the project and of the state. Every sugar company that contracts with farmers for raising beets maintains a skilled corps of field agents who go around among the farmers constantly to help them raise beets the right way and raise enough per acre, and to see that they do so; the companies need high beet production and high sugar content, and know that they will not get it unless they make sure that they get it. There is plenty of opportunity for similar encouragement and agricultural aid to higher productivity on the reclamation projects generally, but the Reclamation Service is not permitted to use its money for such aid work, and the Department of Agriculture does only the little that it can get funds for, which is not much. Besides, some farmers prefer to make a failure their own way rather than a success by advice.

In addition, the danger of decrease in producing power of the soil has to be looked out for, and when necessary fought by whatever means may be required. Some of the irrigation lands are showing signs of decreasing productive power of the ground; and whether this is due to accumulation of salt in the soil from faulty irrigation, or to lack of manuring, or to other causes, it must be studied and combated—which again will usually require a broader view and a more resourceful authority than the local community itself. In fact, the continuing partnership between farmer (or community) and state (or federal government) is a central point of the irrigation business.

To take another aspect of the case, in one of the oldest irrigation states, Utah, fully a fourth of the million and a quarter irrigated acreage has gone out of production through seep, plainly the result of neglect on the part of both individual farmer and local community; this is not reclamation-project land, of course. It is immensely against the interest of the state of Utah (though Utah apparently doesn't know this) to permit the local people to let good agricultural land to go to ruin in this way. The state should have stopped the damage in its early stages, and in any event should take the lead in remedying it. But it failed to do the one, and is not now doing the other. Yet Utah is now angling for many millions of dollars of Reclamation money to put more land under cultivation.

Value of Co-operation—Productivity is only one of several objectives in bettering irrigation and reclamation performance. The right kind of co-operative effort on the part of the local community, the state, and the national government could realize these objectives and at the same time guarantee the equities of the enterprise, but such co-operation does not now exist. The big fighting point of money troubles between reclamation settlers and the Service is closely tied up with productivity. A California man, engaged in orcharding, said that he didn't care how much the water cost, as it was all a question of how much he could get out of his land. An Arizona man emphasized the desirability of higher production on his project by quoting a business epigram, "To hell with the expense account so long as we get the business." In contrast, when

one project is found to be running virtually as a single-crop project, 80 per cent of its production being alfalfa, one is not surprised this project has money troubles.

On that particular project, community action to bring about higher grade farming, chiefly by diversification of crops and planting of high-value specialty crops, has at last gotten a start. In the same way, another project that has had serious money troubles has within the last year developed some energetic community action toward increasing the amount of dairying; bankers and business men in the town have organized for the purchase of high-grade dairy cattle in order to stimulate dairy farming. All such local efforts may in time do away with light-weight farming, planned to give the farmer plenty of time for automobile touring in the best season, much of which is found on some of the projects. "Agricultural aid and enforcing the farmer's financial responsibility are necessary," as one man put it, who in the combined position of farmer, banker and water users' official has wrestled with the project-farmer problem in many campaigns.

Although the states have not taken up their share of the reclamation project burden, they have interested themselves actively in irrigation along another line, within the past few years. They are trying to make irrigation securities attractive to private investors by various devices which purport to give state backing to private irrigation. This matter, however, ties up closely with other aspects of future irrigation and reclamation developments.

Self-Supporting Reinforcement for Concrete Floor

I-Beams With Flanges Slit and Bent to Provide Integral Shear Members Carry Steel Forms—Rods and Wire Mesh

A SELF-SUPPORTING steel reinforcement composed of special I-beams in a framing which also serves to carry steel formwork of special design and thus minimizes the amount of falsework, is a structural feature of the reinforced-concrete floor framing in the Sir Walter Hotel, built recently at Raleigh, N. C. A typical panel is shown in Fig. 1, and a typical floor section in Fig. 2.

In this new type of floor framing, the reinforcement of girders and joists consists of steel I-beams which have the top flanges sheared or slit and the resulting

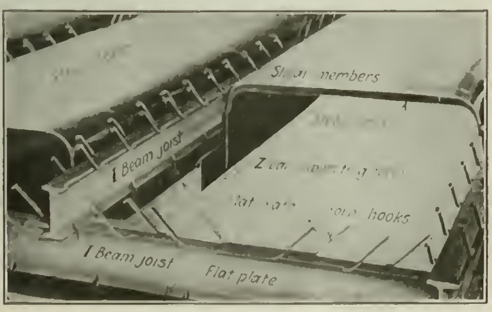


FIG. 1—I-BEAMS WITH INTEGRAL SHEAR MEMBERS FORM REINFORCEMENT FOR CONCRETE

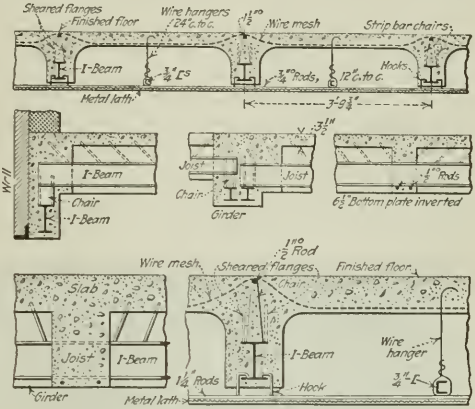


FIG. 2—FLOOR CONSTRUCTION OF SIR WALTER HOTEL

strips bent upward so as to form rigidly connected diagonals or shear members extending into the concrete of the upper part of the girders and joists and into the floor slabs. Where the sheared I-beams rest on similar beams they are fastened together by clips over the flanges. Where the beams pass above supporting I-beams they are bolted to chairs which rest on the lower beams and are clipped to their top flanges. Butt joints in lines of sheared I-beams, such as in joists over girders and in girders over columns, are spliced in the web by flat plates and bolts.

Additional reinforcement is provided in some cases by rib bars bent in the usual way, the bars resting on small blocks or separators on the lower flanges of the I-beams and having their ends bent so as to lie in the concrete slab. Wire mesh laid in the floor slab is raised to the top over the joists, where it is held by ½-in. rods and the diagonal strips of the I-beam flanges. For convenience of transportation, the I-beams are shipped with the shear members raised only slightly above the flanges, as shown in Fig. 3. A special tool is used on the work to raise these members to a uniform angle of 45 deg.

Hooks attached to the bottom flanges of the I-beams carry flat steel forms with edges turned up to catch the hook on a Z-section plate. The lower lip of the Z-plate carries the lower edge of a steel form of inverted trough section. These forms are removed after the concrete has set, so that they can be used several times. The hooks remain permanently and serve to carry rods to which is wired the expanded metal for a suspended ceiling beneath the joists. To prevent sag of the rods they are attached to a ¾-in. channel placed midway between the joists and supported by a hanger wire attached to the steel mesh embedded in the concrete floor slab.

The steel beams are strong enough to carry the dead load of the floor. It is stated that this high carrying capacity not only gives added strength to the reinforced-concrete structure, but also enables the slab forms to be removed in a comparatively short time, thus saving expense and time in erection. Further, since the I-beam framing supports the forms, it can be erected for two or three floors at a time. In the Sir Walter Hotel this type of construction is said to have permitted the use of longer floor spans (35 ft. 2 in.) than

would have been practicable with ordinary reinforced concrete construction, so that one row of interior columns was eliminated and the cost of the building reduced correspondingly.

This type of framing is claimed to combine essential advantages of both reinforced concrete and structural steel construction. It has the former's economy in steel and the latter's self-supporting property, while it eliminates much of the expense and inconvenience of formwork for concrete and the weight and expense of structural steel construction. As a rule the only timber support for the forms consists of a post at the mid-span of each beam, or two posts in spans of over 32 ft. In this way the usual forest of timber falsework is eliminated and the floor space is largely available for storing materials and carrying on the work of the various building trades.

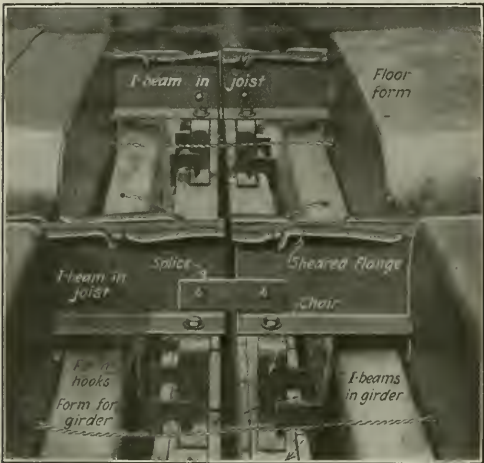


FIG. 3—I-BEAMS AND FORMS IN PLACE FOR GIRDER, JOIST AND SLAB

The Sir Walter Hotel is a ten-story structure, 105 x 140 ft. in plan, of reinforced concrete throughout and having a brick and stone facing. The typical floor panels are about 17 x 18 ft. with joists spaced alternately 4 ft. and 5 ft. c. to c. For the shorter spans there are 4-in. I-beams topped with 6 in. of concrete including a 2½-in. floor slab. For longer spans there are 8-in. I-beams with 10-in. concrete including a 3½-in. slab. Live-loads for floors are 100 and 150 lb. on the first floor, 100 lb. for the second, and 50 lb. for all upper floors.

This new floor system with sheared I-beams was designed by the Truscon Steel Co., Youngstown, Ohio, and was built by the C. V. York Construction Co., which had the general contract for the Sir Walter Hotel. The architect was James Salter, Raleigh, N. C.

Agitate Tennessee-Tombigbee Canal

Interests at Mobile, Ala., are agitating a connection between the Tennessee and Tombigbee Rivers. While their headwaters are separated by only 25 miles, a lock canal would be necessary to carry the waterway over a range of hills. As the waterway would parallel the Mississippi River, some difficulty may be experienced in financing so expensive a development.

Moving Platforms, an Untried Form of Rapid Transit

Large Capacity at Low Operating Costs—Simple Equipment—Eliminates Congestion—Low Train Resistance

A PRACTICAL demonstration of a much-discussed method of rapid transit, the moving platform, is now being made in Jersey City, N. J. This demonstration section is made up of a loop 200 ft. long and 100 ft. wide in its outside dimensions, consisting of three continuous parallel platform loops, operating at 3, 6, and 9 m.p.h., respectively, and one inner stationary loop. Each platform is about 1 in. higher than the adjoining inner platform and overlaps it sufficiently to afford protection on the curve. Each of the moving platforms is made up of a series of small trucks 8 ft. long with circular ends, exactly fitting into each other. These trucks are supported at one end by two independent wheels with ball bearings and connected at the other end to the preceding truck by a universal coupling. The fixed platform and the two inner slow moving platforms are about 30 in. wide and have no seats as they are intended primarily for people getting on and off the fast moving platform, which is about 60 in. wide and provided with two-passenger seats at 32 in. intervals. Most of the platforms are floored with wood, but there are a few sections floored with such material as diamond safety tread and compressed sheet metal covered with anti-slip mastic.

Tests of this equipment made by the Electrical Testing Laboratories of New York on a track section consisting of 73 per cent curves indicate that such a three-stage moving platform would require 150 hp. per mile to operate it. This figure should be considerably less on sections of straight track.

Two methods of propulsion are used for demonstration purposes. The 3- and 6-mile platforms are driven by racks and pinions, the racks mounted on the underside of the platform as independent sections for operation around the curves, but so set that they form a continuous rack when passing over the motor-driven pinions placed on the tangents. The pinions would be spaced from 1,000 to 1,500 ft. apart on large installations. The 9-mile platform is propelled by elements of an induction motor, the secondary or rotating element,

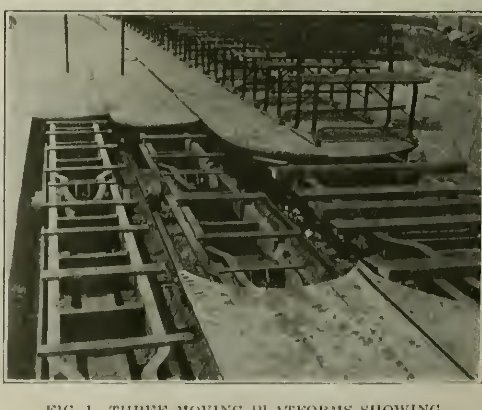


FIG. 1—THREE MOVING PLATFORMS SHOWING ARRANGEMENT OF TRUCKS

made in straight 8-ft. sections clamped to the underside of the cars, forms a continuous secondary, and the stationary or primary element of the motor is made in sections 5 ft. long placed between the rails in groups about 140 ft. apart, with an air gap of $\frac{3}{16}$ in. between the primary and secondary elements. The motor elements are supplied with three-phase alternating current with a frequency of 37½ cycles per second. If the 3- and 6-mile platforms were driven by the same means, the frequency would be reduced to 12½ and 25 cycles respectively.

From the point of view of maintenance, this arrangement has the advantage of few moving parts to get out of order, no concentrated loads or high wear, and few expensive parts. It also has the advantage that as the traction is not developed through contact of the wheels upon the rails, the rails can be kept greased to reduce friction on curves. In the matter of power consumption, such a system has an advantage over independent train units in that there is no power lost in stopping and starting, the platform being always in motion with the passengers walking on and off at the stations by means of the slow-moving platforms. The rolling stock weighs 350 lb. per seated passenger as compared with 1,500 lb. in subway trains. Another advantage claimed for the moving platform as against subway is that as it only requires a clear space 12 ft. wide and 9 ft. high for a platform moving in one direction such a platform system could be put in the space now occupied by sidewalk vaults in city streets. Such a system could have entrances or exits at any convenient points; either directly into the buildings or by stairways to the streets, as it is possible for people to leave the fast moving platform at any point by means of the two slower moving platforms. Another advantage claimed for this type of transit is that should the main fast moving platform be disabled, the two slower moving platforms would still be in operation, and it would be possible for people to use them at the slower speed, and also that in case of some very unusual accident stopping all three platforms, they still would present a well lighted walk, which the people could use to the nearest exit or to continue their journey on foot.

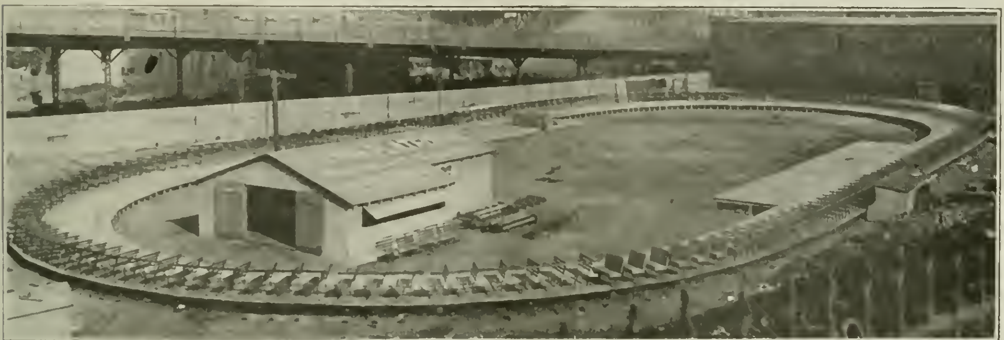


FIG. 2—DEMONSTRATION PLANT OF MOVING PLATFORM SYSTEM
Showing inner fixed platform, two narrow slow moving platforms, and wide fast moving platform on the outside.

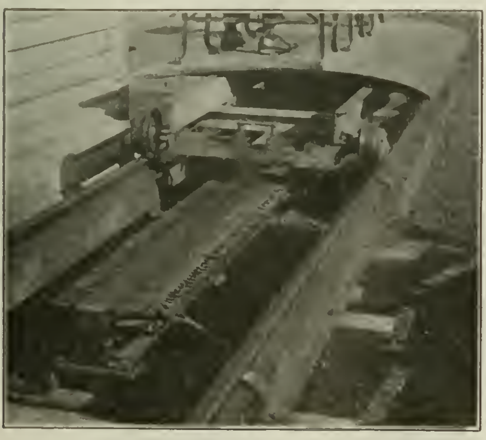


FIG. 3—SECTION OF HIGH SPEED PLATFORMS SHOWING ONE METHOD OF PROPULSION
Showing the secondary or rotating element of the induction motor on the underside of the car body and the primary element in its fixed position between rails.

In the matter of passenger capacity, the seated capacity of the 9-mile an hour platform is 35,640 passengers per hour, which is 50 per cent in excess of the seated capacity of the combined local and express services of the New York subways. With the standing room occupied on the fast platform, this capacity can be more than doubled. In addition, at the times of peak loads, passengers could also use the 6-mile an hour platform. As the platforms are always in motion, there should be no crowding at the loading platforms, as people can walk on as fast as they reach the moving platforms.

U. S. Urged to Improve Flushing Creek

The Board of Engineers for Rivers and Harbors is being importuned by interests in the Queens area of New York City to improve Flushing Creek with the idea of providing industrial sites along its course with 12 ft. of water. It has been pointed out to the board that the development of the Queens area is proceeding at a very rapid rate and that the development proposed would insure the erection of plants in what now is an undeveloped area. The board has expressed no opinion in this particular case, but its general policy is to develop the mouth of such a waterway and leave the development from that point on to local interests. An example of that policy is the Buffalo River.

Federal Land Reclamation: A National Problem

7. Financial Troubles of the Reclamation Farmer and How They May Be Relieved

By JAMES T. WHITEHEAD

President of the North Platte Valley Water Users' Association, and President of the Mitchell State Bank, Mitchell, Neb.

The Seventh of a Series of Articles on the History and Performance of the Great Government Adventure in Irrigation of the Arid Lands of the West.

RECLAMATION of arid lands by the national government is a success so far as the engineering features are concerned. There have been no failures of reservoirs to hold water, canals to carry water, nor dams to divert it into reservoirs or canals, except possibly in very unimportant cases. The increased production of foodstuff and the increased demand for manufactured goods is unquestioned. But there are two features of the problem, other than that of engineering, that are of vast importance and it may be seriously questioned whether as regards these a success has been achieved. They are, *first*, the making of happy and prosperous homes, and *second*, return of the money advanced by the government. The solution of the second of these problems depends on the solution of the first, for the water users will pay the government as fast as they can, and the more prosperous they are the sooner will the fund advanced be returned. Under such conditions the whole matter rests on the question of making prosperous homes on the various projects.

When the Reclamation Act was passed no provision was made for any kind of selection of landowners or entrymen. The only requirement was, in the case of privately owned lands, any kind of a deal that looked to the original owner like a chance to get the purchase price from the buyer, and in the case of entrymen on government lands, a $14 filing fee for the right to a homestead. The result was that the projects were settled by people of all kinds of ability, some good, some average, and others very indifferent. Under such a scheme of settlement it was inevitable that a considerable number of the settlers would not be sufficiently successful to keep themselves out of debt and make the required payments out of their farming operations, their only source of income.

Lack of Initial Capital—To operate a farm under irrigation requires a considerable amount of capital, which the entryman was not required to have and which in many cases he did not have. Any business that is under-capitalized is seriously handicapped; and this is as true of the farming business as of any other. To get sufficient capital to operate at all, the entryman had to borrow, and as he usually had only an entry on land whose title remained in the government he was obliged to borrow on short time and at a high rate of interest, giving such chattel security as he had. Generally this security included the prospective crop. The land being unimproved, it was necessary that the entryman build himself a house in which to live, the barn and other buildings, as well as put the land in shape to raise a crop. Debts were sure to accumulate which it would be difficult to meet.

Generally the land does not produce well enough to pay until the soil is built up by the application of barnyard fertilizer or by the introduction of some legume crop that will add to its fertility. This takes time. When prices for farm products were at the peak and the payments to the government were low, the payments were for the most part made, but unfortunately the slump in farm prices came about the time the payments to the government had reached a high rate per acre, and delinquencies began to accumulate together with the penalties for non-payment. The penalty for failure to pay when due is one per cent per month. With payments due on money borrowed at a high rate of interest, with water payments to be made, under heavy penalties for failure to make them, the land seeded to alfalfa was plowed up and planted to crops which it was hoped would produce enough to meet payments required without regard to the building up of the soil for future crops.

As a result, the crops raised even on the good land were raised at a loss, and the farm was less fertile for the next year's crops. Depletion of the soil fertility was the result of endeavoring to make payments that could not be made from the crops raised, if due regard was given to the future prosperity of the farmer. The payments to the government and payments to other creditors could not be made and of course were not made. But for the ever-present hopefulness of the average farmer, the outlook would be discouraging, and it is not encouraging to any but the most courageous.

Deflation Effects—Agriculturalists have passed (or are passing) through one of the most depressing times in their experience. So much has been said about the deflation of the farmer that it is not necessary to repeat it, except to say that it was real and effective. Everything he had was deflated, except what he owed. Farm labor continues to be high-priced and inefficient, the cost of farm machinery is at the highest point, and the things that the farmer has to buy are at peak prices. This is a condition that all farmers generally have had to meet in all parts of the country, where irrigation is practiced as well as where it is not—in Iowa and in Idaho, in Michigan and in Missouri.

With prices of farm products far out of line with the prices of other things for so long a time, agriculture has been and is hard pressed. The farmers on government projects have had to meet all the discouraging conditions that have seemed so difficult to farmers generally where irrigation is not practiced, and in addition have been expected not only to take care of the obligations that are incident to farming, as all must do, but in addition to make cash payments to the government besides. This they could not do, and so came the demand that some respite be given them until it is humanly possible to make these payments.

Business Management the Way Out—Is the future of these projects hopeless? Has it been a mistake for the government to build these great irrigation works? One has only to travel over many of them with his eyes

open and see the crops raised in such abundance to be convinced that there must be a way of managing these projects so that they will succeed and the settlers on them become happy and be prosperous home owners and good citizens—real men and women, fathers and mothers of a future generation who will carry on the work of making greater a nation already great.

And what is the way? The same intelligent management, under the direction of men who are competent to manage intelligently, that is practiced by any successful corporation or business of equal size and importance. The Secretary of the Interior is the head of all the reclamation work being done by the government. He is the president and general manager of the corporation, so to speak. If failure results he must take the responsibility. Should he be held responsible and should he take the blame for failure if he does not have the authority to put business methods into practice, as has any other general manager?

But the general manager of a corporation works under the direction of and in conjunction with a board of directors. The board of directors is or should be composed of a limited number of men familiar with and interested in the success of the business. When it is found that some change must be made in the operation of the plant, the general manager can get his board together and the change can be discussed with the single thought of improving the plant or its operation. In the case of the government reclamation projects, Congress seems to be the board of directors. And what a board! More than five hundred members, scattered all over the United States, and composed for the most part of men not at all interested in the working of the plant and with little or no knowledge of its needs or requirements! But the board cannot be changed. It is the Congress and it must continue to be the Congress. Under such management the wisest possible discretion must be given the general manager, and he must be trusted to deal with the problems as he sees they must be dealt with and take the responsibility of making a success of the venture. This authority he does not have under the present laws.

Give The Secretary Power—He can, under the law as it now is, build a project and operate it practically as long as he likes, without requiring any payment to the government for the cost of the project, so long as he does not issue a formal order to commence paying. The formal order to commence paying, called Public Notice, announces the date payments shall commence and the total amount that must be repaid to cover the cost. When this is done, then he is helpless to modify either the time or the terms of payment, or the penalties for failure to pay when due. Congress should so amend the law that authority is given the Secretary of the Interior to suspend the operation of any public notice as applied to any project, part of a project or an individual within any project, when in his opinion such suspension is necessary to make more sure the success of such project, part of a project or individual settler.

Suspensions of payments should not be granted, nor would they be likely to be granted, for the purpose of extending the time for repayment, but only for the purpose of making it possible to pay more surely, and finally more quickly. The present law is rigid as to amount of annual payments and the time for making them. High-cost projects, even if crop returns are low, must make repayment as fast as the more favorably situated projects where costs are lower and crop returns greater.

Repayment Based on Crops—Terms of repayment should be such as can be met by the ordinary individual who uses due diligence and is otherwise qualified to succeed under normal conditions, and then he should be required to make his payments. If disaster or other unusual conditions should prevail against an individual or group of individuals, it is useless to insist on the impossible being done; some measure of relief should be provided, and it should not be necessary to ask that Congress pass special laws to cover such cases as they come up. It would seem wise for the terms of repayment to be based on the average returns per acre on the different projects or units of a project. Payments based on a percentage of the gross returns from the farm could be met, with the possible exception of individual cases where some unusual conditions prevail, such as complete loss by hail or some crop disease that might ruin a crop. Such unusual conditions could be determined easily, and, where no such conditions exist, payment should be insisted upon and no leniency exercised.

Under such a plan payments would be made as fast as it is possible for them to be made under any kind of plan, for the reason that they cannot be made unless it is possible for the farmers to make them, no matter what the terms may be under the law. It would do away with the periodical requests to Congress for deferment of charges, make it possible to pay, and give encouragement to those who have to do the paying, for they would know that they could, with reasonable industry, pay as much as they would be required to pay.

Briefly summed up, the Secretary of the Interior should have the power to suspend any public notice and the terms of payment should be based on the returns from the farms. Such a plan is businesslike, is workable, and should be tried out. Under it reclamation by the government can succeed, and it will be shown that it was not a mistake on the part of the government to use its funds for the purpose of building homes where none existed before.

Repairing a Lift Span Bridge

THE counterweight cables of the Halsted St. lift bridge in Chicago were renewed in 1922 after being in service 28 years. F. H. Avery, engineer of bridge maintenance, in the latest annual report of the city engineer makes the following reference to the work:

The cables were in good condition, except at the lower end where they were fastened to the top chord of the span At this point they pass through a long clamp and around a pin. Upon removal, the portion passing around the pin was found to be in a dangerous condition with about one-half of the strands broken, the ends of these strands being corroded until they were as sharp as needles.

The work was done without interrupting traffic, the span being closed to river traffic for the time necessary to change two cables each on two diagonally opposite corners. This change at first took 10 days, but this time was reduced finally to 4 days. Sixteen cables were changed in all and work continued in zero weather, accompanied by high winds, which speaks well for the mechanics. This winter work was made possible by building shelters for the men at the tops of the towers. During the periods the span was closed to navigation, work was carried on continuously with two 12-hour shifts, which, of course, increased the cost ($22,062.19) of the work.

English Roads and London Traffic

By Paul Wooton
Washington Correspondent, *Engineering News-Record*

The material for this article was gathered by Mr. Wooton while on a trip through England and France to study recent developments in highway construction and traffic regulation.

UNEMPLOYMENT and the urgency of the need to effect economies in transportation are the two outstanding influences which are stimulating highway activities in the British Isles. Were it not for these compelling influences, road work certainly would languish because there is much popular clamor against such expenditures when the rate of taxation already is very high.

Road work is proving to be one of the most effective media in providing employment, since more unskilled and inexperienced labor can be used than in many activities. Some contend that costs are being carried to a prohibitive level and the quality of the work impaired by the use of many inexperienced and even physically defective men, but those in charge of the work declare that the laborers are unusually willing to do the best work of which they are capable and they have figures to show that the average progress of the work compares favorably with that of other years.

Scarcely second in importance in stimulating road improvement is the need for cheaper transport. For more than two years a considerable percentage of Great Britain's manufacturing capacity has been idle. In many instances a small reduction in production costs would have made it possible to compete, or in the case of an operating concern, would have increased profit, and the volume of production. The cost of inland transportation is very high. Even where good roads exist, there has been such congestion as to offset the advantage. The far-seeing men directing public policies—among whom may be numbered Stanley Baldwin, the premier—have insisted that traffic conditions must be improved as a necessary step in the revival of industry.

Constructing New Routes—Col. C. H. Bressey, the chief engineer of the Roads Department of the Ministry of Transport, is directing a bold policy of blazing entirely new routes rather than trying to widen existing thoroughfares in cities and towns. This policy has been carried out in enough instances, Col. Bressey assured the writer, to demonstrate its practicability. In doing this it has been necessary to overcome strenuous objections from some of the property owners and others who fear loss of importance to existing avenues of traffic. While property owners are inclined to be very insistent that their particular roadway be improved so as to carry additional traffic, they frequently are not disposed to be generous in their ideas of the worth of that portion of their property necessary to the widening of the thoroughfare. In that connection, however, it was stated at the Ministry of Transport that in many cases the enhancement of values through the widening of the street offsets the loss of area. There are so many cases, however, where the additional width desired leaves lots without sufficient depth to be used to advantage, that the practice is tending more and more to roadways around rather than through towns and villages.

Col. Bressey favors building these roads where the maximum of their course can be run through open fields. The owners of country acreage usually are more than willing to give the necessary right-of-way for the road and in many instances will also contribute to the project. This bypass policy, as it is termed in Great Britain, has the additional advantage of preserving landmarks and the ancient appearance of places—an aspect of the situation to which much importance is attached in the British Isles. All the trouble and expense of conducting construction activities among water mains, street-car tracks and wire conduits are avoided, as is the interference to traffic.

In the United Kingdom, as in the United States, the matter of road location and the question of which road is to be improved results in bitterness of the most intense variety. The problem is the more complicated in Great Britain because of the amount of authority vested in local officials, and because of the very large numbers of such authorities. Greater London, for instance, has 122 local authorities who must be approached and consulted on road matters which affect their jurisdiction. (London proper is confined to an area of 1.4 square miles, having less than 15,000 actual residents, despite the fact that it has a day-time population of more than 2,000,000.)

Negotiations with Local Authorities—One of the reasons for the success which has attended Col. Bressey's administration is said to be the skill with which he has handled these negotiations with local authorities and those pertaining to road location. The secret of whatever success he may have had in that direction is attributed by Col. Bressey to the care which has been used in the selection of the men who have to do with public relations. It is his policy not to put a man in a place requiring broad judgment unless that man has had wide experience. Regardless of the earnestness of the man who has confined his work to his own village or city, Col. Bressey believes his results will suffer because of the lack of the broadening influence of wider contacts.

Trouble with Slippery Roads—In addition to the outcry from those whose vision is limited, against the expense of road improvement, Col. Bressey has had to meet from farmers and wagoners an unbelievably insistent objection to slippery roads. The horseshoers have failed to take into account the changes incident to new road surfacing. The shoe most in vogue does not give a sure footing to the horses. As a result, they are prone to fall frequently. The attention paid to this protest by the authorities and the legislators is hard to understand, especially as 95 per cent of the tonnage handled on the roads of England is in motor vehicles. Despite that fact, the horse is much in evidence throughout the Island. In London their number is so great as to constitute a major cause of congestion. Every effort is being put forth to acquaint the owners of horses that slipping can be avoided by proper shoeing.

The spreading of fine gravel on the roadways, on hills and at sharp curves does away with much of the skidding on the part of rubber-tired vehicles. In London steel bins for gravel are erected at frequent intervals. Just as soon as rain begins to fall, the street-cleaning

force scatters this material over the street surfacing. This practice very materially reduces the number of accidents from skidding. While England makes a larger proportional use of concrete, for general purposes, than does any other nation, there is very little traffic carried on concrete surfaces. The use of roads by a large number of steel-tired vehicles leads Col. Bressey to believe that a resilient surfacing should top the concrete. Experience in England also leads to the opinion that solid rubber tires, after short usage, are almost as destructive to a non-resilient surfacing as are steel tires.

London Traffic Problem—London still is temporizing with the traffic problem, but has come face to face with the necessity for improved practice. During the twelve months ended with May, the latest figures available, the number of motor cars in Great Britain increased by 25 per cent. Of that increase commercial vehicles contributed 11 per cent. This rapid growth in the number of motor vehicles, the failure to co-ordinate street repairs, the large use of buses, the disinclination to scrap horse-drawn vehicles and the absence of parallel streets combine to constitute a traffic problem of unusual difficulty.

The number of motor vehicles per capita still is much less than that in the United States. Indications are, however, that the increase in the number of automobiles will continue at an increasing rate. An important contributing factor to the increase is the very material progress which is being made in road improvement. It is very evident, however, that the number of motor cars cannot continue to increase much longer before determined steps must be taken if traffic is moved at even an approximation of an efficient rate of speed. The speed of operation of London buses, in the business district, has decreased from nine to seven miles per hour within the last six months.

No small part of the traffic tie-ups and the congestion on principal thoroughfares, which has come in for world-wide publicity in the press and on the screen, is chargeable to street repairs. This activity is vested in numerous local authorities who are very jealous of their prerogatives. The parochial boundaries date from the time of King Alfred. The wonder is that the 28 separate cities making up greater London get along as well as they do, but it has been evident throughout the past summer that they are not pulling together in the matter of street repairs. In a city with as few alternate routes as has London, there is unusual need for carefully centralized planning as to the streets that are to be torn up simultaneously. Necessity brought about centralization of police authority. It is expected that a similar step must be taken sooner or later in handling the problems arising from the evolution in transport.

Street repairs were carried on this year on a larger scale than usual. It can be said also that the work is being done with greater thoroughness and with a view to a greater degree of permanency than has been undertaken heretofore. This has resulted in withholding from traffic for longer periods the streets under repair.

Wide Arterial Streets—The bold plan of the Ministry of Transport for driving wide arterial streets into the metropolitan area will do much, when complete, to keep through traffic away from the busy streets in the heart of the city, but by the time those roads are ready the number of vehicles probably will have increased to such an extent that much additional relief will have to be furnished.

Resort to one-way streets must remain limited since parallel streets are few. Many think the only wise way to meet the problem is to embark upon an extensive campaign of street widening. That proposal is surrounded by unusual difficulties, due to the enormous value of property along many of the thoroughfares most in need of relief. Even if such an expenditure were justifiable, the widening process would be limited at many points by edifices which would not be altered because of their historic and sentimental value.

The presence on the streets of London of 3,500 motor buses, a number to which fifty new buses are being added weekly, augments the problem materially. These buses make frequent stops. The stops often halt the entire stream of traffic following, because at most points the street is too narrow to accommodate the stream of traffic moving in the opposite direction and still leave room for vehicles to pass so large a unit as an omnibus. While the buses are responsible for some of the congestion, they do not contribute to it nearly so much as do the horse-drawn vehicles. The business situation at this time is such as to preclude any abandonment of horses or horse-drawn vehicles. So long as they can be continued in service it saves their owners the capital outlay necessary to the change to motors. Animal traction is being abandoned in practically every instance, as fast as the existing equipment wears out.

Steam-driven traction engines with trailers ply all London streets, even during the rush hours. While the presence of these large units, with belching smoke stacks, presents a rather formidable appearance in a traffic jam, they are better handled than are many motor trucks and contribute no more than the latter to congestion.

Congestion at Intersections—The handling of traffic at street intersections is not well performed. While an adequate number of policemen are stationed at these points, tangles are frequent and at the rush hours there is no certainty as to the length of time that will be required to negotiate any of the crowded streets.

A glance at the plan of London is all that is necessary to show how few alternate routes can be chosen for traffic. An unusual number of streets are blind. A thoroughfare starting out to be a parallel street may spread quickly to an unbelievably distant point from the street it may have paralleled for a portion of a block.

Day Labor Tunnel Costs in Chicago

Since 1919 work on the 12-ft. Western Ave. water tunnel has been under way. In the 1922 annual report of the water department just issued excavation progress on 7,977 lin.ft. at the Wood St. shaft is given as 10.81 ft. per 8-hr. shift, at a cost of \$55.52 per lineal foot including labor and explosives. Trimming 9,224.6 ft. cost \$1.05 per foot. Placing footing walls in 7,730.8 ft. cost \$1.65 per lineal foot. Lower figures were obtained at the Sixty-First St. shaft where 9,778 ft. were driven at a cost of \$54.06 per foot, 5,327 ft. of footing walls placed for 83c. and trimming 6,957 ft. cost 41c. per foot.

Chicago Union Station Forms Double-End Terminal

Heavy Traffic Served by Two Sets of Stub Tracks on Opposite Sides of Concourse—Low-Roof Trainshed With Raised Skylights—Tracks on Concrete Base—Office Building Utilizes Air Rights

PROMINENT among great modern railway passenger terminals will be the new Chicago Union Station, which is now entering the final stages of its construction and which in size, traffic and facilities will rank with the two great terminals at New York and the one at Washington. Initiated in 1914 and interrupted by war, protracted strikes and industrial and commercial disturbances in addition to railway difficulties, it is now expected to have the new station completed in 1924.

Distinctive features of this new Chicago terminal station are as follows: (1) In spite of its large size it has tracks, concourse and all main station facilities on the same level, instead of having the more usual double-deck arrangement; (2) it is said to be the largest one-level station ever built; (3) it is a double-end terminal,

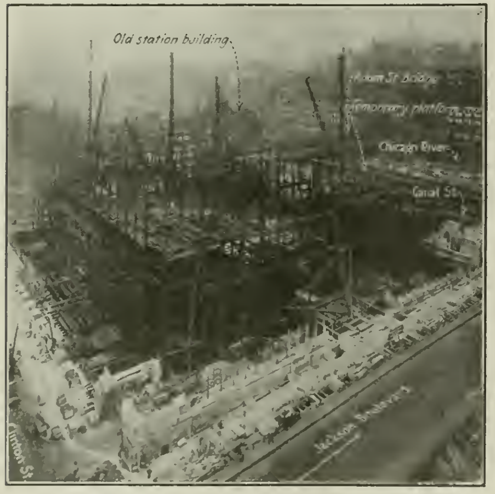


FIG. 1—CONSTRUCTION OF CHICAGO UNION STATION: OCTOBER, 1923

View looking northeast from Jackson Boulevard and Clinton St. Steel frame of headhouse and office building in foreground, with station tracks and platforms at the right and below street level. Beyond the headhouse is the Adams St. bridge over tracks and Chicago river, with the old station building at Adams and Canal Sts.

with two sets of stub tracks abutting on opposite sides of a wide transverse concourse; (4) platform tracks are arranged singly instead of in pairs; (5) passenger and baggage movements are kept separate by assigning alternate platforms for these respective uses; (6) a concrete base under the approach tracks will minimize maintenance work; (7) air rights are utilized by a lofty office building over the headhouse; (8) the trainshed is of the low-roof type but with high longitudinal skylights; (9) compact position-light signals eliminate the usual semaphores; (10) extensive alterations to streets, bridges and public utilities were required; (11) construction work was carried out with little interruption to railway traffic or street traffic.

A view of the station under construction is shown in Fig. 1. The headhouse, surmounted by an office building, occupies an entire city block. Its steel frame is being erected by four large guyed derricks, while stiff-leg derricks place the masonry. Beyond the headhouse is Adams St., with the old station building, a truss bridge over the station tracks and a swing bridge over the river. In Fig. 2 is shown the old steel trainshed in process of removal in August, 1923. This view shows the old through tracks, but in the new station the space shown will be occupied by a concourse between two sets of stub tracks. At the left is the old brick headhouse, but the new headhouse is in a different location. A plan of the new station and adjacent railway structures is shown in Fig. 3.

During the ten years of work and delay in the carrying out of this project there have been changing conditions leading to successive developments of the original plans. The most conspicuous of these developments has been in the design of the headhouse, which is now to be a lofty office building to utilize the air-rights of the site, instead of being a low structure for railway purposes exclusively, as originally planned.

Two special features in addition to the station itself are: (1) Extensive and costly auxiliary works necessitated by the taking of land formerly occupied by various railway and industrial activities; (2) a great amount of reconstruction of streets, bridges, sewers and other adjacent municipal facilities and public service utilities, as indicated in *Engineering News-Record*, Feb. 3 and May 18, 1916, pp. 212 and 948, and March 13, 1919, p. 528. Of no less interest and importance are the numerous construction problems and difficulties encountered in carrying on such complicated work in and around the congested conditions of an outgrown railway terminal in a busy city district.

Traffic Conditions—Daily traffic at this station averages 123 main-line trains and 132 suburban trains in and out, with 14 and 24 trains respectively during the busiest rush hour. The number of passengers averages 25,650 daily, 11,500 of these being main-line and 14,150 being suburban passengers. Furthermore, about 4,750 pieces of baggage are handled daily. For New York, official figures give 133 main-line and 225 suburban trains daily at the Grand Central Station, and 181 and 310 respectively at the Pennsylvania R. R. Station. But the record number of trains appears to be held by the old South Station at Boston, with 344 main-line and 297 suburban trains daily.

Double-End Terminal—A double-end station having two groups of stub tracks and platforms arranged end to end but separated by a broad concourse or transverse platform is the unique plan adopted to meet the particular operating conditions. Different railroads use opposite ends of the station and the old arrangement consisted of three through tracks and five stub tracks at the north and south ends, with a concourse on one side of and parallel with them. This through-track plan is objectionable, however, and could not be permitted in a busy modern station, since it not only requires passengers to cross tracks at grade in going to and from the trains, but it also tends to confuse them in finding the right platform and train.

In both the old and new stations the tracks are below the street level. The old headhouse has the waiting

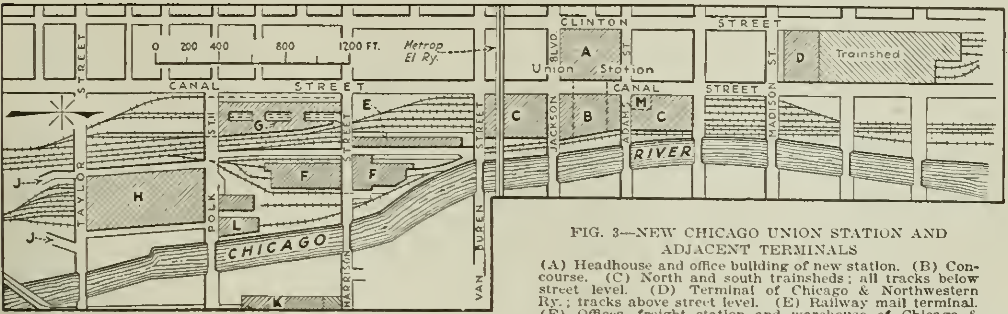


FIG. 3—NEW CHICAGO UNION STATION AND ADJACENT TERMINALS

(A) Headhouse and office building of new station. (B) Concourse. (C) North and south trainsheds; all tracks below street level. (D) Terminal of Chicago & Northwestern Ry.; tracks above street level. (E) Railway mail terminal. (F) Offices, freight station and warehouse of Chicago & Alton R.R. (G) New freight station of Chicago, Burlington & Quincy R.R. (H) Freight station and warehouse of Pennsylvania R.R. (J) Inclined driveways from viaduct to team yards of Pennsylvania R.R. (K) Grand Central Station (B. & O. R.R.). (L) Private warehouse. (M) Old headhouse of Union Station.

room and ticket office on the upper or street level, and it would have been possible to incorporate this arrangement in the new station by building the concourse as a bridge over the through tracks, with stairs or elevators to the platforms, as in the union stations at St. Paul and Kansas City. But in the design of this new Chicago station, to handle a heavy main-line and suburban traffic averaging a total of 255 trains in and out during 24 hours, it was considered by far the most desirable arrangement to locate all the main facilities at the track level. Then with the waiting rooms, ticket offices, baggage checking room and cabstand all at the track level, the logical track layout was the double-end stub plan described above and shown in Fig. 4.

A single through track on the east side provides for transfer movements between the two parts of the terminal. Beyond this are two through tracks of the Pennsylvania R.R., which road has two divisions using opposite ends of the station and therefore requires a through line. The site extends to the river, along which is built a concrete bulkhead or dock wall of gravity section supported on four rows of 35-ft. wood piles. Columns on this wall will support a driveway at street level, covering the through tracks.

Tracks and Platforms—In the south end of the station there are fourteen stub tracks with platforms of various lengths for trains of 7 to 18 cars, with their locomotives, allowing 70 ft. for each car. In the north end there are ten stub tracks and the platforms provide for 9- to 18-car trains. The total car capacity of the platform tracks is 191 cars in the south end and 141 cars in the north end.

Single tracks alternating with comparatively narrow platforms constitute an unusual station plan. This arrangement was adopted in order to keep all trucking clear of the passenger movements, each alternate platform being assigned for handling baggage and express exclusively. In the original design this plan was proposed, but in order to secure the maximum number of tracks in the given width of property it was at that time abandoned in favor of the more usual arrangement of tracks in pairs, separated by platforms 16 ft. 3 in. in width, each platform to be used for both passengers and trucking. In this second or modified layout two tracks of each group were assigned for loading and unloading mail. But these tracks were released later for general station purposes by the decision to construct a separate railway mail station, the location of which is shown in Fig. 3. This structure was described in *Engineering News-Record*, Dec. 22 and 29, 1921, pp. 1011 and 1058. Mail cars are switched between this station and their trains standing in the passenger station. On further study, therefore, it was decided to revert to the original plan of single tracks and separate platforms for trucking. In the adopted layout, Figs. 4 and 5, the widths of passenger and trucking platforms are 13 ft. 9½ in. and 10 ft. 9 in. respectively, with alternate track spacings of 23 ft. 3 in. and 21 ft. 6 in.

Low platforms are used, although high platforms approximately 4 ft. above the top of rail were planned originally, following the type of construction used in the Grand Central and Pennsylvania terminals at New York. Although there were advantages in this latter plan, particularly in the convenience of passengers and the less vertical distance to be overcome between the car and the street, it was abandoned largely on account of the great cost of altering car equipment to adapt it for use at this one station. As constructed, the height of edge of platform above top of rail will be 7¾ in. for the passenger platforms and 20 in. for the baggage platforms. Since the passenger platforms are about 4 ft. below the concourse elevation and are reached by ramps having an inclination of 6.37 per cent, it is practicable to build high platforms later, if desired, without altering the present concourse.

The platforms will consist of reinforced-concrete slabs resting on concrete side-walls which are built on a 10-in. foundation slab of plain 1:3:6 concrete. Slabs for the passenger platforms are 6 in. thick at the sides, with a

FIG. 2—REMOVING OLD TRAINSHED OF CHICAGO UNION STATION

Station opened in 1880. Old headhouse and Adams St. viaduct at left. Swing bridge for Adams St. over Chicago River at right. During removal of trainshed traffic was handled temporarily on additional tracks between trainshed and river.

crown of $1\frac{1}{2}$ in. at the middle and having ribs on the underside to lock with the side-walls. Slabs for the baggage platforms are 8 in. thick at the sides and have a slope of $\frac{1}{8}$ in. in 12 in. from the center line. The underside is flat, without the ribs used on the passenger platforms. In all platform slabs the upper edge is finished with a curb bar with a radius of 1 in. A solid fill of sand or cinders is placed under the platforms, except that under some of the baggage platforms the space is left open to serve as a gallery for pipes, wires and other utilities. Temporary plank decks level with the rails were provided on some of the new platforms first put in service (see Fig. 4).

The separate trucking platforms will facilitate baggage handling materially, for with the baggage room placed beneath the concourse it can be connected with these platforms by ramps, the slope of which is 6.75 per cent. This arrangement eliminates the delay, first cost and operating cost incident to the use of elevators at the ends of the platforms to raise and lower baggage trucks. With the adopted arrangement, tractor-trailer trains will operate directly between the cars and the baggage room. An incline from the street on a grade of 4 per cent will lead to a driveway alongside the baggage room, with 380 ft. of tailboard space, so that wagons or motor trucks can receive and deliver baggage directly, without requiring elevator service.

Track Approaches—At each end of the station yard a six-track main line approach is provided, with tracks spaced 13 ft. c. to c. As the approaches are approximately in line with the east side of the station, the usual V or fan-shaped connection with the platform tracks is replaced by a double-track diagonal ladder, with slip and split switches enabling any approach track to

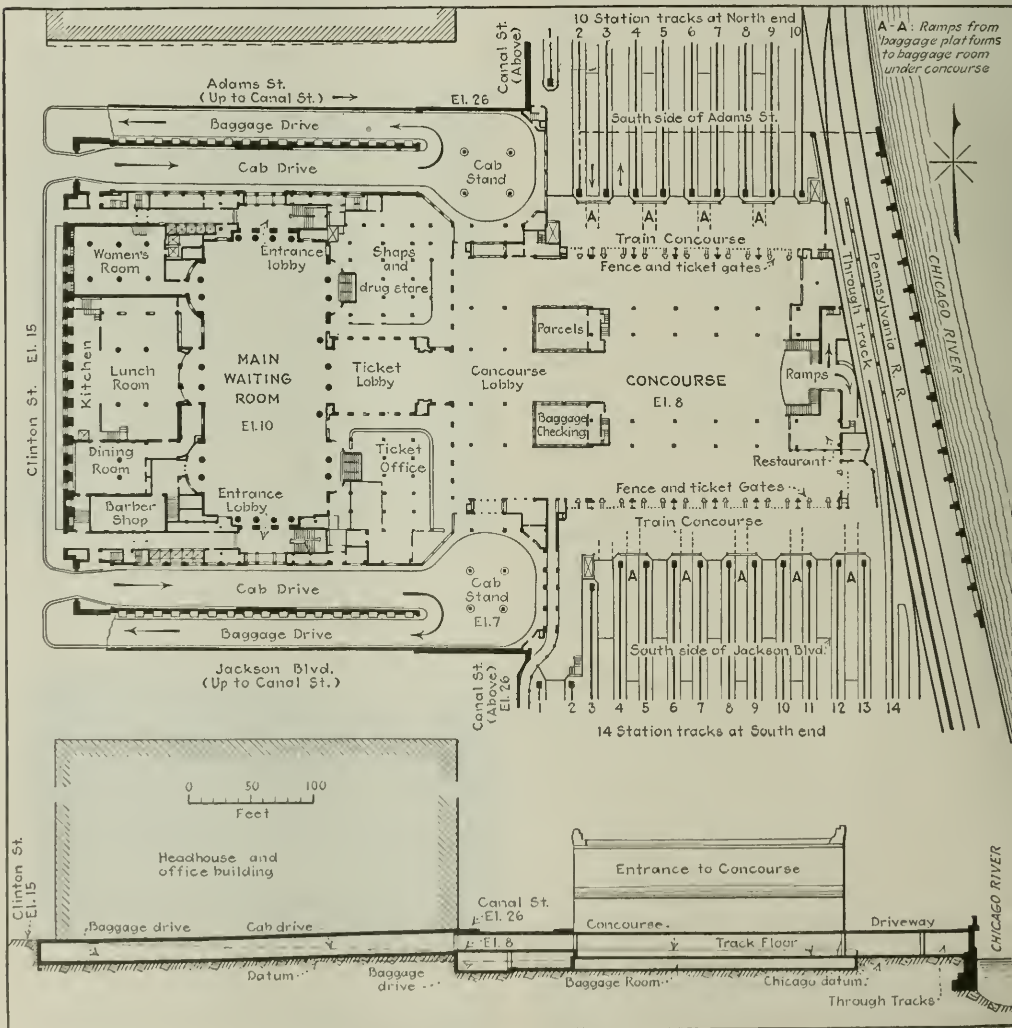


FIG. 4—PLAN OF HEADHOUSE, TRACKS AND PLATFORMS

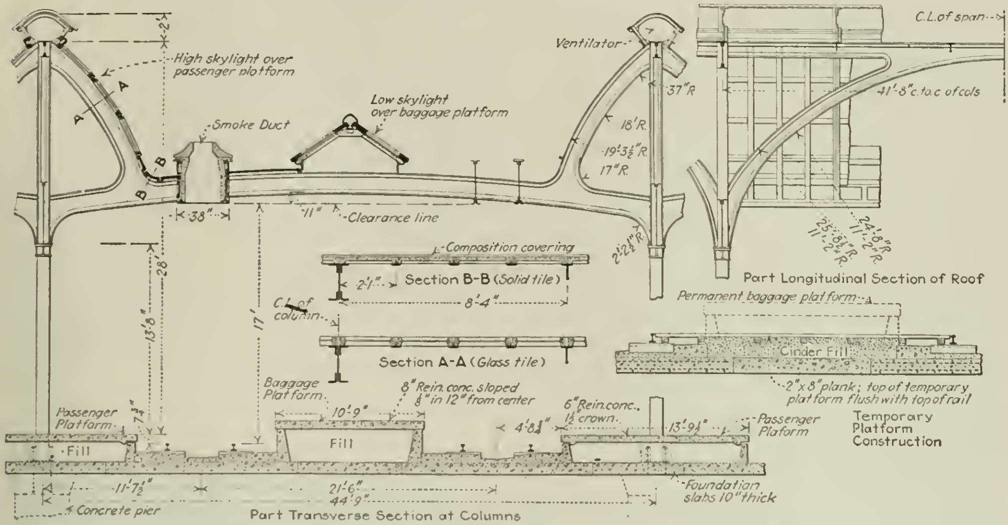


FIG. 5—TRAINSHED AND PLATFORMS: CHICAGO UNION STATION

be connected with any one of the platform tracks. Part of the south approach is shown in Fig. 6. There are thirty-three double slips and nine diamond crossings in the south yard and sixteen slips and six diamond crossings in the north yard. All slips are No. 8 or No. 9 and have movable-point frogs.

Track Construction—A concrete slab roadbed is another special feature of the station, this construction being provided under the ladders and slip switch connections and on part of the main-track approach. Since the subgrade elevation is only about 4 ft. above the water level in the Chicago River, which is close beside the tracks, the roadbed will be of necessity somewhat soft, in spite of drainage. Under the pounding of heavy loads, especially at the frogs and switches, the ballast would gradually be driven into the roadbed, so that continual work would be required in surfacing and adjusting track. Such work would be slow and costly, owing to the heavy traffic. It would also interfere more or less with train movements and would involve hazard to the trackmen.

In order to provide against this condition, the roadbed is covered with a 10-in. slab of reinforced concrete on 12 in. of cinders. The surface of the slab is approximately at subgrade level, but is formed in drainage planes, with sumps connected to a system of tile underdrains and served by automatic electrically operated pumps. Upon the slab is crushed stone ballast 8 to 10 in. deep under the ties. Where the concrete slab is not used the ballast is 12 in. deep under the ties. This unusual roadbed construction was described in *Engineering News-Record*, July 29, 1920, pp. 193 and 233.

In the station, each track has a reinforced-concrete slab, shaped to form a central drain, with creosoted red-oak or yellow-pine blocks embedded along each side, as shown in Fig. 7. These blocks are 6 x 8 x 30 in., spaced twenty to each 33-ft. rail. They are fitted with shoulder tie-plates 7 x 11 in. and ¾ in. thick, each plate being held in place by two spikes while two other spikes form the rail fastenings. These platform tracks have 100-lb., 33-ft. rails. On the approach tracks, 130-lb. rails are used, in 33-ft. lengths, spliced with four-bolt angle bars 24 in. long. Shoulder tie-plates as described above are placed on all ties and the rails are secured by 6½-in. drive spikes. All ties are of red oak, treated with zinc-chloride or creosote. The 10-in. slab under each track, with a width of 14 ft., is of 1:2:4 concrete. Above this, the concrete forming the track surface is a 1:1½:3 mix with a ½-in. cement finish.

Except for the slips and crossings, which were designed by the engineers of the Union Station, all track material is of Pennsylvania R. R. standards. Special work is avoided as far as possible in the complicated turnouts and switch layout. At the slip switches, the end frogs have manganese centers and cast steel heel and toe blocks bolted between ordinary rails. Switch rails are 15 ft. long with 4½-in. throw; movable-point frogs are 12 ft. long with 4-in. throw. Anchor straps, fastened at the heel joints of the rails and to the five ties on each side of the joint, or twenty ties in all, effectively prevent any creeping at switches. In the No. 8 slip switches, the length is 54 ft. 7 in. between switch points and 76 ft. 1⅞ in. between the frog points of end frogs. Frog guard rails are of cast manganese steel. Main tracks on the approaches are spaced 13 ft. c. to c. The sharpest curves on these approaches are 12 deg. at the south end and 13 deg. 17 min. at the north end.

Signals and Interlocking—Design and location of signals constituted a special problem. With the complicated track layout and the limited lateral clearances, as well as the numerous low-level bridges across the tracks, giving only 17 ft. headroom, it was practically impossible to locate supports for signal bridges at the proper positions to allow full track capacity. To meet this difficulty, posts and semaphores are eliminated and the entire equipment consists of high and dwarf position-light signals. Dwarf signals are provided at the throat of the station, where all movements through the switches are made at low speed. High signals are used where the movements are numerous but generally with-

out diverging from one track to another. These latter are placed conveniently on the track sides of the parapet walls of street bridges which cross the tracks.

Position-light signals were adopted in preference to color-light signals, mainly for the reason that the former permit of a larger number of indications with a minimum size of signal. The indications are shown in Fig. 8. A new development in signaling is the four-position dwarf signal, giving the following indications: (1) "Proceed," two lights in a vertical line; (2) "Proceed under control," two lights in a 45-deg. line below the horizontal; (3) "Caution, prepare to stop at next signal," two lights in a 45-deg. line above the horizontal; (4) "Stop," two lights in a horizontal line. The second or permissive indication enables trains on the same track to follow each other with safety.

High signals on the approach have each seven lamps giving five indications by the arrangements shown in Fig. 8. The permissive signal indicates that the track immediately ahead is occupied but that the train may proceed prepared to stop at once. The slow-speed signal means that the route is set to diverge over a slow-speed turnout. The caution signal is a warning that the next signal is at "stop." Switch and signal movements are controlled from two towers, one at each end of the station.

Low-Roof Trainshed—A steel-frame trainshed of the low-roof type was adopted after consideration of different types. This is in accordance with general modern practice, but for the Chicago station it was considered desirable to provide greater lighting and ventilating facilities than are provided in some low-roof trainsheds. In the design adopted, therefore, the low roof with open smoke duct over each track is supplemented by a high triangular ventilated skylight over each passenger platform and a low monitor skylight over each baggage platform. This arrangement, shown in Fig. 5, is somewhat similar to that of the trainshed of the Indianapolis Union Station (*Engineering News-Record*, July 10, 1919, p. 84, and Aug. 19, 1920, p. 351). The Indianapolis trainshed, however, does not include the continuous low skylights, since the tracks are arranged in pairs and special baggage platforms are not provided as at Chicago.

Columns supporting the transverse curved roof ribs are spaced 41 ft. 8 in. c. to c. along the middle of each passenger platform. They give a transverse span of 44 ft. 9 in. c. to c. of columns, with clearance line 17 ft. above top of rail. Longitudinal arched ribs are framed between the columns and support intermediate transverse ribs, thus minimizing the number of columns. Longitudinal girders framed between the ribs form the sides of the smoke ducts and will be cased in concrete for protection against corrosion. Instead of the smoke ducts being of uniform width, as is the usual arrangement, they are reduced from 32 in. in the lower portion to 18 in. in width at the top. This is done to afford the platforms additional protection against driving rain or snow, while it provides ample area for ventilation and for the escape of blast from the engines.

Cement tile laid on steel framing and covered with waterproof composition roofing will form the main part of the roof. Wire-glass tiling will be used in the high and low skylights, the glass being of a special tint selected after extended experiments to secure absorption of heat rays and thus avoid excessive heat in the trainshed during hot summer days.

This trainshed, covering both groups of terminal tracks and the concourse between them, will be 2,380 ft. long, with a width of 180 ft. 6 in. for the north yard and 250 ft. for the south yard. It will not extend over the three through tracks along the east side of the station, these tracks being covered by a driveway along the river front. For platforms built previous to the erection of the trainshed, temporary butterfly roofs of timber construction are provided. In the old station a steel truss trainshed with trusses of 66-ft. span on columns spaced 24 ft. 10 in. longitudinally covered five tracks and platforms. It was 34 ft. high from rail to top chord of truss. This structure, shown in the course of removal in Fig. 2, has been repaired and reinforced in recent years, owing to severe corrosion of some of its members, and has now been dismantled.

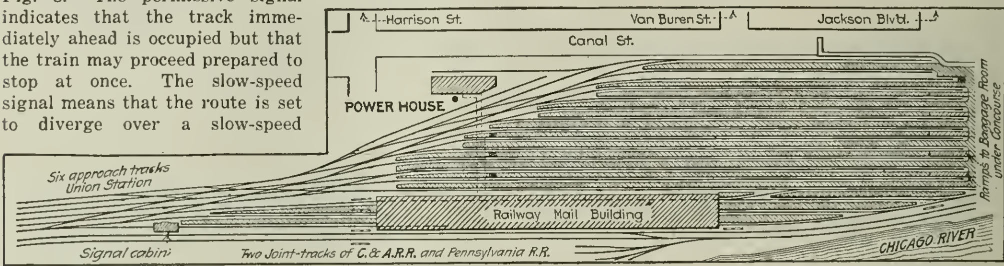


FIG. 6—TRACK LAYOUT OF SOUTH APPROACH

Headhouse Forms Office Building—In the old station, all facilities were east of Canal St. (see Fig. 3), the station building having its front on that street and the tracks lying between this building and a row of buildings (now removed) along the river front. To provide adequate accommodation for the new station, additional property was secured covering an entire block 296 x 320 ft. west of Canal St. as the site for the new headhouse. The river front property was also secured, so that the tracks and platforms will occupy all the space between Canal St. and the river, as shown in Fig. 3. A broad subway under the street will connect the headhouse with the other part of the station.

One of the fundamental features of the headhouse layout is the placing of all main station facilities at the track level, below the street. This arrangement is made the more easy and convenient by the fact that the street level falls west of the station. Thus Canal St., along the east side of the building, is at El.26; Clinton St., along the west side, is only at El.15, while the main waiting room is at El.10 and the concourse is at El.8. These levels are indicated on Fig. 4. Stairways, elevators and inclined walks and driveways will extend from the street level to the station level.

In accordance with the plan for a one-level station, at

the lower or main level are arranged the tracks, platforms, concourse, waiting rooms, ticket office, baggage room, dining and lunch rooms, cabstand and carriage entrance. On the upper or street level floor of the headhouse are arranged shops and the entrance lobbies to the main waiting room. Among the several special facilities provided is a jail or detention room where prisoners in transit can be held securely and kept apart from the traveling public. Entrances to the office portion of the building are entirely separate from those to the station.

The main waiting room is to be 100 x 217 ft., with a height of 114 ft. to a roof composed mainly of skylights. From this room a lobby 185 ft. wide, with ticket office along one side, will extend under Canal St. to the concourse, which is 190 ft. wide and 280 ft. long. A screen or railing on each side and provided with gates will separate the concourse from the train platform. Outside this railing will be a train concourse 36 ft. wide, by which employees or passengers can pass from platform to platform.

As planned in 1915, this new headhouse was to be a low structure, handsome in architectural design and devoted exclusively to station purposes. An office building was considered, but studies made at that time indicated that the location was not favorable, being several blocks from the business district. In the next few years, however, there was a decided trend of business to extend beyond this limited district and even across the river. Furthermore, financial conditions made it desirable to develop the air rights above the station for revenue-producing purposes.

When the headhouse design was again considered in 1919, at which time work on the terminal was resumed, it was finally decided to erect a 22-story office building over the site. This new design was described in *Engineering News-Record* of Dec. 1, 1921, p. 894, and the lower 8-story section is now under construction. This building will be 374 x 312 ft., with a central light court 132 x 204 ft. over the waiting room, the roof of which will be at approximately the seventh floor level.

Concrete cylinder piers founded on a deep stratum of hardpan at a depth of 60 to 66 ft. below city datum (or water level in the Chicago River) form the foundations for this building. There are 449 of these piers, of which 181 were required by the change to a 22-story structure after the foundations had been built for the low structure originally proposed.

With the redesign of foundations, trouble arose over a suggestion from the city authorities that the foundation should be carried to rock, at a greater depth. A combination of piers founded on rock and hardpan was considered highly undesirable for such a structure, besides which the additional cost for the deeper new piers would have been considerable. To demonstrate the carrying capacity of the hardpan, two piers were built in the usual way and loaded to a maximum of 87½ tons per square foot, with only slight deflection, as described in *Engineering News-Record* of Nov. 10, 1921, p. 763, and May 18, 1922, p. 822. As a result of this test the

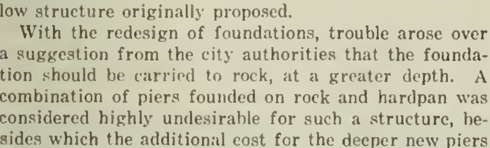


FIG. 7—STATION TRACK CONSTRUCTION

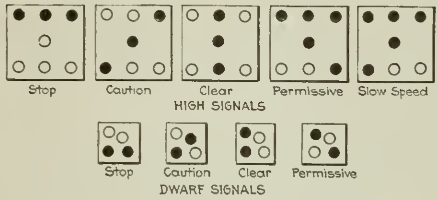


FIG. 8—POSITION-LIGHT SIGNAL INDICATIONS
Black spots show lights displayed for each indication. Open circles show lamps not lighted.

building commissioner approved the hardpan foundation with a load not exceeding 10 tons per square foot. A somewhat complicated arrangement of concrete girders on the piers is required to distribute the load and to provide supports for the new column arrangement in the larger superstructure.

Power House for Station—A complete power plant and electric generating station was proposed originally as part of the terminal. But in view of the great development of electric utilities in Chicago it has been decided to purchase all electric current. A power house south of the station will supply steam and compressed air service for the terminal, station and office building.

History of Chicago Union Station—The old union station at Chicago, put in service in 1880, was remodeled in 1892 to take care of the prospective heavy traffic of the World's Fair of 1893, since which time it has accommodated the ever increasing traffic with only minor alterations. The original Union Station Co. was formed jointly by the Pennsylvania R. R., the Chicago, Milwaukee & St. Paul Ry. and the Chicago, Burlington & Quincy R. R., with the Chicago & Alton R. R. as a tenant road. The Pennsylvania R. R. was the majority owner, since it had two lines using the station: the Pittsburgh, Fort Wayne & Chicago R. R. entering at the south end and the Pittsburgh, Cincinnati, Chicago & St. Louis Ry. entering at the north end.

Studies for enlargement and reconstruction were made at various times, but it was not until 1906 that a definite plan was proposed and was adopted by the several railways after extended negotiations. This plan was substantially what is now being carried out. It was submitted to the city authorities in 1913, an ordinance was passed in March, 1914, and was accepted by the railroads in June, 1914. Preparation of detail plans was then undertaken, but the opening of the World War halted the project and with the entrance of the United States into the war in 1917 the work was practically suspended.

While the old station occupied an area of about 225,000 sq. ft. with its buildings and tracks, the new plan required nearly 1,400,000 sq. ft., including land occupied by freight houses, team yards, a large electrical power house, large warehouses of wholesale firms and a number of streets with sewers, water and gas mains and the utilities of public service companies.

Before proceeding with work on the station proper, therefore, it was necessary to provide new railroad and other facilities to replace those to be destroyed and also to carry out extensive alterations to streets, bridges, bridge approaches, and various public utilities. As this work was scattered and largely underground it made no great show, so that the public has not realized the progress being made or the vast amount of work

required as a preliminary to reconstruction of the station. The additional work outside of the terminal has included three large freight terminals, a railway mail station and a 20-story warehouse built for Butler Bros.

Progress on the station proper up to July 31, 1923, included partial reconstruction of platforms, tracks and track approaches, demolition of the old trainshed, and partial erection of the steel frame for the lower portion of the combined headhouse and office building. Work was commenced in 1916, but was delayed by a 10-months strike and postponed indefinitely in the spring of 1917. When resumed in 1919, it was hampered by strikes, car shortages, high prices and the various other disturbances which followed the war period. It is now expected to have all the work completed by the end of 1924.

To carry out this extensive project a new company was organized under the name of the Chicago Union Station Co., in which the Pennsylvania R. R. owns 50 per cent of the stock and the Chicago, Milwaukee & St. Paul R. R. and Chicago, Burlington & Quincy R. R. hold 25 per cent each. The Chicago & Alton R. R. continues as a tenant road. No other railroads use this station. The company has its own chief engineer and engineering department in charge of design and construction, but for the consideration of important technical problems there is a board of advisory engineers composed of representatives of the three owning roads.

J. D'Esposito is chief engineer of the Chicago Union Station Co., and Thomas Rodd (formerly chief engineer of the Pennsylvania R. R.) is consulting engineer. Graham, Anderson, Probst & White are architects for the headhouse and office building. The John Griffiths & Son Co. has the contract for this building, the steel for which is being fabricated by the American Bridge Co. and erected by the Overland Construction Co. Foundation work was done by the R. C. Wieboldt Co. The cost of the station or terminal proper will be about $60,000,000, including land, trackage, signaling, station facilities and headhouse structure. The total expenditure involved in the terminal reconstruction, including also the new freight stations, railway mail station, warehouses, city bridges, street elevation and miscellaneous reconstruction of streets, viaducts and public utilities, will amount to approximately $95,000,000.

Mormon Flat Dam to Perform Regulating Service

Work has been pushed actively on the Mormon Flat dam, 27 miles below the Roosevelt dam on Salt River in Arizona. This improvement follows the increase in the storage capacity of the Roosevelt dam from 1,300,000 to 1,600,000 acre-ft. by the installation of 15-ft. gates in the spillway of the dam, which also gives an additional head for power. The Mormon Fat dam is being constructed primarily to increase the water power available to the Salt River Valley. The new dam, however, also performs a regulating service. It has a storage capacity of 90,000 acre-ft. Five power plants now are in operation which delivered 78,000,000 kw.-hr. last year. The construction of the new dam makes possible the installation of an additional 7,000-hp. unit. This improvement is desired because of the wide fluctuation between the minimum and maximum amounts of power now available. To carry out these improvements the Salt River Valley Water-Users Association bonded itself for $1,800,000.

Bronx Parkway Bridges Tested by Heavy Loads

Withstand Stresses Many Times as Great as Those for Which Intended, Including Weight of 70-Ton Excavator Used on Job

By Arthur G. Hayden
Senior Assistant Engineer, Bronx Parkway Commission, Bronxville, N. Y.

The parkway drive in the new Bronx River Parkway Reservation, which extends from Bronx Park, New York City, to Valhalla, Westchester County, N. Y., crosses the Bronx River at several points and required the construction of about 30 drive bridges. It was originally intended that most of these bridges should be true arches, but the rise in cost of materials following the war led to the adoption for some of the shorter spans of a reinforced-concrete beam type. Some of the bridges have granite arch facing to resemble the much more costly stone arch bridge; others are faced with timbers so as to resemble rustic beam bridges. Some of these structures have had to carry abnormally heavy

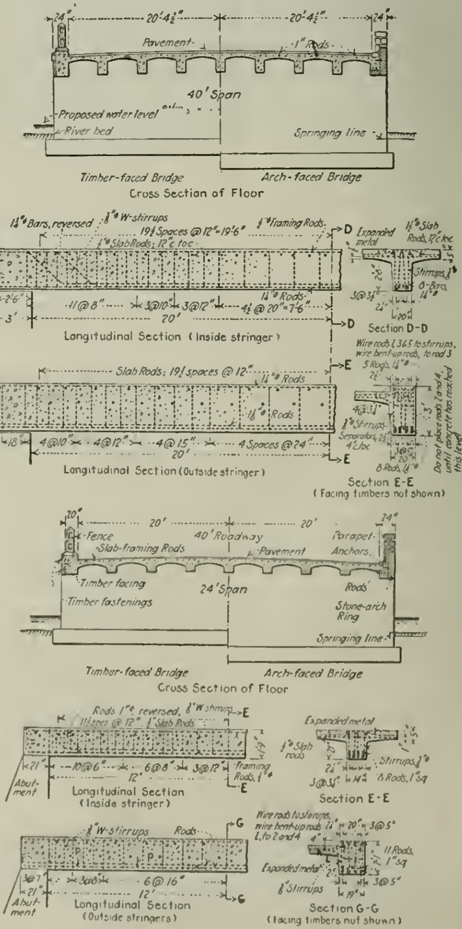


FIG. 1—FLOOR CONSTRUCTION OF BEAM BRIDGES

FIG. 2—TIMBER-FACED CONCRETE BEAM BRIDGE ON BRONX PARKWAY
North of Crestwood, N. Y. Span 35 ft., roadway width 40 ft.

loads, which they did safely. Stresses far beyond accepted limits of safe practice do not appear to have injured them.

The design of all the reinforced-concrete beam bridges was to some extent influenced by the dimensions of steel forms used in the construction of New York City subways, which had been purchased second-hand for Parkway use. Standard designs were made for clear spans of 24, 30, 35, 40, and 45 ft., all 40 ft. wide between curbs. Although commercial traffic will be prohibited in the Parkway, the bridges were designed to carry a concentrated load of 15 tons (including impact allowance) on two axles 11 ft. on centers, which will correspond to the heaviest maintenance machinery. There are no experimental data for determining the concentrated load distribution in floors like these, but judging from tests on floors that were different in design and have smaller stringer spacing it was decided that a fair assumption would be that about 80 per cent of a concentrated load would be carried by the underlying stringer. On this basis the assumed concentrated load would cause stresses of 16,000 lb. per square inch in the steel and 650 lb. in the concrete. Architectural requirements imposed a limit upon the depth of stringers which is less than the economic depth, but every structure has exhibited a great reserve of strength and rigidity under very severe test.

The Parkway Commission owns and operates many heavy pieces of construction machinery which had to be transported over the completed bridges as Parkway construction progressed. The heaviest is a Monighan 2-T dragline excavator, which weighs about 75 tons, and has crossed several of the bridges. This machine "walks," that is, during transportation it is supported alternately first on a circular base 15½ ft. in diameter and then on two "feet" or walking platforms, one on each side of the machine, each being 3½ ft. wide and 16 ft. long. It imposed a load on the bridge stringers several times as great as that for which they were designed, but none of the bridges which it crossed showed the least sign of distress. Such a test demonstrates the value of attention to the details of design and construction which is necessary to develop the strength of a member.

FIG. 3—DRAGLINE CROSSING CONCRETE BEAM BRIDGE
Structure similar to that of Fig. 1: span 35 ft. A 75-ton dragline excavator of "walking" type is crossing it, overloading the floor several hundred per cent.

For studying the effect of this emergency load, a wider lateral distribution in the floor should be assumed than given by the design rule. With the machine resting on the circular base, 70 per cent of the load is assumed to be carried by the three underlying stringers and distributed along a length of 16 ft. of the stringers, then the calculated stresses are 26,000 lb. per square inch in the steel and 1,020 lb. in the concrete. With the machine resting on the feet, assuming 70 per cent of the load on one foot to be carried by the underlying stringer and distributed along a length of 18 ft. of stringer, the calculated stresses are 34,000 lb. per square inch in the steel and 1,400 lb. in the concrete. Using a factor of 60 per cent instead of 70 per cent the calculated stresses are: with machine resting on the circular base, 24,000 and 960; with the machine resting on the feet, 30,000 and 1,200. The above calculations are for the 35-ft. span, over which the photograph shows the drag-

FIGS. 4 AND 5—TWO ARCHED BRIDGES—STONE ARCH AT LEFT, ARCH-FACE CONCRETE BEAM BRIDGE AT RIGHT
At left, bridge 33, located between Hartsdale and White Plains; a concrete arch of span 52 ft., rise 12 ft., with stone facing architectural design by Gilmore D. Clark, of Pelham. At right, bridge 13, Bronxville; reinforced-concrete beam bridge of 40-ft. span with arched stone facing; architectural design by C. W. Stoughton, New York.

line crossing. Calculated stresses for the bridges of 30, 40 and 45-ft. span would be nearly the same—a little greater for the longer spans.

On two 40-ft. bridges between Mt. Vernon and Bronxville a 30-ton bucket excavator operated in deepening the river channel, standing at the extreme side of the roadway and handling wet material with a ¾-yd. bucket at the end of a 45-ft. boom. Machines weighing 30 tons mounted on caterpillars of narrow tread, have repeatedly crossed nearly all of the bridges.

The commission's engineering department expects to make field tests on one or more of the Parkway bridges to determine, as closely as may be, the distribution of heavy concentrated loads over the stringers.

Kutter's *n* for Rough Rock Channel Excavated by Explosives

By C. E. Ramser
Senior Drainage Engineer, U. S. Bureau of Public Roads, Washington, D. C.

To the writer's knowledge Kutter's *n* has never been determined experimentally for channels excavated in rock by means of explosives where the condition of the channel was similar to that of the Sals Creek Diversion Channel in the Little River Drainage District, Mo., as shown in Fig. 1. Horton's table gives values ranging from 0.025 to 0.035—with 0.033 as the most commonly used values—for canals excavated in rock, which values are no doubt intended for use where the inside of the channel is made fairly regular and smooth. Engineers of the Little River Drainage District used a value of 0.045 in designing the rock cut of the Sals Creek Diversion Channel. Measurements on this channel were made by the writer to determine experimentally the value of *n* as a check on the design and to afford information for future application. The slope of the water surface was measured along two courses, one 255 and the other 161 ft. long, the latter course being included in the former. Measurements of seven cross-sections of the channel along the slope courses were made. No attempt was made to show the projecting rocks in the cross-sections but points were selected that represented fairly well the size and shape of the cross-sections. The discharge was measured with a current meter for two different stages in the channel with average maximum depths of 5.42 and 5.67 ft. for the long course and of 5.61 and 5.86 ft. for the short course. The cross-sections are platted superimposed in Fig. 2, from which an idea of the shape, size, and uniformity of the cross-sectional area can be obtained.

FIG. 1—SALS CREEK ROCK CHANNEL FROM LOWER END OF SLOPE COURSE

HYDRAULIC ELEMENTS AND VALUES OF *n* IN KUTTER'S FORMULA
Sals Creek Diversion Channel in Rock; Little River Drainage District, Mo.

Elevation Water Surface, Ft.	Average Maximum Depth, Ft.	Average Surface Width, Ft.	Discharge, Sec.-Ft.	Average Cross-Section Area, Sq.Ft.	Wetted Perimeter, Ft.	Mean Hydraulic Radius, Ft.	Slope of Water Surface	Mean Velocity, Ft. per Sec.	c	n
Length of Slope Course = 255 Ft.										
98.33	5.42	10.0	160.0	44.1	17.7	2.49	0.00268	3.63	44.4	0.0385
98.58	5.67	10.1	177.9	46.2	18.0	2.56	0.00288	3.85	44.8	0.0385
Length of Slope Course = 161 Ft.										
98.33	5.61	10.1	160.0	46.2	18.1	2.56	0.00279	3.46	41.0	0.0420
98.58	5.86	10.2	177.9	48.4	18.5	2.62	0.00274	3.68	43.5	0.0395

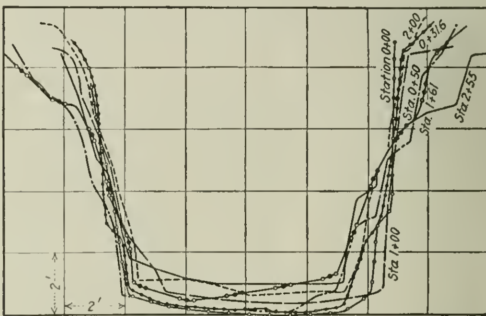


FIG. 2—CROSS-SECTIONS OF SALS CREEK ROCK CHANNEL ALONG COURSE OF SLOPE

Values of *n* in Kutter's formula, and hydraulic elements of the channel, are given in the table from which it is seen that the values of *n* obtained range from 0.0385 to 0.0420.

Ball Test for Measuring Concrete Quality

At Purdue University investigations have been made into the value of the ball test as a determinant of the quality of cement mortar and of concrete. This test consists in the application by pressure of small steel balls on the surface of concrete, the measure being the depth of impression made for various pressures. In a bulletin of Purdue University by R. B. Crepps and R. E. Mills, the following conclusions are drawn: The ball test applied to cement products affords a valuable and convenient means of determining compressive strength. It is a very reliable index of strength for any age or mix. By means of the test material already in place may be tested. It will be useful to contractors and inspectors in determining accurately when a concrete road may be opened for traffic or the forms removed from a structure. The test indicates a new means of studying the following questions in connection with concrete pavements: (a) effect of wheel loads upon surface strength; (b) effect of different types of tires upon surface strength; (c) effect of tire inflation upon surface strength; (d) distribution of damage on an area of contact; (e) effect of impact, and (f) recovery of surface strength.

Can We Best Do Public Work By Day Labor?

By L. G. Holleran
Paul Brown
Charles H. Paul

The question of contractor versus force account is analyzed here in an article by Mr. Holleran, which was submitted for comment to Mr. Brown and Mr. Paul.

Advantages of Force Account System Favor Its Adoption

By L. G. Holleran
Deputy Chief Engineer, Bronx Parkway Commission, New York, N. Y.

WHY NOT carry on all municipal construction by force account instead of by contract? Important public works have been successfully constructed in this way. Among these are the Panama Canal, many of the U. S. Reclamation Service irrigation projects, the flood protection works of the Miami (Ohio) Conservancy District, and the development of the Bronx River Parkway Reservation in New York City and Westchester County, New York.

Statement of Force Account Problem—To do municipal work by force account, a large business must be conducted by the municipality; and any large business, to be successful, must have a permanent organization with a personnel commensurate both in ability and in number to the nature and importance of the business to be handled. The fundamental difficulty lies in building up and maintaining such an organization, owing to the constantly changing policies of municipal administrations and the likelihood of political interference.

Construction work in general is a manufacturing business, but, unlike factory operation, it is not generally susceptible of standardization beyond a rather moderate degree. It is a manufacturing business where different types of machinery and different materials are used, not for each job only but often for each operation. The selection of the machinery and often the selection of the materials, or some of them, is a matter of judgment which must be exercised not at considerable intervals as in factory operations, but daily and hourly. In other words, construction on a large scale is not only financially hazardous, but it requires for its economical and successful conduct the highest skill and judgment, not by a few men but by many men, often widely scattered and therefore not under the continuous and sustained control which can be exercised in factory operations where the organization is centralized in the factory buildings.

The two phases of the problem touched upon emphasize the necessity for mature deliberation on the feasibility of force account in any particular case before any attempt is made to adopt it. The conditions which may be considered favorable to adoption are noted in the adjacent panel.

Five Requirements for Success

As Set Forth by

L. G. Holleran

(1) Assurance that the organization will be entirely unhampered by political interference.

(2) A municipal administration in sympathy with the method and ready to support it against attempts at political influence and against unjust criticism.

(3) Willingness to pay salaries commensurate with the ability required for successful operation.

(4) A construction program of such magnitude and planned ahead for such a time as to allow a reasonably large and permanent organization to be built up and maintained.

(5) Absence of restrictive laws and regulations, including civil service regulations, which would hamper the conduct of the work by this method.

Advantages of Force Account—Assuming that favorable conditions exist, let us consider the advantages to be expected:

(1) There should be a very considerable saving in time. Under the contract method, the contract and plans must be printed, and then approved; the contract advertised; bids taken and canvassed; bidders investigated, and contract and bond executed and delivered before work can be started. At least two months is the average time for this procedure and often it takes much longer. If the municipality were doing the work with its own forces, it could begin before all the detail plans were made, and the cost of printing, advertising, investigating, etc., would be eliminated. The cost of the bond and a considerable proportion of the cost of workmen's compensation insurance would also be saved, as municipalities would in most cases become self-insurers, and would be able to insure themselves at a fraction of the rates charged by the casualty companies.

(2) Changes in plan under the contract method usually mean additional cost and often a delay in completion. By force account both the delay and generally the additional cost would be eliminated; in fact the cost of the work might often be decreased by judicious changes in plans. It would also be possible to make many advantageous changes in plan which are not now made because the advantages to be expected are disproportionate to the delay and cost involved.

(3) Contractors seldom complete work within the contract period and very often meet with financial or other difficulties which make it necessary to readvertise the work. This procedure often delays completion for months or even years. Failure of a contractor almost invariably means litigation and financial loss to the municipality as it is difficult, if not impossible, to collect from the surety.

(4) Under the contract method, the municipality loses any benefit from a drop in the price of labor and materials during the life of a contract.

(5) There would be better control as a whole of work under construction. If conditions arose where one

piece of work was badly needed, it could be expedited at the expense of delay on another piece for which there was not such immediate need. This would not generally be practicable where the two pieces of work were under separate contracts.

(6) The cost of engineering and inspection service could be considerably decreased. It would not be necessary to make measurements and computations for progress estimates, and while it would not be possible to eliminate all inspection service, it need not be so severe nor expensive.

(7) With a large construction program and practically unlimited credit, the municipality would be able to purchase materials and supplies in quantity and therefore to better advantage than any except the very largest contractors.

(8) Probably the greatest advantage under proper and able management, would be providing work to take care of unemployment in slack times.

(9) Another great advantage would be the conduct of maintenance work on a more economical basis than at present by the interchange of forces and machinery between the construction branch and the maintenance branch.

Disadvantages of Force Account—There are obvious objections to force account construction:

(1) Most men look upon the expenditure of public funds differently from the way they look upon the expenditure of the funds of the individual, firm or corporation which employs them. They seem to lack power to visualize any particular one to whom they are required to account, and since no one person is going to be very much injured by lack of strict economy, they do not strive for economy.

(2) In the very nature of things there is bound to be a lack of incentive to produce economical work. In the first place, the funds of the individuals in charge of the work are not at hazard. If a contractor's costs for any item of work are higher than the bid or higher than he expected, he is naturally most anxious to find out why and to remedy conditions. Generally he puts forth the necessary effort to find a solution of the problem and lower his costs. Indeed his business life will often depend on finding the proper method. The case of the man in charge of construction of public works by force account is different. His business life will in all probability continue just the same whether or not the costs are within the estimate. It is far easier for him to say "we are doing the best we can" than to make that determined effort to lower costs which actually does lower them in the case of the contractor.

(3) Of much the same import is the lack of competition. Contractors know that in order to obtain a contract, their bids must be reasonable, and generally they are. Often they are too low which is bad for the municipality, and bad for the contracting business. Therefore, while competition has its merits, too keen competition, which leads to a bid lower than the price for which good work can be done, also has its adverse points. Moreover, competition can be developed under the force account method. Different superintendents and different foremen can compete against each other on items that are alike or comparable, bonuses can be offered for low costs and in time an organization, which would be eager to produce work at the lowest possible cost, can be built up.

(4) The municipality would have to stand the increased costs due to any rise in the price of labor and materials, such as might not have been foreseen by a contractor bidding on the same work. In the long run, a municipality would probably break even on the rise and fall of prices because it would also have the advantage of prices lower than those prevailing at the time the estimates were made.

(5) There will always be special and infrequent forms of structures or works requiring special equipment or especially trained workmen, which it will be more economical to contract for than to build by force account, because the infrequent use of special machinery would allow it to deteriorate rapidly and the machinery charges for such work as could be done by it would be much higher than the same charges to a contractor who has such equipment in continual use.

Small-Scale Test Inadvisable—Force account cannot succeed on a small scale for the reason that there would not be sufficient work to justify the employment of competent and able men to organize and supervise the labor force. The experiment would, therefore, be more likely to prove a failure than otherwise. If tried at all, it should be on a scale which would justify the employment of competent men and the purchase of adequate machinery and equipment for the classes of work to be undertaken.

On the other hand, it would not be possible to organize a labor force, purchase machinery, equipment and materials and take over all of the construction work in the larger cities on any certain date. The change would have to be made gradually; first taking over the paving, say, and then the construction of bridges, then the construction of docks, etc., with sufficient intervals between to allow the previous classes of work to get on a good working basis.

The magnitude of the construction business which would have to be organized in the larger cities is such as to fire the imaginations of the ablest organizers in the country. The head of the construction department in New York, Chicago, Philadelphia or San Francisco would have to be as capable as the presidents of our largest railroad systems or the general managers of the greatest manufacturing corporations.

If ably managed, such organizations would be schools for the younger generation of engineers and construction men, offering such a variety of experience as has never before existed in one organization in this or any other country. They could also well afford to maintain laboratories for research work in the use of new materials, new methods and labor and material saving designs for structures and equipment. Such laboratories are badly needed in this country if we are not to be excelled by foreigners in fields which we have heretofore considered peculiarly our own.

Conclusion—It is submitted that the organizations mentioned at the beginning of this article have demonstrated that the construction of public works of large magnitude can be economically and substantially carried out by force account, and it is thought that most of those familiar with present procedure will agree that there would be decided advantages in so constructing such works where favorable conditions exist or can be brought about.

The question whether or not the force account method can be generally adopted in view of the grave difficulties in the way of organizing labor forces which

could or would do the work economically is one which needs discussion to bring out the actual conditions from the viewpoint of public officials, engineers and contractors, and this article was written primarily as a basis for such discussion by one who believes that force account is going to be gradually adopted as the most economical and satisfactory method of constructing public works.

* * *

Conditions Favoring Day Labor Not Generally Possible

By Paul G. Brown
Contractor and Engineer, New York, N. Y.

SOME YEARS ago I did a large amount of tunnel construction for the city of Chicago by direct employment of labor and made very good progress and remarkably low costs so that I feel I can come to this discussion with an open mind. I was so puffed up with the success of this undertaking that when the editor of *Engineering Record* asked me to write an article describing the work accomplished, I gratuitously recommended that all municipal work be done by that method. Since that time I have been continuously engaged in construction work on the contractor's side and have come to the conclusion that only in very exceptional cases can public works of any kind be economically carried out by force account methods.

The Panama Canal was a matter of national pride and the government was able to secure first Mr. Wallace and then Mr. Stevens, engineers of great ability, both to plan and to organize, yet I have not the slightest doubt that any one of a half dozen of the then contractors would have organized to do the work more quickly and carried it to a finish in less time and at lower cost. I also think that a contractor on the job would have had the foresight to execute the work in such a manner that the closing of the canal after its opening would have been avoided.

The wisdom of the execution of the projects of the U. S. Reclamation Service by force account is being much discussed in the daily press at present.

The Miami District was very fortunate in securing Charles Locher to head this project. Few such men would ever be available for force account jobs.

We have just read of 1,600,000 men operating as well as maintaining the railroads with their present large volume of traffic, while 2,000,000 men under the government failed both in operation and in maintenance.

In Italy where the government is taking a hand at operation, the total receipts of the railroads in the past few months were not equal to the payrolls.

The municipal operation of the Detroit street railways is a startling object lesson to those who wish to learn.

My discussion will be limited to Mr. Holleran's five conditions "which might be considered favorable to the adoption of the force account method."

(1) The minor politician only stays in public life for such a period as he can please his constituents—and that is only as long as he can get jobs for the lame, the halt and the blind. The pressure for jobs is always too great to withstand.

(2) The administration might be able to support itself against unjust criticism but there will always be enough criticism to condemn such a method.

(3) The proper compensation for a qualified administrator to take charge of even a modest construction project is in excess of that usually paid to any municipal or state official, so that the chance of getting properly compensated and qualified leaders is very small.

(4) Readily possible.

(5) Most of our states and cities have civil service and other laws now enacted that would prevent the proper selection of men; as those best qualified could or would never pass examinations. These laws would also protect incompetents. The purchase of materials is so restricted by law as to be a great handicap.

Four of the five conditions assumed as necessary to successful conduct of force account work being found absent, further discussion would be fruitless.

* * *

Politics Hampers Force Account Construction

By Charles H. Paul
Chief Engineer, Miami Conservancy District, Dayton, Ohio

OF THE FIVE conditions favorable to force account methods, the vital one is: "*Assurance that the organization would be entirely unhampered by political interference.*" With this assurance, one of the biggest handicaps to force account construction is out of the way.

Under present conditions of municipal politics, however, is it often that assurance can be had?

And if conditions are favorable at the inception of the work, is there a reasonable probability that they will continue so, over a period of years?

It is not safe to assume that the success of the work will be its own defense, because ordinarily public interest in routine municipal work is extremely phlegmatic. Criticism travels much farther and faster than praise. A small minority of active critics will make much more impression on the public mind than a host of satisfied observers who usually are undemonstrative and are attending to other business. The unscrupulous politician, though he may be quieted and pushed aside for a time, is never asleep. He is patient, shrewd, and accustomed to guiding public opinion. If it meets with his plans to get a hold on your municipal force account job, the chances are that in due time he will succeed.

The writer has been actively engaged in force account construction on public and semi-public work for a number of years. Two of the jobs most recently carried through on that basis were the Arrowrock Dam, for the U. S. Reclamation Service, and the flood control work for the Miami Conservancy District (Ohio). The economy of handling those jobs by force account has never been questioned and in both cases the work was finished ahead of schedule. Political influence was entirely absent in both of those organizations, due largely to the personalities and the uncompromising attitude of the men at the directive heads of the undertakings.

Such jobs as those cited, however, are in a different class from routine municipal work. You have a project of more than ordinary interest to the public, not only because of its unusual construction features, many of them almost spectacular, but because of its vital necessity from an economic standpoint. Speed and quality of work are two essentials which have first place in the public mind from the beginning. Community pride in the accomplishment of the unusual soon establishes itself. With public interest thus kept alive there is little danger of political interference. Furthermore the organization itself is tuned up to do a certain definite

job, starting fresh, with a clean slate. New associations, new surroundings, new problems, all make it easy to keep the men on their toes from the start.

Routine municipal work, on the other hand, is of a nature not to excite or hold the interest of the public, except perhaps for a short time or in a restricted locality. Political interference is much more likely to creep in and it is much harder to keep an organization keyed up to high efficiency. Municipal work of a special nature, however, like the development of a park system or a municipal light and power plant, or a water supply reservoir, may come in the first class.

It is the writer's opinion that political interference on force account construction for routine municipal work might be so hard to control as to make it inadvisable to attempt such an arrangement on a large scale or as a regular thing. Special conditions as to public sentiment, personality of leaders, labor or industrial conditions, may throw the balance the other way in certain cases. Projects of special interest, large enough to justify the expense of organization and equipment, may often be handled by force account at a considerable saving of both time and money, and without danger of getting into politics.

The other conditions mentioned by Mr. Holleran as favorable to force account construction need little comment. Not only should size of organization and adequate salaries be important considerations, but ordinarily the job should be large enough to justify the purchase, and absorb the cost, of suitable equipment. Only in unusual cases is it economical to rent equipment.

Savings from Day Labor—The advantages of force account construction under suitable conditions are many. The saving in time of getting started stands out as one of the most important. Of no less importance is the opportunity to change plans as the work proceeds in cases where the exposure of foundations, character of materials, or other considerations make such changes advisable. Many such changes have been made in force account work under the writer's direction, at a large saving in cost or time or both, which on a contract job might not have been practicable because of possible complications with contractor or surety company. The location of the Arrowrock Dam was moved several feet downstream after the exposure of bedrock, at a considerable saving in cost. A similar change at another dam of the Reclamation Service, which was being built by contract, resulted in extra work claims and a suit by the bonding company, with a final settlement which offset a large part, if not all, of the saving effected.

Changes in cost of labor and materials go where they belong in case of force account work, as do also costs of unforeseen difficulties such as floods, unfavorable weather conditions, etc. A contract bid usually covers a reasonable number of such contingencies, and the owner pays for them whether they occur or not. If they do occur, and amount to more than was anticipated, the owner usually pays in the end anyway, by way of delays, extra work claims, inferior work, or other alternative. He ought to. There is no justice in making a contractor responsible for conditions beyond his control, and little does it profit a community to secure a job at less than its legitimate cost. But on the other hand why pay for speculative contingencies which never occur? That cannot well be avoided in contract work; it is taken care of automatically by the force account method.

As to engineering, it has been the writer's practice to organize engineering and inspection just about as it would be on a contract job, measuring quantities periodically for the purpose of cost and progress records, and providing inspection in the same way, so as to assure quality of work while giving the construction forces full opportunity to concentrate on speed and economy of operations. The real saving in engineering comes from the fact that what is ordinarily classed as contractor's engineering—layout of construction plant, design of falsework, cost records, clerical work, etc., can be taken care of by the same engineering organization without additional expense. Then of course there is a profit to the job growing out of the feeling of co-partnership between engineering and construction forces, which is hard to translate into money value but is nevertheless real.

Interest Kept Up—Under "Disadvantages" Mr. Holleran mentions the danger of "letting down" on the part of the force account organization, and the lack of incentive to produce economical work. Isn't that largely a matter of personnel and conditions of operation? Published records of progress and costs, merit ratings, and perhaps a well planned bonus system, will go a long way towards keeping up the right spirit on the job. The sporting instinct in our American workman rarely fails to respond to a challenge. The job of keeping the progress line up and the cost line down, if put up to the men in the right way, brings out a surprising response, especially if night shift can be pitted against day shift, or one gang against another.

There has been no indication, in the writer's experience, that it is any harder to keep up interest on a force account job than on one done by contract. Output records are a good indication of the spirit of the job. At Arrowrock in four consecutive months 205,000 cu.yd. of concrete were placed in the dam, by three 1-yd. mixers, working 16 hours a day. In one month the output was 56,520 cu.yd., an average of better than 45 cu.yd. an hour for a month. As far as is known that is a record for that size mixer. On the Miami Conservancy work one 15-in. dredge pump put 91,500 cu.yd. of material into one of the dams during a month of 26 working days, two 10-hour shifts. At another dam two 15-in. pumps, one working only part time, pumped 180,000 cu.yd. into the dam. Over a million cu.yd. of hydraulic fill per year was placed in the latter dam in two successive years of nine working months each. One dragline machine equipped with an 85-ft. boom and 4½-cu.yd. bucket loaded 9,900 12-yd. cars with gravel, in one month of 26 days, two 10-hour shifts, an average of better than 190 cars per shift for a month. Those may or may not be world's records, but there certainly wasn't any loafing on the jobs where they were made.

Some effort has to be made of course to keep up enthusiasm on any job, whether it be force account or contract, but there are any number of ways of doing it, effective for foremen, superintendents and general managers as well as the men themselves. On the other hand, concern over financial difficulties on contract work, while a stimulus up to a certain point, may often become a real detriment to the job if it gets to be too serious.

Apathy on the part of the administrative officer himself is just as likely to be reflected in injudicious awards or indulgence to favored contractors as in lax attention

to force account work. Here again the special job stands out in a different class from that of routine operations.

Must Have Large Scale Work—Ordinarily force account methods can not well be tried out on a small scale, as has been said, but in some cases that has been done, and with marked success. The city of Dayton, Ohio, is now resurfacing with asphalt a number of streets by the force account method. As to rate of progress and character of work, the plan is highly successful. Very little additional equipment was needed over and above what was already required for street maintenance. The work is well organized, and the job is going ahead rapidly, and with very little inconvenience to the traveling public. It is understood that cost figures are considerably lower than have been obtained from recent bidding.

All of which goes to show that each job should be studied by itself, and whether or not it should be handled by force account depends largely upon the conditions surrounding that particular job.

Even on a force account job there are often many small incidental jobs which are better handled by contract, just as on a contract job parts of the work may be sublet to advantage. An organization built up to handle big work is not usually fixed to handle small isolated jobs economically. A small contractor with an outfit under his personal control can often take care of such jobs much better and at lower cost, because of close personal supervision and low overhead. Also, when a relatively small job requires special equipment or special methods, it is often possible to find a contractor fixed to handle it more satisfactorily than the main organization can. While the work of the Miami Conservancy District was a force account job, still there were many parts of it handled in this way by small contractors, with most satisfactory results. To overcome some of the disadvantages of straight unit price contracts, a cost-plus-variable-fee contract was worked out, which is virtually a compromise between force account and ordinary contract methods, combining some of the best features of both. A detailed description of that plan is given in Part IX of the *Technical Reports*, published by the Miami Conservancy District.

We know that force account methods, on a large scale, can be used to advantage and with economy, when conditions are favorable or suitable. Often there are conditions which are not suitable, as has been outlined in the original paper and in this discussion. Every job should be studied carefully before adopting force account methods to see that conditions warrant that arrangement. Because it has been conspicuously successful in some cases is no reason why it is always desirable. Generally speaking, routine municipal work, in the opinion of the writer, does not offer as attractive a field as do special jobs of greater public interest.

Canals Tonnage Shows Slight Increase

The Sault Ste. Marie canals carried during September 1,700,624 more tons than in September of 1922. Iron ore shipments increased from 6,658,148 to 9,480,891 tons; wheat fell off 14,885,743 bu., and other grains 7,366,433 bu. Total freight carried over the Welland canal last September amounted to 566,452 tons, as compared with 520,779 tons in September a year ago. On the St. Lawrence canal during September Canadian steam vessels showed an increase of 124,920 net tons, and United States vessels a decrease of 60,371 tons.

Timber Preservation in 1922

WOOD preservation in the United States during 1922 amounted to 166,620,347 cu.ft. of wood, or 20 per cent less than during 1921, according to a statistical report made by R. K. Helphenstine, Jr., U. S. Forest Service, and published in the annual "Proceedings" of the American Wood Preservers Association. The principal cause given for the smaller output is the reduced use of treated ties owing to the need of strict financial economies on the part of the railways, together with the coal shortage, the car shortage and the railroad strike. There was a volume reduction of about 25 per cent in ties treated and 36 per cent in wood blocks treated, but on the other hand there was an increase of 65 per cent in piles, poles, cross arms, construction timbers and miscellaneous material. In total there were 123,949,422 cu.ft. of ties, 3,947,551 cu.ft. of wood blocks and 17,008 cu.ft. of the third class.

The total consumption of creosote, paving oil and miscellaneous preservatives was greater than in 1921. But the consumption of zinc-chloride was less, owing probably to the fact that it had been used temporarily by several plants on account of the creosote shortage consequent upon the war.

Railroad ties represent by far the greatest amount of wood treated, constituting 75 per cent or more of the total annual treatment. Of the 41,316,474 ties treated in 1922 the preservatives and their amounts per cubic foot were as follows: Creosote, 20,208,362 ties, 6.59 lb.; zinc chloride, 17,418,107 ties, 0.50 lb.; zinc emulsion, 3,681,971 ties, 0.50 lb. zinc and 2.74 lb. creosote; miscellaneous preservatives, 8,040 ties. About 97.5 per cent of the ties were for steam railroads, and of these 4,841,464 ties were adzed and bored before treatment, 1,269,117 were adzed only and 178,594 were bored only. As to the woods used, 40.9 per cent of all treated ties were oaks (including all varieties); 23.1 per cent yellow pine; douglas fir, 9.4; beech, 6.8; western pine, 3.9; maple, 3.6; birch, 3.5; gum, 3.3; tamarack, 1.5; hemlock, 1.4; elm, 0.6; others, 2 per cent.

There were 144 timber treating plants in 1922, of which 128 were in operation; 89 were commercial plants, 30 railroad plants and 25 owned by mining and power companies or public utilities. Twelve new plants were built during the year and three plants were abandoned.

Domestic oil consumed (made from coal tar and water gas tar) amounted to 50,859,151 gal., as compared with 35,462,238 gal. of foreign or imported oil, or 59 and 41 per cent respectively. The consumption of paving oil was 1,414,682 gal. Miscellaneous preservatives amounted to 2,176,843 gal., showing an increase which is attributed principally to the use of petroleum oil and coke-oven tar to dilute creosote oil. The consumption of zinc chloride was 29,863,639 lb., or about 41 per cent less than the 51,375,360 lb. in 1921, which was the highest annual figure on record.

Waterproofing of Mellon Bank Foundation

Hydrolithic waterproofing was used in the foundation and basement of the Mellon Bank, described in our issue of Nov. 1, p. 714, in place of Cow Bay waterproofing cement mortar mentioned in the article. Cow Bay waterproofing was called for in the specifications, but the contract for the waterproofing was awarded to the Hydrolithic Waterproofing Co., of New York, for application of the material first mentioned.

Winter Building Is Practicable and Profitable

Speakers Before New York Building Congress Claim Lower Prices and Higher Output in Winter

"BUILD in winter and keep the architect, the builder, the subcontractor, and labor busy. It will better balance up the industry." These statements by John W. Lowry, Jr., struck the keynote of the winter construction conference held Nov. 21 by the New York Building Congress. "With an expenditure of $3,863 for protection of workers and materials and for heating," continued Mr. Lowry, "there was a saving of $87,710 on a job which cost $750,000." Giving details he said:

Considering the bricklayer production in the summer of 1922 as 100 per cent, in the erection of this job during the winter of 1922-23, the bricklayer production was 109 per cent. This last summer, the bricklayer production was 91 per cent. On this job, carried on during the winter, therefore, I produced 18⅓ per cent more brick per day per man than I was able this last summer.

Bricklayers got $10 a day. The payroll was $28,150. If the work had been conducted this last summer of 1923, the dropping off in production, or in efficiency, if you so choose to call it, would have added $5,360 to the cost of bricklayers alone. If the bonus of $4 be included, that is $14 per man per day, the bonus would have cost $11,260 more. In other words, the brickwork on this job would have cost $16,890 in addition to the $28,150 actually paid. The payroll for bricklayers, carpenters, labor and engineers amounted to $130,667. If the work had been done last summer, rather than the previous winter, the dropping off in production and the bonus award would have added $25,680.

In addition to the saving in labor on this job, the saving on materials and in sub-contracts amounted to $16,030 compared with prices in the summer of 1922. Between labor and the purchase of materials and sub-contracts, then, there was a saving of $87,710 on building work which cost $750,000. To offset this sum, the expenditures for winter construction were: Temporary protection to labor and material, $871; tarpaulins cost $667, with a salvage of $442, net cost $225; temporary heat, $668; salamanders, $302; coke, $304; boiler attendants, $1,036; coal for boiler heating $150; temporary lighting, labor and service, $196, and snow clearing, $111. These are a total of $3,863, or about one-half of one per cent of the total cost of the job.

That working with concrete during the cold season is practical from every standpoint was explained by W. J. Barney, president of the Barney-Ahlers Construction Co. He said:

From our files, I have taken three typical contracts, and the amounts given under the total contract column are practically for the reinforced-concrete structure, the enclosing walls, sash and roof, in other words, for that part of the building which requires protection from winter winds, freezing and cold in the course of construction. Once the building is enclosed, the matter of heating for the finishing trades is comparatively simple, especially if the permanent heating plant has promptly followed up the structural work. In a general way, about 5 per cent of the contract represents the cost for winter protection.

Total Contract	Time of Protection	Cost of Protection	Percentage Costs
$263,000	Dec.-Jan.	$13,000	5
180,000	Dec.-Jan.	8,800	4½
95,000	Jan.-Feb.	6,300	6½

This, however, does not represent the true cost of winter construction, as the cost of this winter protection, especially under present conditions of the labor and material markets, is more than offset by the lower cost of materials during the winter, the absence of bonuses paid to mechanics and the greater efficiency of mechanics under conditions when work is not so plentiful.

Take the past year for example, we find that lumber purchased in June would cost approximately 10 per cent less if purchased in November. We find that roofers, or ¾-in. boards, which enter so largely into form construction, are purchased for $1 per thousand less in November than in August. We find that common brick entering into the curtain walls is purchased for $3 less per thousand in November than in August. We find that reinforcing steel is purchased for 7c. per hundred pounds less in November than in August, and we know that cement has had its seasonal drop.

Moreover, it is a matter of common record that during the past summer bricklayers were paid $14, $16 and $18 and even as high as $20 a day; that cement finishers were paid as high as $15 per day; that carpenters frequently received bonuses of from $2 to $3 per day, that all labor was scarce, difficult to obtain and very naturally not working at full efficiency under such conditions. We know that it is now possible to obtain practically all laborers and skilled mechanics, especially in reinforced-concrete construction, at the established union rates, and that, moreover, the men are anxious and willing to work efficiently and skillfully and have interest in holding their positions.

A still more vital factor to be weighed is the selling psychology of the general contractor which always follows a definite seasonal trend. In the spring and summer when work is plentiful, the general contractor and the special contractor will invariably place upon his work a considerably larger margin of profit and contingency, justifiably so against the skyrocketing of summer costs. In the fall when work begins to become scarce and the contractor is confronted with the problem of holding his organization together during the winter months, he will invariably lower his percentage of profit and take work on a closer basis as to contingencies, appreciating that he will be able to manage, control and direct his work far more efficiently during the winter months than in the summer; and, consequently, can operate safely upon a closer margin than when he does not know from week to week, as during the summer months, whether mechanics' wages will increase two, four, six or eight dollars per day.

I have had our estimating department take from their files typical estimates and, using these various factors, the same building would have been estimated by us in August at $208,000 and today for winter construction at $203,000, showing a saving to the owner of at least $5,000 or 2½ per cent, this including all cost of winter protection. Therefore, under present labor and material conditions, it is certainly conservative to say that winter construction costs no more than summer work.

Railway Statistics for 1922

A preliminary abstract of statistics of common carriers for the calendar year 1922, issued by the Interstate Commerce Commission, gives the following particulars of first-class railroads, exclusive of switching and terminal lines:

Miles of road	234,986
Miles of second track	32,321
Miles of main track, sidings and yards	382,101
Operating revenue	$5,559,092,708
Operating expenses	4,414,522,334
Net revenue from operation	1,144,570,374
Gross income	1,191,674,595
Net income	371,256,333
Steam locomotives	64,139
Other locomotives	373
Freight cars	2,293,402
Passenger cars	54,354
Company service cars	105,610
Ties laid in replacement	86,639,547
Ties laid in additions and extensions	4,110,213
Rails laid in replacement, tons	2,618,556
Rails laid in additions (only 374.76 miles main track), tons	197,788
Total freight carried, tons	1,840,954,570

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Engineers May Be Eligible for Scholarships

Sir—Since writing the memorandum mentioned in your editorial of Nov. 29, 1923, p. 873, which expressed the then official attitude of the Department of Education of New York in regard to scholarships in engineering courses, we have had a conference with certain deans of engineering schools and we have agreed upon an amendment to be submitted to the legislature next winter which will, I am very sure, be entirely satisfactory not only to all the engineering schools of the country but to the engineers as well. By this amendment, if it shall be enacted into law, applicants for scholarships pursuing engineering courses will be eligible to receive such scholarships. I am glad to give you this information which you are at liberty to use as a postscript to your criticism of the department.

Albany, N. Y., Nov. 30, 1923,
AUGUSTUS S. DOWNING,
Directing Professional Education,
State Department of Education.

Why the Garden City Project Failed

Sir—Your articles on the trail of the truth about reclamation have been of more than ordinary interest to me. I especially enjoyed reading the article by F. H. Newell on Origin, Problems and Achievements of Federal Land Reclamation, but I cannot agree with Dr. Newell when, with reference to the Reclamation Service project in Kansas, he says, "this project did not succeed largely because the climate was not sufficiently arid."

The Garden City project was planned to pump groundwater to supplement the river supply for the Farmers' Ditch, a ditch which had been in operation since about 1880. Much information regarding this project was given in the 1905 report of the Reclamation Service. The proposed plant was to "recover an average of 100 sec.-ft. of groundwater during the irrigation season of five months, to be delivered into the Farmers' Ditch about one mile northeast of its headgates."

The cost of construction was to be about $30 per acre, based on the 8,600 acres then under that ditch. Charges were to be in two parts, the first a fixed charge of approximately 75c. for each acre of land under the project, whether the owner used water or not, the second charge for distributed water, the cost of which, based upon a total of 25,000 acre-ft. delivered to the water users, would be 77c. per acre-foot. On this basis a water users' association was organized, and on Sept. 14, 1905, an allotment of $258,000 was made for the construction of this project.

Before the project was completed and put in operation the construction charge was raised to $37.50 per acre. The charge for maintenance and operation was raised to a minimum of $2.75 whether water was used or not; 2 acre-ft. per acre was to be furnished. In addition to these charges it was required that the water users operate and maintain their distributing system "at their own expense."

The delivery of water was begun in 1908 with 10 of the 23 pumping units installed. The others were utilized as they were installed in June and July, but the amount of water pumped that year is not given in the annual report. In 1909 the plant was in operation 96 days and 7 hours, and pumped a total of but 7,555 acre-ft. of water. This was at an average rate of a little less than 40 sec.-ft., or less than 40 per cent of the expected amount. Furthermore, running this small amount of clear water in a ditch having a capacity of 200 sec.-ft., which the Farmers' Ditch had, resulted in an unusually large ditch loss, and a wholly inadequate quantity of water reached the land. Upon the failure of the Service to deliver the expected amount of water, the farmers refused to pay the assessments and the project was abandoned.

If, as Dr. Newell says, the project did not succeed because the climate was not sufficiently arid, it was only because the climate was not sufficiently arid to compel the farmers to pay an almost prohibitive price for an unsatisfactory amount of water to supplement their river supply, and not because they did not appreciate the value of water. As an irrigation engineer I have been in close touch with irrigation at Garden City for more than ten years, and personally know many of the farmers under the Farmers' Ditch. They have consistently utilized all the water available, and if a dependable supplementary supply could be developed at a reasonable cost they would gladly avail themselves of it. Of the five ditches in operation in the Garden City district in 1905, all are well maintained and are in operation at this time. In 1922 they diverted and used 67,800 acre-ft. of water out of a total of 107,500 crossing the state line into Kansas during the water year Oct. 1, 1921, to Sept. 30, 1922.

Furthermore, the failure of the Reclamation Service to develop a satisfactory water supply from wells did not demonstrate that it was not practical to pump groundwater. Within recent years about 20,000 acres in that district have been brought under irrigation by private pumping plants on individual farms. These plants cost from $2,000 to $2,500 for units having a capacity of 3 or 4 sec.-ft., which is large enough for 160 acres. This is a construction charge ranging from $12.50 to $15 an acre. Operation costs are about $2 an acre annually with electricity, which can be obtained at 4c. per kilowatt-hour.

The Garden City project failed partly because the Service was unable to construct and operate the project within the figure fixed in the original agreements, but in larger part because of the fact that they failed to deliver the water for which charge was being made. The increase in both cost of construction and charge for maintenance and operation had caused some dissatisfaction among the water users, but this could have been overcome had it not been for the fact that the Service was unable to deliver the water for which charge was made.

GEORGE S. KNAPP,
State Irrigation Commissioner.
Topeka, Kan., Nov. 6, 1923.

Traffic Congestion Costs

Sir—In connection with your editorial, "Capitalizing Traffic Congestion Cost," in the issue of Nov. 8, p. 747, the following may be of interest.

The cost, merely in terms of gasoline consumption, of starting from a stop the cars in a heavy traffic stream is not generally realized. About 42,000 ft.-lb. of energy are required to accelerate a ton of car weight from a stop to a speed of 25 m.p.h. One gallon of gasoline will furnish approximately 4,200,000 ft.-lb. of effective energy when burned in the average motor vehicle now in use. In other words one hundredth of a gallon of gasoline is consumed in accelerating every ton of car weight from a stop to a speed of 25 m.p.h.

If 10,000,000 cars of an average weight of 1½ tons move through the traffic stops of Fifth Avenue each year and make on the average five stops per car, approximately 750,000 gal. of gasoline will be consumed in accelerating the vehicles in the traffic stream. At a gasoline cost of 20c. a gallon the driving public spends about $150,000 per year for the fuel required to bring the cars up to driving speed after traffic stops, or the interest on an investment of $3,000,000. Were each car stopped and the engine idled for five minutes during its trip on the Avenue, the annual expenditure for gasoline so consumed would be about $50,000, or an additional capitalized cost of $1,000,000. Although I do not have the exact number of traffic-control stops on Fifth Avenue per year, the above figures at least indicate the magnitude of the annual cost to the driving public of two of the items of the cost of car operation through traffic stops.

WILLIAM S. JAMES.
Washington, D. C., Nov. 27, 1923.

Temperature of Irrigation Water

Sir—Plans are being made for a large hydro-electric development in Japan where the river water is used for the irrigation of rice. The rice growers are fearful that the temperature of the water drawn from the storage reservoir to be constructed will be lower than that at present drawn directly from the river.

The plans as submitted for the government permit provide for a dam to raise the water surface about 210 ft. with a storage of about 20,000 acre-ft. The minimum flow of the river is about 1,000 sec.-ft. The intake as planned provides for a draw down of 50 ft., so as to give a regulated flow of about 1,500 sec.-ft. The reservoir will, however, be full during the rice growing season.

The rice growers' associations insist that the plans be changed to provide for drawing the water from near the surface of the reservoir unless evidence is submitted to show that water drawn 50 ft. below the surface of the reservoir will have a temperature as high as that of the river water under existing conditions.

The only printed information which we have found on this subject is contained in the following papers in the Transactions of the American Society of Civil Engineers: "Temperature of Water at Various Depths in Lakes and Oceans," by Hamilton Smith, Jr., Vol. 13, p. 73; and "The Temperature of Lakes," Desmond FitzGerald, Vol. 34, p. 221.

These papers show that in reservoirs during the summer months lower temperatures increase with depth to certain limits, but no information has been found to show the temperature of water at various depths, as compared with the temperature of the running water in the river.

Any information which can be furnished on this subject will be much appreciated. E. C. MACY,

Manager for Japan for Stone & Webster, Inc.

Boston, Mass., Nov. 5, 1923.

Contract Bond Reform

Sir—I was interested in the editorial in *Engineering News-Record*, Nov. 8, p. 748, entitled "Contract Bond Reform."

I heartily agree that 1½ per cent is too high a rate for responsible contractors to pay, and that this rate is due to the "unwise risks which are constantly being taken."

In this connection, I am enclosing extracts taken from a letter I recently wrote to a large bonding company, which may be of interest.

It is probable if negotiable securities are accepted in lieu of bonds, the bonding companies will be compelled to select their risks with more care, and reduce their rates. Of course a material reduction in rates will be possible if the bad risks are eliminated. FRANK M. WEAKLEY,

Norfolk, Va., Nov. 10, 1923. Civil Engineer.

[The discussion inclosed by Mr. Weakley follows.—EDITOR]

Some years ago I was bonded on a building contract. The standard rate at that time was 1 per cent but I paid 0.8 per cent because my business was "preferred."

The agent informed me that he personally investigates his patrons and prospective patrons, and upon his recommendation they were given a special rate.

In checking up on contractors who have gone bankrupt, leaving the bondsmen to finish the work at a loss, I find that in most cases the risk could have been ascertained by the bondsmen by a proper careful investigation.

You will note that a large proportion of the bankruptcies are cases where the contractors have been in business for a number of years.

The manner in which a business is being operated can be learned in a number of ways, apparent to me, or to anyone else sufficiently interested.

If a business is being poorly managed, it is usually only a question of time until it goes broke, causing a loss to the bondsmen.

I had difficulty in securing my *first* bond; after that it was easy.

The biggest losses to bonding companies are from contractors who have been operating for a number of years, sufficiently long for anyone interested to ascertain how they were handling their work.

A contractor who gives personal attention to his work, who pays his bills promptly, handles his workmen intelligently, treats his sub-contractors fairly, and secures his work at reasonable prices will nearly always succeed. He is a good risk.

The man who does the opposite is a bad risk, even though he has to his credit a number of completed contracts.

Why then, do not the bonding companies establish credit and investigation offices in the larger cities which will check up on their risks and prospective patrons?

These offices can get information as to how the contracts are being executed, the payments made on material and labor, payments to sub-contractors, and, in fact, everything regarding the way the contractors are handling their work and finances.

Such an office should be independent of the agent who writes the business, just as the fire insurance offices which fix rates are independent of the agents who write the fire policies.

As a practical business man and builder, I can see no good reason why a careful check on contractors' work cannot reduce losses considerably.

I have occasionally been surprised by seeing contractors of questionable reputation and ability secure bonds from large companies who later on had to make good on the failures that were to be expected.

National Construction Week Advocated

Sir—I note the editorial in *Engineering News-Record*, Nov. 1, 1923, p. 704, relative to the possibility of a Construction Show.

I am sending you a little article I prepared some months ago along the same lines, which may interest you. The possibilities are immense, and while perhaps Atlantic City is the only town with sufficient hotels and display facilities to accommodate a real Construction Week, I think a biennial or triennial meeting can gradually be brought about, and it would certainly put the construction industry on the map of the United States. Alternate years, each national association could move about the country as its best interests might require, and take the mountain to Mohammed through America, which is perhaps equally essential.

A. P. GREENSFELDER,

Secretary, Fruin-Colnon Construction Co.

St. Louis, Mo., Nov. 15, 1923.

[The following extract from the article forwarded by Mr. Greensfelder contains the substance of his proposal. —EDITOR.]

The idea of a national construction week is that the National Federation of Construction Industries could arrange the first two days of that week, taking up the broad construction problems of interest to the entire industry, such as transportation, finance, standardization, co-operation, etc., referring the problems back to each group for the co-operation of their organizations. On the following three days of that week, it is hoped that the various groups, such as the Associated General Contractors of America, the American Institute of Architects, the Builders' Exchanges, the recently formed federation of engineering societies, the Material Dealers' Association and a lot of other national associations, could hold their individual conventions in different hotels simultaneously in the same city. On the last day of the week the executives of the various national associations could again gather together under the leadership of the National Federation of Construction Industries, reporting the action of their various organizations and establishing a uniform policy of action for the coming year.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

At the Recent Convention of the City Manager's Association in Washington, D. C., Montreal was chosen as the next meeting place and George W. Thompson, Westmount, Que., as first vice-president. The new president is Earl C. Elliott, Wichita, Kansas.

For the Statue of Colonel William F. Cody (Buffalo Bill) Mrs. Harry Payne Whitney, sculptress, has engaged Russell Kimball, engineer, of Casper and Cody, Wyo., to take charge of the erection of the base. The base will be of red granite quarried from the Shoshone canyon and the estimated cost is $40,000. The statue when completed will be placed near the city of Cody, Wyo.

The First National Conference on Immigration is to be held in New York City, at the Hotel Astor, Dec. 13 and 14 the call having been issued by the National Industrial Conference Board, New York. An attendance of 2,000 of the nation's leading industrialists, public officials, leaders in business and trade organizations, and authorities on social service is expected. All sessions will be public.

Hiressi Yamamato, Marine Superintendent of the Japanese Government Rys., Tokyo, Japan, has arrived in Canada to study the car-ferry system which connects Prince Edward Island with the mainland. It is the intention of the Japanese Government to connect the southern island of Yesso with the larger one of Hondo by means of a car ferry over a strait about 60 miles broad, conditions being somewhat similar to those of the Northumberland Strait.

Winnipeg, Manitoba, Has Adopted a by-law for the issue of debenture bonds to the amount of $550,000 for the purpose of establishing a central district steam heat producing and distributing plant in connection with the city hydro-electric standby plant. The total cost will be $875,000, leaving a balance of $325,000 to be transferred from the capital account of the hydro-electric system. The work will be proceeded with as soon as enough heating contracts have been signed to insure the success of the system.

Application for a License Covering the remainder of its projects on the Tallapoosa River has been made by the Alabama Power Co. The company has recently completed the survey of the entire stream by means of aerial photography and has found that the estimated storage capacity of the upper region has been over-estimated. Consequently it proposes to increase the height of the Cherokee Bluff dam from 105 to 150 ft. The five additional dams are to be constructed above the Cherokee Bluff dam, which will have a combined head of 306 ft. and an installed horsepower of 114,000.

Knickerbocker Theater Co. Wins Three Damage Suits

The Knickerbocker Theater Co., Washington, D. C., has been exonerated of civil liability in three of half a hundred cases brought against it as a result of the collapse of the theater's roof Jan. 28, 1922. The three suits, the first civil cases to be decided, were for $10,000 damages each, and were based on the death of two patrons and the injury of a third. Attorneys for the plaintiffs will seek a new trial, and if that is not granted, intend taking the cases to the Court of Appeals.

Japan To Spend $525,000,000

Conditions in Japan are gradually becoming settled. Military law has been discontinued and sufficient temporary structures have been provided to care for all who were without shelter, says a cable received by the Far Eastern Division of the Department of Commerce from its Tokyo representative. It is unofficially estimated that reconstruction expenditures during the first five years will reach only $525,000,000, of which amount $375,000,000 will be spent in Tokyo and $150,000,000 in Yokohama, indicating that either the damage caused by the earthquake was not as great as it appeared, or that the program of reconstruction will be carried out over a long period of years.

International Board Disallows Rio Grande Claim

Fred K. Nielsen, agent for the United States before the American and British Claims Arbitral Tribunal, has informed the Department of State that the claim of the British Government for £755,400 with interest against the government of the United States, known as the Rio Grande Claim, has been dismissed by the arbitral tribunal which is now sitting in London. The claim is based on an alleged interference by the Government of the United States with real property rights at Elephant Butte, Sierra County, New Mexico, of an English company called the Rio Grande Irrigation and Land Co., Ltd., which about 1896 had taken steps to construct a dam in the Rio Grande River at Elephant Butte. Pursuant to acts of Congress approved Feb. 25, 1905 and March 4, 1907, respectively, a dam was constructed at Eagle, New Mexico, a short distance below Elephant Butte, as a result of which the site of the dam which the Rio Grande Irrigation and Land Co., Ltd. had proposed to construct at Elephant Butte was submerged. The company's dam had not proceeded beyond the initial stages (it is said that the small beginning had been practically obliterated by floods, etc.) and the time limit within which the law required completion of the work had meanwhile expired.

Huge Appropriation Asked for More Western Reclamation

An appropriation of $250,000,000 by Congress for Western reclamation is demanded in a resolution passed by the Western States Reclamation Association in its third conference, held at Salt Lake City, Nov. 18-20. The association also voted thanks to Secretary of the Interior Hubert Work and to the Reclamation Commissioner D. W. Davis for their work in dealing with reclamation problems. The claims of the South to federal reclamation expenditures were recognized in a resolution assuring the South that the West wishes to co-operate with it.

Several principles of future reclamation policy were advocated in formal resolutions. They include "completion" of existing projects, legislation to give the government a percentage of the increase in value of land when sold prior to full payment of the government charges, formation of interstate agreements on interstate water problems, and international agreements on international water problems.

R. E. Shepherd, Jerome, Idaho, was elected president, and W. L. Boise, Portland, Ore., vice-president. The executive committee includes: R. E. Caldwell, Utah; W. G. Wendsen, Idaho; W. E. Meacham, Oregon; C. Pease, Texas; J. M. French, New Mexico; D. A. Scott, Washington; William Wisener, Arizona; F. L. Lucas, Colorado; A. Lindley, California, and R. A. Smith, Nebraska.

Work Favors Department of Public Works

Washington Correspondence

Secretary of the Interior Work states that he is ready and anxious to co-operate in the effort looking to the establishment of a major division of public works in his department. Secretary Work expressed this determination last week to L. W. Wallace, the executive secretary of the Federated American Engineering Societies, whom he called into special conference on this subject.

Secretary Work told Mr. Wallace that he is in entire sympathy with the Brown plan for reorganizing the Department of the Interior. That plan provides for the division of the Department into two major branches, one to deal with public works and the other with matters of the public domain. The public works branch is to be under the immediate direction of an assistant secretary, who is to be an engineer. Secretary Work went so far as to suggest to Mr. Wallace that the engineers begin thinking of a man who would be qualified to fill that position.

In his conversation with Mr. Wallace, Secretary Work made the point that it would be wise to provide for the use of Army engineers in connection with the public works program. He expressed the opinion that Congress would not approve of the plan unless this were done.

Ohio Filter Operators Discuss Problems

Practically Every Plant in State Represented—Sand, Chlorine, Iodine and Carbonation

Engineering News-Record Staff Report

All but two of the sixty-five water purification plants in Ohio were represented at the third annual conference of operators, Nov. 21 to 24, at Columbus. Probably no other state has so many purification plants under laboratory control, for even the smallest plants have a laboratory for "minimum" determinations, each supervised by a technically-trained operator of a larger plant, who may have as many as five plants to which he gives attention and for which he is responsible to the State Board of Health which must approve his employment.

Besides the dozen papers on filtration, water softening and carbonization, the "tricks of the trade," or original features of plant operation, were described. A joint session on iodine and goiter was held with the county district commissioners of Ohio. The unanimous opinion seemed to be that medication with iodine in the water was wasteful (only 0.4 per cent used) and much more expensive than individual treatment. A day was used to visit the softening plants at Newark, where an 8-m.g.d. plant under construction has a baffled mixer, and at Delaware, where mechanical mixing is used in the 2-m.g.d. plant, completed last year.

Carbonator Experience

Experience with carbonators at the Defiance plant was given by H. T. Campion, superintendent, who stated that the filtros plates for distribution of the CO_2 had been replaced by perforated pipes with satisfactory results. Sand growth has been prevented with 1 to 10 p.p.m. of CO_2 in the effluent. C. P. Hoover, chairman of the conference and chief chemist, Columbus, described a carbonator recommended for Newark and Columbus. Flue gas, scrubbed to free it from CO_2 and water, is blown through porous concrete blocks, the gas being distributed through the bottom of the blocks by a perforated pipe. Ordinarily any steam-producing pumping station furnishes double the amount of CO_2 necessary for the carbonation process.

F. E. Sheehan, superintendent, Portsmouth, has found that a secondary application of coagulant midway in the 8-hour detention period reduces his alum dosage and gives higher efficiencies, particularly as shown by the B. coli index. Progress being made by the U. S. Public Health Service in the study of efficiency limitations of water purification processes, was outlined by H. W. Streeter, sanitary engineer. A 0.16-m.g.d. experimental filter has been installed at Cincinnati and a survey is under way of sixteen plants from which monthly reports are received.

Electrolytic action between brasses of different composition in the East Liverpool filter strainers, said D. H. Rupp, was partly responsible for underdrain troubles which finally resulted in revamping the underdrains. Strainers were found plugged with concrete and oakum. In some cases plugs were found in lieu of strainers. Tons of sand were taken from the false bottom. A control valve did not work and was found installed backwards.

The newly elected officers are: Chairman, Clarence Bahlman; vice-chairman, W. I. Van Arnum; secretary, E. E. Smith.

Chinese Engineer Prominent in Flood Protection Work

Among China's prominent engineers is S. W. Lao, formerly director of the Yellow River Bureau in Shantung from 1918 to 1922. He is a native of Shantung, was educated in Tientsin, China, where he studied engineering; has followed railroad engineering for twenty-five years. He has had active practice in railway location, construction, and maintenance on several of the principal roads of China including the Shanghai-Hangchow, Tientsin-Pukow, Peking-Mukden, and Chinese Eastern. In 1918 he was put in charge of the work of the Yellow River Bureau where he remained until his appointment as Vice-Minister of Communications at Peking in the summer of 1922.

Accept Principle of Arbitration for Standard Contracts

Acceptance of the principle of arbitration by the representatives of the American Railway Engineering Association and a reconsideration of certain other contract principles which pave the way for a general agreement were the outstanding accomplishment of the Joint Conference on Standard Construction Contracts at its meeting in Washington, Nov. 19.

The railway engineers submitted a detailed criticism of the documents previously formulated with which they were not in full accord and those matters which could not be immediately agreed upon at the meeting were referred to a sub-committee which will report about Dec. 10. The sub-committee is instructed to reach a basis for universal agreement on each of the contract provisions referred to it, redrafting these provisions if necessary and submitting its recommendations to the conference for approval.

As a result of discussions in the past year the sentiment among all of the representatives actively participating in the conference has crystalized into agreement upon an arbitration clause, with the exception of the National Association of Builders' Exchanges which has not yet rendered a definite report. There now appears little doubt that within the next few months unanimous agreement will be reached in the conference upon both the building and the railroad documents.

Associations represented on the Joint Conference are: American Association of State Highway Officials, American Institute of Architects, American Railway Engineering Association, American Society of Civil Engineers, American Water Works Association, Associated General Contractors of America, Federated American Engineering Societies, National Association of Builders' Exchanges and the Western Society of Engineers

To Start $12,000,000 Water-Works Extensions at St. Louis

The sale before Feb. 1, 1924, of $2,000,000 of the $12,000,000 water bond issue voted by the people last February has been authorized by the St. Louis Board of Estimate and Apportionment, in accordance with the program of E. E. Wall, water commissioner. The money will be used for the construction of railroad yards, buying rights-of-way and for constructing intakes and engine pits. In June pipe lines connecting the new water-works with the city mains and in September the construction of the new settling basins are projected. The entire program for 1924 contemplates an expenditure of $5,590,000.

Reopening St. Louis Zoning Case Denied by Court

The Missouri Supreme Court, on Nov. 20, denied a petition of the City of St. Louis for a rehearing of its recent decision against the validity of the zoning ordinance under which the city has been acting for some three years past. The earlier decision held that the zoning ordinance was beyond any police power granted to the city by the state. The latest ruling confirms the earlier one but appears to be somewhat more specific in that it says, in part: "The ordinance before us provides for the taking of private property for a public use without compensation and without a judicial hearing. It is not a regulation that would fall within a reasonable exercise of the police power. It is confiscation, pure and simple."

Court Holds Public Utilities Act Cannot Invalidate Contract

The U. S. Supreme Court in the suit of the Superior Water, Light & Power Co. against the city of Superior, Wis., reversed the lower courts which had held for the municipality, declaring, in effect, that a state legislature is without authority to invalidate contracts between public utility corporations and political subdivisions.

The predecessor of the Superior Water, Light & Power Co. had been granted a 30-year water-supply franchise by the city of Superior. Subsequently this franchise was amended to provide either a 25-year extension or purchase of the plant by the city on a fixed basis of payment rated on income. After this amendment the water company made extensive improvements and extensions. The Wisconsin public utility act of 1907 provided that utility franchises should be indeterminate, and subsequent legislation made the indeterminate franchise mandatory.

When the franchise expired, the Superior Water, Light & Power Co. called upon the city for an extension or for purchase of the plant according to the terms of the franchise. The city refused, relying upon the state act, and started condemnation proceedings to acquire the plant by terms other than those in the franchise. The company resisted in the courts. In upholding the contentions of the company, the Supreme Court asserted that the franchise and its amendment constituted a valid contract, not subject to abrogation by the state public utilities act.

Proposes Power Development on the Headwaters of the Tennessee

The Federal Power Commission has received an application from the newly-organized Southern Appalachian Power Co., of Asheville, N. C., for a preliminary permit covering a 170 ft. dam and power house to be constructed at a point on the Hiwassee River one mile above Murphy, N. C. The dam would control the annual run-off of the river and provide a low-water flow of 1300 c.f.s. It is estimated that 50,000 hp. could be developed at this site.

The most attractive feature of the project, however, arises from the fact that 400 ft. of head can be developed in the river below Murphy, which would make possible the development of 150,000 hp. in that stretch.

The Hiwassee is a tributary of the Tennessee and has its source just over the ridge from the Tugaloo and other streams which have been so thoroughly developed on the eastern slope of the range. This new development will increase the low-water flow at Muscle Shoals by 10 per cent, and will benefit materially the Hale's Bar project of the Tennessee Electric Power Co. It will also increase the navigable capacity of the Tennessee.

Incidentally this development would drown out the dam proposed by the town of Andrews, N. C., a small municipality which is defying the Federal Power Commission. It has sold its bonds and has let contracts for its project which is seven miles above the site of the Southern Appalachian Power Co. Materials are being transported to the dam site. The district representative of the Corps of Engineers has instructions to request an injunction from the Federal Court when ground is broken.

Electrify and Elevate New York West Side Freight Line

The new plan for a general revision of the west side freight line of the New York Central on Manhattan Island, New York, noted in last week's news pages, is submitted by the railroad company in order to clear up the matter of how it is to conform with the legislation requiring the electrification of this line and at the same time eliminate all grade crossings.

The plan as now submitted is similar in many respects to the one which was submitted in 1916, but does not include the expensive subway work along Riverside Drive. As far as possible in this new project the railroad company has endeavored to keep to its present right-of-way, thus avoiding the question of obtaining large parcels of land from the city, one of the stumbling blocks in the way of the other plan.

The present terminal at St. John Park will be abandoned and also all tracks below Canal St. The construction of the vehicular tunnel westward from Canal St. makes this change necessary. A new elevated terminal will be built north of Canal St. between Washington and West Sts. with trucking space and platforms under the tracks at street level. North of this terminal a two-track elevated structure will be built along a private right-of-way roughly parallel to Washington St., to near 14th St., where the elevated structure will be carried along 10th Ave. for three blocks on account of the new warehouses built or building in that area. From this point it will again continue in private right-of-way west of 10th Ave. to the 30th St. yards, where it will turn west to the marginal way along 12th Ave. The 30th St. yard will be an elevated structure but will have some street level tracks west of 11th Ave. to connect with the car ferry slips. From the 30th St. yard to the 60th St. yard will be a four-track elevated structure along the marginal way. At 60th St. the tracks will come down to the present level of the yard, but the east side of the yard, now occupied by stockyards, will be developed into a double-deck structure, the upper deck being for the delivery of milk and perishables. North of this yard the railroad will have five tracks at grade on the present right-of-way as far as Manhattanville, with over-crossings at 79th St. and at 96th St.

At Manhattanville the railroad will be carried over the West 125th St. valley on a six-track elevated structure to the yard, which will have two track levels. Continuing north, the tracks will come down to grade as a five-track line to Fort Washington Park and then four track to Dyckman St., where it will be elevated over the street and ferry entrance. The plans call for a small yard at this point for local business. North of Dyckman St. the track will be carried on a four-track fill to Spuyten Duyvil creek, which it will cross on a new high-level bridge having the same clearances as the other Harlem River bridges. Above the bridge, overhead connections will be made to the north and east, and some changes will be made in the location of the main line to the east to conform with the new ship canal plan.

George W. Kittredge is chief engineer for the New York Central on this work and J. M. Doorly is engineer of West Side improvements.

Construction Council Announces Apprenticeship Committee

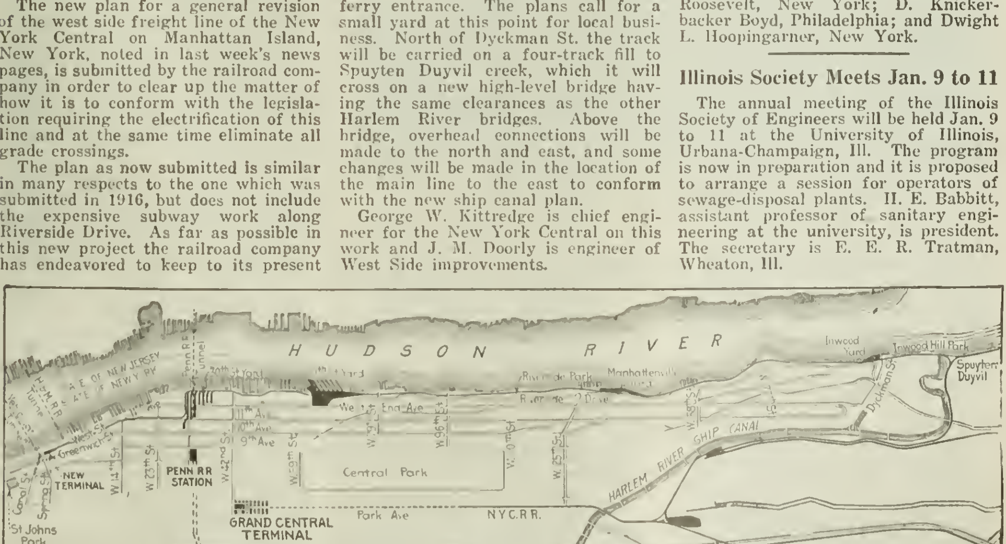
The American Construction Council has announced the personnel of the Committee on Apprenticeship, Vocational Guidance and Craftsmanship, of which F. W. Walker, of Beaver Falls, Pa., is the chairman. The committee will co-operate with employees' and employers' organizations, building congresses, and all other elements in the construction industry, and with the educational bodies, local and national, in providing for apprenticeship which will be attractive to young men and will afford the fullest means for the employment and training of efficient workers as apprentices, and will produce the skilled workmen needed in the construction industry.

Members of the committee are: James Baird, New York; Charles F. Bauder, Philadelphia, Pa.; E. L. Bowman, Evansville, Ind.; Howard L. Briggs, Cleveland; H. Whittemore Brown, Hampton, Va.; Prof. W. W. Charters, Pittsburgh; Wharton Clay, Chicago; R. L. Cooley, Milwaukee, Wis.; John W. Cowper, Buffalo, N. Y.; George Dautel, Cleveland; John Donlin, Washington, D. C.; F. L. Dykema, Grand Rapids, Mich; Burt L. Fenner, New York; R. C. Gaskill, Atlantic City, N. J.; Frank M. Gunby, Boston; Lewis Gustafson, St. Louis, Mo.; Fred. J. Hartman, Pittsburgh; Dr. L. S. Haskins, Chicago; Warner S. Hays, Philadelphia; Mr. Malcolmson, Detroit, Mich.; G. A. McGarvey, Washington, D. C.; A. H. McChan, Washington, D. C.; James S. Meade, Philadelphia; Fred F. Moran, New York; W. Stanley Parker, Boston; Thomas R. Preece, Indianapolis, Ind.; C. A. Prosser, Minneapolis, Minn.; H. H. Rosenberg, Chicago; Ralph P. Stoddard, Cleveland; M. F. Westergreen, New York; L. C. Wason, Boston; R. Winstead, Chicago; Edward L. Wertheim, New York; and J. C. Wright, Washington, D. C.

Ex-officio members are Franklin D. Roosevelt, New York; D. Knickerbacker Boyd, Philadelphia; and Dwight L. Hoopingarner, New York.

Illinois Society Meets Jan. 9 to 11

The annual meeting of the Illinois Society of Engineers will be held Jan. 9 to 11 at the University of Illinois, Urbana-Champaign, Ill. The program is now in preparation and it is proposed to arrange a session for operators of sewage-disposal plants. H. E. Babbitt, assistant professor of sanitary engineering at the university, is president. The secretary is E. E. R. Tratman, Wheaton, Ill.



PROPOSED IMPROVEMENTS IN NEW YORK CENTRAL FREIGHT LINE ALONG THE HUDSON RIVER AT NEW YORK

Random Lines

The Interstate Commerce Commission, in order No. 13,462, finds that something about shipping "pancake flour in carload lots" is unreasonable. Shades of all the small boys on Sunday morning—Can there be that much pancake flour?

* * *

Pronounced In-jeé-ner

Sir—Referring again to the popular abuse of the term "Engineer":

I am not a Latin scholar nor a delver into languages, but have observed relationships and ancestry of many of our modern English words when glancing through my "Websters Unabridged Dictionary."

I find that most words beginning with or containing *gen* or *g n* pertain to creation, production or reproduction; we have *gen*esis, meaning the creation; *gen*itive, pertaining to reproduction; *gen*ius, one of creative or inventive mind; likewise in*gen*uity the quality of ready invention, etc. Then, eureka! I find the word "ingē'ner," one who contrives, a "designer," but, alas, it has (obs.) tacked onto it. This last seems to be the nearest ancestor or possibly an older disinherited brother to our modern "engineer."

The English have always had a habit of changing and modifying the spelling of words from their original. The continental European languages all spell the word, beginning with "ingen"—like the French "ingenieur."

And herein lies another inconsistency: where, in other European nouns, denoting vocation (adding *er* and *or* to a verb to denote one who), the accent is on the last syllable, the English always pronounce with the accent *before* the final *er*.

Now, according to this pedigree, an engine or a gin really means any works which have been contrived or designed by an "ingener."

In this respect a bridge or any fixed structure and all kinds of machinery, which would include sewing machines, washing machines, etc., as well as the steam engine (properly, motor), is an engine, hence why should those who operate steam motors be called engineers at all. If so called, then the woman who operates a sewing or a washing-machine is an engineer and every one is an engineer because practically everyone operates or cares for some device designed by an ingener.

The ingener, as a designer, has to precede the operator for the reason that the father precedes the son.

If the trade-and-lay-people in general persist in using the term so promiscuously, lets have that (obs.) deleted from the dictionary and have it read, "ingener, one who etc." and "engineer, (obs.) see ingener."

It is easy to say—just put the accent back in its English or American place. Now, all together,

"Ingē'ner."

* * *

The Chicago Daily Tribune's booze hound (who is a sleuth and not an inebriate as in the early use of that solecism) has found that the prize speakeasy in the big lake city hides behind an office door labeled "International Council of Experimental Engineers' or something." Let's hope its "something."

Tile Manufacturers' Association Ordered Dissolved

Washington Correspondence

Collection of trade statistics practically is limited to those which may be requested by a governmental agency, is the final decree in the case brought by the Department of Justice against the Tile Manufacturers' Credit Association. The proceeding was in the United States Court of the Southern District of Ohio. Before the decree was made final the law department of the National Association of Manufacturers urged the Department of Justice to permit the periodic collection of facts relating to capital employed, power used, wages, taxes paid, fuel consumed, machinery employed, in addition to production, sales, shipments, stocks, prices and like pertinent trade information. It was specified that all such information was to be a record of accomplished facts.

It is known that the Department of Justice gave long and careful consideration to the proposal. The significance of the decree is increased greatly by the fact that the collection of trade statistics is not made permissible after the Department's study of the proposal. It is anticipated that this decree will have a far-reaching effect upon trade associations.

In the decree the credit association is ordered dissolved, though it again may function in accordance with rules laid down by the court as an educational and research body and for the interchange of certain credit information.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 10-11, 1924.

AMERICAN ROADBUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 14-18, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York, Jan. 16-18, 1924.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Chicago, Ill., Jan. 21-24, 1924.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 22, and Ottawa, Jan. 23, 24, 1924.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

The Engineers' Club of Philadelphia will hold a meeting Dec. 18 at which J. Franklin Stevens will give an address on the Pacific Islands and Japan.

The Society of Terminal Engineers, New York City, will have for discussion at its meeting Dec. 11 the subject, Cartage Practice at Inter-Terminal and Off-Track Freight Stations; the speaker will be J. F. Murphy, vice-president of the Terminals Co., St. Louis, Mo. At the meeting of the society held Nov. 13, the following officers were elected; President, Maurice W. Williams; vice-presidents, J. Spencer Smith, William Joshua Barney, Edward Anderberg, M. A. Long, and H. C. Yost; secretary-treasurer, Charles H. Newman.

Personal Notes

R. H. Sherlock, formerly structural engineer with the American Bridge Co., at Toledo, Ohio, has taken up duties this fall as assistant professor of civil engineering in the college of engineering, University of Michigan.

W. M. Spann, division engineer for the Missouri State Highway Department with headquarters in Kansas City has been promoted to engineer of construction at Jefferson City, succeeding A. C. Lingley, recently resigned H. M. Brush, assistant engineer of construction, will fill the vacancy caused by Mr. Spann's promotion. A. R. Axom, division maintenance engineer at Willow Springs, has been made assistant engineer of construction.

John Albers has been appointed city engineer of Beverly Hills, Calif.

Dr. Paul Whitfield Horn, now president of Southwestern, University, Georgetown, Texas, has been appointed president of the new Texas Technical College at Lubbock, Texas, and will assume the duties Jan. 1. For the construction of Texas Technical College, the architects are Sanguinet, Staats & Hedrick, of Ft. Worth. with William W. Watkins of Houston and Cram & Ferguson of Boston as associates. L. W. Robert of Atlanta and Dallas will be consulting engineer. The college will be opened in the fall of 1924.

Malcolm Ramsay, Greenville, Texas, has been appointed city engineer of Temple, Texas, and will have charge of an extensive paving program.

Walter A. Shaw, consulting engineer, Chicago, and formerly member of the Illinois Public Utility Commission, has been appointed a representative of the city of Chicago on the Board of Supervising Engineers, Chicago Traction.

Ezra B. Whitman, consulting engineer and a member of the Public Service Commission of Maryland, will become chairman of the commission Dec. 31, at which time the resignation of William Milnes Maloy, present chairman, will become effective.

Robert Isham Randolph, secretary of the Randolph-Perkins Co., engineers, has been nominated (equivalent to election) vice-president in charge of industrial development and public improvements of the Chicago Association of Commerce. Major Randolph has served on ten committees since 1915.

William J. Gray, who for the past ten years has been civil engineer in the U. S. Engineers office at Wilmington, Del., has resigned to become superintendent of the water-works at Springfield, Mo., for George West & Son of Portland, Maine.

Frank E. Shepard, who was president of the Denver Engineering Works until it consolidated with Stearns-

Roger Manufacturing Co., and a consulting engineer since that time, has been appointed superintendent of the Denver Mint. Mr. Shepard graduated from the Massachusetts Institute of Technology in 1887 as a mechanical engineer.

ALEXANDER POLLOCK has been appointed field engineer by the zoning commission of Denver, Colo. He will check up the various types of buildings and work in conjunction with the commission toward the perfecting of a new zoning ordinance.

DWIGHT P. ROBINSON & CO., INC., of New York, has opened an office in Atlanta, Ga., in the Healey Bldg., with W. RAWSON COLLIER in charge. Mr. Collier for many years was with the Georgia Ry. & Power Co. and more recently with the Poughkeepsie Gas & Electric Co. He is a graduate of Massachusetts Institute of Technology.

WILLIAM OEHRLE, formerly with the George A. Fuller Co. and recent manager of George A. Fuller Co. of the Orient, Ltd., announces the opening of an office at 342 Madison Ave., New York City, where he will transact his business of building construction.

Obituary

COL. ARCHIBALD O. POWELL, of the firm of Powell and Jacobs, consulting engineers, Seattle, Wash., died suddenly at his home in that city, Nov. 18. Col. Powell was born in Milwaukee, Wis., and graduated from the University of Wisconsin in 1880. He was for many years attached to the U. S. Engineers office with headquarters in St. Paul. In 1906 he moved to Seattle to take charge of the original Lake Washington Canal Project and upon completion of that engagement entered private practice as a consulting engineer, specializing in river and harbor work. He is a past-president of the Pacific Northwest Society of Engineers and of the Seattle Section, American Society of Civil Engineers. He served as a captain of engineers in the Spanish-American War and as a Lieutenant-Colonel of Engineers in the World War.

THOMAS J. WYCHE, San Francisco, Calif., consulting engineer for the Western Pacific Ry., died recently, at the age of 64 years. He was a native of Mississippi and a graduate of the University of the South. Mr. Wyche built many large water systems for the Union Pacific R.R., and tunnels for the Western Pacific at Sherman and Aspen, Colo.

WILLARD A. SMITH, publisher of the *Railway Review*, who died at Evanston, Ill., Nov. 29, was known specially for his work as chief of transportation exhibits at the Columbian Exhibition, Chicago, 1893; Louisiana Purchase Exhibition, St. Louis, 1904, and Paris Exhibition of 1900. Mr. Smith was born at Kenosha, Wis., in 1849. He was an affiliate of the American Society of Civil Engineers and a member of the Western Society of Engineers. He was prominent in the work of the Railway Master Mechanics and Master Car Builders Association before they were absorbed as the mechanical section of the American Railway Association.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Interviews with Industrial Executives—2

On Making Concrete Road Finishers and Subgraders Do Their Best Work

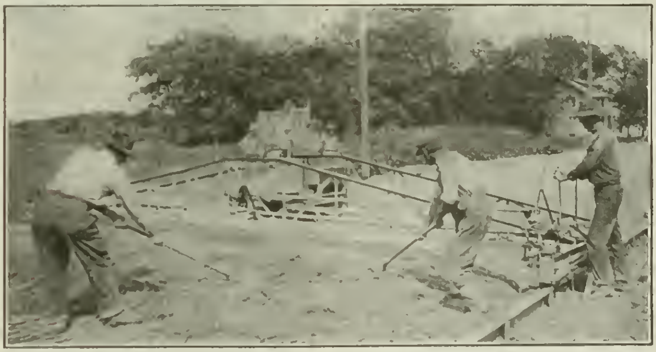
Lion Gardiner, Vice-President Lakewood Engineering Co., Tells How Sales Are Followed Up by Field Inspection and Constructive Suggestions on Operating Methods.

A PERUSAL of the various state highway specifications for concrete roads issued during the past five or six years indicates clearly the increased attention which is being given to preparing the subgrade, setting the forms and finishing the concrete. The development of machinery and equipment for doing this work has made possible reduced operating costs for the contractor and at the same time has given the highway departments and the public longer-lived roads. In this movement the Lakewood Engineering Co., of Cleveland, has been active, not only in designing equipment for building better roads, but also in helping contractors operate their plant so as to realize from it the maximum in quality and quantity of work. The result has been the development, by the Lakewood organization, of a definite policy of field service. From Lion Gardiner, vice-president of the company, *Engineering News-Record* has obtained the following notes on how this service functions:

SUBGRADE A VITAL PROBLEM

A completed subgrade upon which the side forms are set is in effect a mold or form to contain the concrete and produce an accurate concrete slab in the same sense that metal or wood forms on monolithic concrete construction produce a column, lintel or arch. Strength and accuracy of this mold or form, both from the standpoint of the highway department and the contractor, are essential.

"A manufacturer of equipment used in forming this mold," said Mr. Gardiner, "has a two-fold responsibility: First, to produce a machine which operates to give the results desired; and, second, to teach its use and function so that the contractor may produce in the finished work and in an economical manner the qualities of road surface and slab required by the specifications. The service on the operation of Lakewood equipment begins with the sale. Our salesmen must know not only the advantages of the finishing machine, subgrader or road forms, but bust also be thoroughly acquainted with the limitations in operation of any unit. The sale of a machine for a job necessarily imposes a responsibility for satisfactory operation."



FINISHING MACHINES CAPITALIZE ADVANTAGES OF DRY CONCRETE WITHOUT MATERIALLY INCREASING LABOR COSTS OF SPREADING AND TAMPING

For instance, the sale of a road-finishing machine necessitates making sure that the road forms which will carry the machine are substantial and that the soil upon which they will be set has the proper bearing power to hold them in alignment under the action of the finisher or subgrader. Further, such a sale, as interpreted by Mr. Gardiner, means that if there are any local conditions on the job which would work against the satisfactory operation of the finisher in any way they should be pointed out to the contractor by the manufacturer's representative so that, if necessary, correction can be made.

The responsibility of furnishing road-

building equipment which fails to perform satisfactorily at a critical time, thereby holding up the job and allowing the contractor's overhead expense to pile up at a tremendous rate, is a large one. This responsibility is further increased by the fact that the construction season in most localities is short—scarcely more than 100 working days a year—and time lost due to faulty operation of equipment cannot be regained.

Furthermore, it is the Lakewood company's experience that the servicing of road-building equipment is complicated because the contractor's organization is often not a stable one. Since the construction season lasts only part of a year the organization has to be broken up at the close of the season and the operators of the various machines are frequently changed as a result.

Checking Up On Operation

"The continued and increased sale of our equipment," Mr. Gardiner continued, "depends upon its satisfactory performance, and to insure such satisfactory performance under the conditions outlined we keep on the road during the active construction season field men whose duty it is to check up the operation of our units. This inspection is rendered not only at the request of an individual contractor, but is systematically made so that we have a fairly accurate record of the performance of all of our equipment in any territory.

"These inspectors visit the work and advise the operator and the contractor concerning the use of the machine, its adjustment, or repair. Besides having contact with the contractor and his men in charge of the equipment, our inspectors are also in touch with the engineers of the highway department and its inspectors. Thus we are assured that the requirements of the contractors and the State are being met.

"When such an inspection has been completed our man obtains the signature of the superintendent or the contractor himself, if possible, to an inspection report showing satisfactory operation of our equipment, and setting forth any suggestions which our man may have made for better operation. One copy of this form goes to the contractor's home office and another is sent to the state engineer in whose district the work is located as an indication to both that our interest in the equipment has not ceased with its sale.

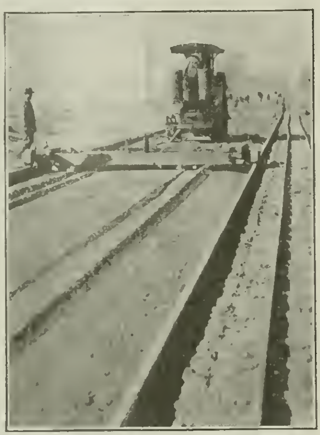
"Aside from this provision of field service, every effort is made, whenever there is opportunity for mechanical improvement of the machines, to make the new parts interchangeable with the old, so that early model machine owners may benefit with new users."

The functions of the three units—finisher, subgrader and forms—are so closely related that service problems overlap. Nevertheless, in the following notes, an attempt is made to segregate and discuss the more important problems of each of these units:

The Finishing Machine

In so many states do the specifications require the finishing machine, because of the added strength and density of the concrete, that the Lakewood organization regards its responsibility as a double one, to the highway department and to the contractor. A concentrated and specific service, therefore, is insisted upon.

Mechanical finishing machines have made possible the use of drier concrete, with its attendant advantages of greater strength and density without increasing materially the labor cost of spreading, tamping, and finishing. Mechanical finishing machines, however, cannot produce a road surface more accurate than the side forms upon which they run. Specifications for road construction lay emphasis upon the smoothness of the surface, and require it be tested with a straight edge to detect any appreciable variation. High or low spots may be the cause of the rejection of part



Machine-Made Subgrade Forms Accurate Mold for Concrete

of the work, or may make it necessary for the contractor to spend additional time in correcting them. It is essential, therefore, that the side forms be properly set, and particular emphasis is placed upon this point, not only by the manufacturer's field service men but also by his salesmen.

When a finishing machine is shipped to a contractor there is included with it a printed instruction book based upon the company's five years' field experience with this unit. This book contains information as to the assembly of the machine and its operation, and in addition tells about troubles which may be caused by lack of adjustment, the remedy and the lubrication of the machine. It gives pointers on the care and storage of the equipment during the winter months. Photographs and drawings are used to illustrate instructions, and bring out the points to be emphasized. It is realized that the operators of these machines will not have the time nor the inclination to study from a printed page the necessary steps in assembly, operation or adjustment. Therefore, the printed matter is kept to a minimum and consecutive steps are shown by pictures.

In addition to sending such an instruction book to the job with the machine, another copy is sent at the time of shipment to the home office of the contractor, so that the information will reach the contractor himself as well as his operator. The points in this instruction book are reiterated by both the Lakewood company's field-service men and its salesmen, who also make it a point to visit the job in operation after the equipment is sold. Some of these important points are:

1. Set your forms well, and see that there is a good foundation for them.
2. Some hand spreading must be done ahead of the strike-off of the machine, as it is not possible for the finisher to spread a bank of 6 in. or more of concrete ahead of it without causing unevenness in the road.
3. Control the water supply on the mixer so that batches are maintained at a uniform consistency.
4. When placing concrete on grades uniformity of mix is of even more importance than on level work, because upon it depends the smooth-riding surface that must be obtained.
5. Clean the concrete off the machine at night. Do not allow 200 or 300 lb. of concrete to collect on the strike-off and tamping members.
6. Lubricate thoroughly.
7. A set of important spares is sent with the machine, and when one is used see that it is replaced immediately to avoid any possibility of a delay in your work.
8. Keep the float belt clean and flexible.
9. Check the finished work frequently to see that the desired results are being obtained. With some consistencies of concrete it is necessary to set the strike-off blades higher or lower than for others.

In addition to the foregoing points attention is directed to the use of the machine on pavements built under modified or changed specifications. For instance, the practice of building roads in half-widths brought about a specific problem to be met with the finisher. This was done by providing a special set of wheels to be used when finishing the second half of the road. The first slab is finished as any standard pavement. For the second slab the outside wheels of the finisher run on the road form, and are doubleflanged. The inside wheels run on the first slab and are flat tread. The working out of this method for best results means that the manufacturer's service men must be thoroughly posted upon its application and any special problems to be encountered.

The Subgrader

The function of the mechanical subgrader is to plane or trim the subgrade to the final cross-section required, and upon its proper functioning depends the accuracy with which the road slab conforms to the specifications. The subgrader travels on the side forms, and the same necessity of seeing that they are well set obtains as for the finisher. The variety of soils upon which the subgrader is used requires that field men know how such different soils should be handled. With some it may be necessary to sprinkle the subgrade before the final cut is made. With others such sprinkling might be a detriment rather than a help. Speaking of practical points in subgrader operation Mr. Gardiner said:

"The subgrader is intended primarily for the final fine grading, but often the

men on the job, seeing how ruggedly the machine is built, attempt to take cuts which are entirely too deep. Considering an 18-ft. road a cut ¼ or ½ in. deep for its full width produces considerable material to be removed or drifted to the low spots. Very often it is found that the contractor is not obtaining full advantage of his subgrader because he is attempting to take his first cut too deep. The subgrader serves as a marking templet to indicate high and low spots, and makes for efficiency in moving earth from the high to the low spots if the first cut is not too deep.

Equalizing Cuts and Fills

The operation of the subgrader for the first time so that the blades will cut the top of the high spots will indicate immediately where fills must be made. If the cut is too deep this advantage is lost. Further, moving the material which is cut from the high spots to the low spots on the subgrade makes it unnecessary to bring in material from outside the forms. With the low spots filled and rolled the function of the subgrader is to plane the subgrade ½ in. at a time, if necessary, until it conforms to the required depth at all points. To get full advantage from the subgrader it is also necessary that forms be set well ahead of where concreting is in progress, so that a sufficient amount of subgrade can be completed at one operation."

Some instances are found by Lakewood service men where contractors owning subgraders are not using them because they do not appreciate the fact that this tool can be used in conjunction with motor-truck haul of materials without stopping operations. "Very often," Mr. Gardiner continued, "it is possible to use a subgrader in the morning, at noon and in the evening, when hauling is not in progress, so that sufficient subgrade can be completed for the entire day's run. Then there are some instances where instructions are given about moving the subgrader to one side of the road, after it has completed its operation, so as to clear the right-of-way for the trucks. Even the method of handling such a simple operation may mean a saving to the contractor. Our men are very often able to demonstrate on a job the advantage of carrying two short timbers upon the subgrader upon which it is lowered and moved to one side of the road when it is desired out of the way.

"The length of hitch used has considerable influence upon the results obtained. Too short or too long a hitch will cause difficulty in side play, with resulting damage to forms. We, therefore, furnish with the machine the proper length cable to be used and our service men keep the contractor posted on this point."

Road Forms

The advent of mechanical finishing of the subgrade and the mechanical finishing of the surface of the concrete slab, has increased the importance of proper setting of the forms. They have become not only the mold for the side of the slab, but a templet from which the subgrader shaves the subgrade to the proper depth and the finisher strikes off, tamps and belt-floats the concrete to the proper height. Accordingly, a firm foundation for road forms is infinitely more important than before, as low spots at the joints or in the forms will immediately reflect irregularities in the subgrade and the surface of the road. Service on road forms has to do primarily with seeing that they are properly staked and properly aligned.

Manufacturers during the past year have doubled not only the thickness of road forms to get strength, but also have increased the width of the form base to give added bearing surface. It devolves upon the contractor, Mr. Gardiner believes, to prepare the grade to receive these forms so that the required accuracy is maintained and a good support given to bear the weight of the subgrader and finishing machine.

Not only has Lakewood's field service had to do with the proper setting of forms, but the company's engineering department has spent considerable time in the development of its own form and the study of the service which it must meet. In an effort to insure the rigidity of the forms the company has manufactured sections 12-ft. in length against those of 10-ft. ordinarily sold, thereby reducing the number of joints required. Experience has further developed a round-top or line-point surface form upon which the concrete cannot lodge to cause irregularities in the surface of the road as the finishing machine goes over them.

"To sum up," Mr. Gardiner concluded, "it is the policy of our company to see to it that equipment is sold only with the proper understanding on the part of the contractor as to its performance, and that after the sale is completed full and sufficient instructions are given either by printed books, correspondence or personal visits to the end that the units function to the entire satisfaction of all concerned."

To Manufacturers of Machinery and Materials

You received from "Engineering News-Record" last week a letter requesting a brief statement covering the outstanding improvements made in your products during 1923.

This information is desired for the

Annual Review of Machinery and Materials

to appear in the first issue of the New Year, Jan. 3, 1924.

It is important, if the developments in your machines or materials are to receive adequate editorial treatment, that you send us the information desired as soon as possible—in any event not later than Dec. 17.

Paving Brick Shipments Continue Heavy

That the paving season because of a wet spring generally and a late start, is running later in the fall this year than is customary is indicated by the continued heavy shipments of vitrified paving brick reported by the National Paving Brick Manufacturers Association. Shipments for the month of October were 34,287,000 brick as against 34,761,000 for September. The total number of brick manufactured was 34,317,000 for October and 34,457,000 for September.

Sanction Sought for Joint Sales Organizations

Movement on Foot to Amend Webb Act—Initial Action on Construction Materials Probable

Washington Correspondence

WHILE it is too early to predict what concrete action will be taken by industy following the discussion at the Department of Commerce of selling combinations, it is known that much interest is being manifested in the general question. Definite steps are expected shortly because of the need for prompt action if economies are to be effected in handling reconstruction sales in Japan. The time also is opportune to secure an amendment to the Webb-Pomerene act, if it should be found desirable to organize under that statute.

The agitation at this time for joint sales organizations or selling corporations comprised of non-competing units is more than an effort to handle Japanese business in the most effiecient way. It is being considered in connection with the movement to expand all of our export activities. It is recognized that all possible economies must be secured if we are to compete in the world markets.

May Amend Webb Act

Joint sales organizations can be established abroad by non-competing industries without legislation. There are some who believe, however, that advantages would accrue were it possible to organize non-competing activities into Webb law corporations. It is known that the Webb act is to be taken up for amendment at this session of Congress. The principal amendment which will be proposed is to permit of combinations for import purposes. These combinations doubtless will be limited to commodities produced entirely or in great part abroad, in the handling of which artificial price levels are maintained.

While many industries are interested in these proposals, the first definite step is likely to be taken by the manufacturers of construction materials. It is evident that important economies could be effected were sales of lumber, steel, sash, doors, plumbing, glass, paint and other building materials handled through the same agency. If organization along those lines expedites and makes more efficient the handling of the Japanese orders at this time, it is argued that it should be equally useful in handling other export business.

In the export trade American manufacturers are having to meet competition from countries where it is entirely legal to combine. The depression in Great Britain is forcing large-scale combinations, which mean reduced overhead charges and the elimination of the less efficient production units. One of the principal savings is in selling costs. Knowledge and experience in manufacture can be pooled. Research can be undertaken on a more ambitious scale.

While American manufacturers may not take advantage generally of many of these economies by reason of our anti-trust statutes some of them can be secured in the handling of exports. It is believed that Congress is disposed to consider sympathetically various amendments to the Webb-Pomerene Act.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

"Commerce Yearbook" Presents Survey of American Industry

A new government service to business has just been made available in the form of the "Commerce Yearbook," prepared by the Department of Commerce to meet demands of American business men, bankers, economists and trade association executives for an authoritative review of the economic year throughout the world from the point of view of American industry. The first issue covers the year 1922 and the early part of 1923. It comprises 692 pages, containing, in addition to the text, many charts, maps and tables of statistics.

The book is intended not merely as a reference source but to be read for general commercial information on such outstanding facts of trade as production, price changes and market conditions. Among the chapters dealing with the nation's important industries is one on the "Construction Industry."

Business Notes

Lakewood Engineering Co., Cleveland, manufacturer of concrete chuting equipment, steel road forms, subgraders and finishing machines, announces that the sale of its equipment has been placed in the hands of Brown & Sites, 30 Church St., New York, N. Y. From 1912 to 1918 this company handled the Lakewood line of construction and paving equipment in the New York territory, so that, in resuming this representation, the Brown & Sites Co. has full knowledge of Lakewood products and policies. Special attention will be devoted to giving service to contractors who purchase this equipment.

Equipment and Materials

Imported Trass Available in U. S.

Recent importations from Germany now make available for the first time on a commercial scale in the United States supplies of trass, a mineral product of volcanic origin which, when mixed with portland cement, is claimed to produce concrete exceptionally hard, watertight and resistant to acid and sea-water. The material has been extensively used for years past in European practice for concrete dams, pipe and structures in sea water. The distribution of trass in the United States is being handled by Emil Stahl, 531 Palisade Ave., Jersey City, N. J.

Publications from the Construction Industry

Snow Plows—Good Roads Machinery Co., Inc., Kennett Square, Pa., has issued an illustrated 7-p. bulletin on its Champion snow-plows for attachment to the front ends of heavy tractors. The plow consists of an inclined platform carried on rollers and sleds with a V-type moldboard mounted on it on a push frame arranged for attaching to the tractor.

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 305 to 320, are the following:

School, New York, N. Y., to G. Colon & Co., $1,089,000.

Apartment Hotel, St. Louis, Mo., to P. J. Bradshaw, $1,500,000.

Factory, Rocky Hill, Conn., to Dennis O'Brien & Sons Co., $1,000,000.

Apartment, New York, N. Y., A. D'Antona by day labor, $1,000,000.

Apartment, New York, N. Y., to Turner Constr. Co., $1,000,000.

Winter Building Advocated

That the usual summer shortage of skilled building trades mechanics is becoming more pronounced each year, is the opinion of Monks and Johnson, architects and engineers, of New York and Boston.

"Each spring and summer," they point out, "see contractors offering inducements in the form either of premium wages or assurance of overtime at the regulation rate in order to secure workmen. There is little or no opportunity to select artisans for the quality of their workmanship. All are employed and all are eagerly sought by employers. Inefficiency abounds and costs mount high.

"In the winter, however, there is unemployment. A chart recently published by the Boston Building Congress gives the percentage of employment during the months of December, January and February as follows:

Trade	Per Cent
Common labor	40
Carpenters	50
Masons	25
Lathers	40
Plasterers	50
Painters	25

"Experience has shown that winter building is possible, and in most kinds of construction without sacrifice of quality. There remain therefore only considerations of economy. It would cost more to build in winter, were other factors the same, than in the warmer months. Materials must be heated and protection provided to prevent fresh concrete and mortar from freezing. Numbed fingers are not nimble. Snow must be removed. There is a well recognized additional expense involved in these factors. But there are factors on the other side.

Ample Supply of Labor in Winter

"In the winter there is ample supply of labor. Wage premiums and overtime assurances are unnecessary. Selection of artisans is possible and competition spurs them to greater efforts. The market for building materials almost invariably eases up in the late fall and winter. Shrewd purchasers can buy for midwinter delivery substantially below spring and summer prices. Contractors anxious to keep their organizations functioning and thus meet the cost of that bugaboo of business executives, overhead, are often glad to forego in the winter months further profit. These factors all favor winter building and may balance or outweigh the cost of heating and protection."

Next week—Production and stocks of basic buildng materials in several important centers.

Business Briefs

Call money easier at 5@4½ per cent.

Time money quiet and unchanged at 5@5¼ per cent.

Commercial paper unchanged at 5@5¼ per cent.

Foreign exchange advances and then declines. Sterling, $4.34⅜; last week, $4.38¼; year ago, $4.53¾. Franc, $0.0540½; last week, $0.545¾; year ago, $0.0702¼. Lire, $0.0434; last week, $0.0435; year ago, $0.0501½.

Common Brick Imports Increase

A total of 18,365,000 common brick was imported into this country, through the Port of New York, during the third quarter of the current year, as against 10,379,000 for the preceding quarter.

In *Engineering News-Record*, issue of Nov. 29, p. 911, the import total for the first quarter was incorrectly stated at 10,379.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 305 to 320, are the following:

Bank and Office, Dallas, Tex., Republic Nat'l Bank, $1,500,000.

Apartment, Chicago, Ill., R. W. Matteson, $1,000,000.

Ties, Montreal, Que., Canadian Pacific Ry., 6,000,000 ties $4,000,000.

Mill, Temiskaming, Que., L. N. Huard, $1,000,000.

Hotel, Memphis, Tenn., Southern Hotel Co., $3,000,000.

Bank and Office, Buffalo, N. Y., Liberty Bank, $2,000,000.

Hotel and Office, Philadelphia, Pa., Middle City Realty Corp., $10,000,000.

Foreign Projects of Interest to Americans

A number of foreign construction projects which should be of interest to American engineers, contractors and manufacturers has been reported by the United States Department of Commerce. They are noted here, further information being available at the Bureau of Foreign and Domestic Commerce or its district co-operative offices, when a reference number is given.

Water for two Greek cities from artificial lake. Specifications are now available for examination by interested American firms. Reference No. 12,599.

Modern hotel for Czechoslovakia. Hotel along American lines to be erected in Prague. Estimated cost, $2,500,000. Reference No. 12,558.

Subway to be built in Argentine city. A street car company plans to build a subway to take care of heavy business traffic. Reference No. 35X-A.

Power station to be built at Guadeloupe. Plant to furnish power for chocolate factory and light for two neighboring sections. Reference No. t11,348.

Value of November Contracts 16 Per Cent Heavier Than for Same Month Last Year

Total of 795 Awards During November, Average Value $196,402, Compared With 699 in October, Averaging $230,724

The total value of contracts awarded on large engineering construction projects, in the five November issues of *Engineering News-Record*, reached $156,140,000 as compared with $161,276,000 in the four issues of October. This represents an average weekly value of $31,228,000 for November, against $40,319,000 during the preceding month.

The weekly average of $31,228,000 for the month of November represents an increase in money value of nearly 16 per cent above the weekly average for the corresponding period in 1922.

Minimum costs observed in Construction News on each class of construction are as follows: Waterworks, $15,000; other public works, $25,000; industrial construction, $40,000; and commercial buildings, $150,000.

All classes of construction fell off during November with the exception of water-works, bridges, excavations, commercial buildings and certain unclassified jobs. Water-works awards gained 72 per cent in total money value during the month, while bridges increased 42 per cent and commercial buildings, 20 per cent. Contracts awarded for excavations, drainage and irrigation, totaling $2,749,000, were over three times greater than those for the preceding month.

Among the large projects awarded during October were the following: A central station at Davenport, Ia., $10,000,000; bank and office building, Cleveland O., $5,000,000; 5,000 tons of steel for shipping terminal, Seattle, Wash., $4,000,000; filtration plant, Cleveland. O.. $2,885,000; hotel, Louisville, Ky., $2,300,000; and a high school, New York, N. Y., $2,145,000.

Engineering News-Record Construction Cost Index Number

December, 1923	217.30
November, 1923	220.90
December, 1922	192.60
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number dropped 3.6 points since last month, owing to decline in prices of lumber and cement. Prices of other basic building materials remained unchanged during the month. The average rate for common labor is still 54c. Thus, general construction cost is 13 per cent higher than one year ago and 21 per cent under the peak; it is 117 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
November, 1923 (*5 issues of E. N.-R.*)	125
October, 1923 (*4 issues of E. N.-R.*)	127
November, 1922 (*5 issues of E. N.-R.*)	122
1913	100
Yearly	
1922 (entire year)	130
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 125 for the month of November, and 130 for the whole of 1922, as against 100 for 1913. This means that the actual volume of construction in 1922 (not the mere money-value of the contracts let that year) is 30 per cent above the volume of construction for 1913. Our monthly volume number, 125 for November, 1923, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING NOVEMBER, 1923

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total United States	Canada	Grand Total
Waterworks	$89,000	$328,000	$218,000	$3,436,000	$1,656,000	$507,000	$6,234,000	$30,000	$6,264,000
Sewers	58,000	421,000	24,000	1,225,000	1,358,000	368,000	3,454,000	133,000	3,587,000
Bridges	216,000	544,000	1,247,000	829,000	441,000	2,507,000	3,486,000	.	4,678,000
Excavations, drainage and irrigation		.. .	249,000	25,000	895,000	676,000	2,674,000	75,000	1,557,000
Streets and roads	612,000	2,184,000	6,408,000	4,188,000	6,015,000	4,099,000	23,506,000	177,000	23,683,000
Industrial works	705,000	2,665,000	840,000	6,700,000	12,407,000	1,724,000	25,041,000	415,000	25,456,000
Buildings	2,320,000	27,951,000	8,026,000	15,688,000	8,455,000	8,324,000	70,764,000	998,000	71,762,000
Federal Government	80,000	905,000	1,084,000	391,000	1,032,000	820,000	4,312,000	..	4,312,000
Unclassified	150,000	3,669,000	874,000	324,000	2,534,000	407,000	7,958,000	2,368,000	10,326,000
Materials and equipment	.. ....	238,000	.	25,000	46,000	4,206,000	4,515,000		4,515,000
November, 1923	$4,230,000	$38,905,000	$18,970,000	$32,831,000	$34,839,000	$22,169,000	$151,944,000	$4,196,000	$156,140,000
October, 1923	4,958,000	55,001,000	18,435,000	38,573,000	15,924,000	24,855,000	157,746,000	3,530,000	161,276,000
September, 1923	6,585,000	40,893,000	20,757,000	39,116,000	32,055,000	27,534,000	166,940,000	6,132,000	173,072,000
Total 3 months	$15,773,000	$134,799,000	$58,162,000	$110,520,000	$82,818,000	$74,558,000	$476,630,000	$13,858,000	$490,488,000

Labor Rates and Conditions Throughout the Country

Wage increases reported during November were far in excess of reductions despite the seasonal slowing down in construction, the marked curtailment in the cotton textile output and a decrease in bituminous coal production. The advances occurred principally among steam and electric railway employes and in the printing industry.

Increased wages and higher living costs, particularly in food, clothing and fuel, are contrasted with the perceptible slowing down in general industrial activity. Proposed legislative action affecting tax reduction; soldiers' bonus; child labor; railroad, agricultural and immigration problems, is one of the principal factors governing the present state of industrial uncertainty.

An increased pig iron demand, however, stands out as the most favorable factor in the whole business situation.

The average rate paid common laborers (pick and shovel men) in construction operations has remained at 54c. during the last six months; the June rate being 53c. per hr., according to *Engineering News-Record* figures. Local conditions are as follows:

Atlanta—Small demand for building trades mechanics within city; construction active in outlying districts.

Baltimore — Conditions normal in building trades with possible exception of structural iron workers and common laborers.

Birmingham—Structural iron workers now receiving maximum of $1 per hr., against $1.25 formerly. Men employed on municipal jobs being paid the lower rate.

Boston—Building trades mechanics plentiful; all classes. Carpenters, however, receive maximum rate of $1.10, compared with $1.05 per hr., on residential construction work.

Cincinnati—New carpenters' union formed under auspices of Building Trades Council, due to dispute between carpenters and sheet metal workers. Wage scale still $1.05 per hr.

CURRENT BUILDING TRADES WAGE RATES PER HOUR

(Higher rates indicated by +, decreases by —)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$1.12½	$0.90	$0.70	$0.50	.....	$0.75	$0.30@.35
Baltimore	1.50	1.00@1.12½	.90	.87½	$0.65	.80@1.00	.30@.50
Birmingham	1.00	1.00	.50@1.00	.30@.40	.....	1.00	.30@.40
Boston	1.25	+1.00@1.10	1.25@1.35	.82½	1.05	1.12½	.60@.75
Cincinnati	1.25	1.05	1.05	.82½	1.05	1.05	.45
Chicago	1.25	1.15	1.00@1.25	.88¾	1.10	1.25	.82½
Cleveland	1.40	1.25	1.25	.87½	1.00	1.10	.87½
Dallas	1.50	1.00	1.00	.40	.87½	1.00	.30@.50
Denver	1.37½@1.50	1.12½	1.12½@1.18¾	.75@.81¼	1.00	1.15⅝	.35@.55
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	1.37½	+1.12½	1.00	.87½	1.00	1.00	+.40@.60
Los Angeles	1.25	.87½@1.00	.87½@1.00	.62½	.....	1.00	.50
Minneapolis	1.12½	.87½	.87½	.71½	.....	.87½	.50@.55
Montreal	.90	.65	.50	.35	.50	.65	.30
New Orleans	1.25	.90	1.00	.65	.80	1.00	.35@.40
New York	1.50	1.25	1.25@1.50	1.00	1.00	1.25	+.62½@.75
Philadelphia	1.50	1.12½	1.02¼@1.13½	.70@1.00	1.00	1.10@1.12½	.45@.50
Pittsburgh	1.40	1.20	1.12½	1.00	......	1.25	.70
St. Louis	1.75	1.50	1.25@1.37½	1.25	1.25	1.25@1.50	.45@100
San Francisco	1.25	1.00	1.00	.81¼	1.00	1.12½	.50@.55
Seattle	1.25	1.00	1.00@1.12½	.93¾	1.00@1.12½	1.12½	+.62½

Dallas—Excessive demand for bricklayers and carpenters; ample supply of other trades.

Detroit—Release of men from manufacturing plants has supplied needed labor for construction work. No shortage in any of the building trades.

Kansas City—Carpenters advanced 12½c. per hr. since last month. Minimum rate for common laborers 40c. as against 35c. per hr., formerly.

Montreal—Ample supply of all crafts.

New York—The old Building Trades Council with a membership of about 100,000 men, demand a wage increase of $1 per day for a period of two years, beginning Jan. 1. Present base pay of $9 per day, with a bonus of $1, making $10, would be advanced to a base pay of $11 should this demand become effective.

Philadelphia — Sufficient building trades mechanics to meet all demands. Surplus of common laborers. Maximum rate for hoisting engineers $1.13½ as compared with $1.02¼ per hr. formerly.

Pittsburgh—Building labor plentiful; demand "eased off" during last few weeks.

St. Louis—No change in present building trades wage schedule. Lathers have served notice that they will ask $15 for an 8-hr. day on March 1, the largest wage ever reached in St. Louis under a contract. Bricklayers and plasterers now receive $1.75 per hr. with some talk of asking $2 with a 5-day week. Electrical workers, carpenters, elevator constructors, plumbers and steam fitters get $1.50 per hr., with individual workers being paid bonuses above that amount.

San Francisco—Building trades well employed.

Seattle—Plasterers on strike for $10 @$12 per 8-hr. day. Two large jobs, however, are paying $11 per day; most other jobs non-union.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—November iron sales reached million ton mark. Present low iron prices may rise to meet steel or latter may tend downward in the direction of iron quotations. No. 2 foundry iron, $22 at Birmingham, against $24 per ton one year ago.

Railway Supplies—Minimum on light rails up $2 per ton at Pittsburgh mill, during month; present price $2@5 per ton above year ago. Standard spikes down in San Francisco; track bolts lower at Pittsburgh mill.

Pipe—Wrought pipe demand largely confined to butt weld sizes in small tonnages. April 19 basing card still in effect at Pittsburgh. Cast-iron pipe slightly lower than month ago in New York; over $7 per ton higher than one year ago. Sewer-pipe and clay drain tile firm at present levels.

Road and Paving Materials—Downward trend in Mexican asphalt in Boston and Atlanta. Road oils unchanged. Average daily crude oil production declining.

Sand, Gravel and Crushed Stone—Sand down about 5c. per cu. yd. in Cincinnati and Atlanta. Gravel declined 10c. per ton in Atlanta and rose 25c. per cu.yd. in New York, during month. Crushed stone down 10c. per ton in Atlanta.

Lime—Hydrated lime declined in Boston and Atlanta; lump lime in Atlanta, Dallas and Detroit. Common lump, however, advanced 20c. per bbl. in Boston.

Cement—Reduction of 10c. to 25c. per bbl. at various mills throughout the country. Drop reflected in dealers quotations. Owing to change in freight rates in Illinois and Wisconsin, effective Nov. 24, price at Peoria, dropped from $2.41 to $2.27 and at Milwaukee from $2.37 to $2.25 per bbl. A voluntary downward adjustment in mill prices brought the delivered price, f.o.b. Detroit, to contractors, to a basis of $2.37, against $2.48 last month. These reductions while in part seasonal, were also made to stimulate renewed interest in winter construction.

Structural Steel—Steel bars continue firm at $2.40 per 100 lb., Pittsburgh. Shapes and plates have been quoted as low as $2.40 for large tonnages; small lots or specified deliveries, however, bringing a minimum of $2.50 per 100 lb.

Brick and Hollow Tile—Common brick advanced 50c. in San Francisco and 60c. in Dallas, during month; Boston reports decline of $1 per M., delivered. New York quotations are $19 per M., wholesale, at dock, against $19@$20, one month ago and $15@15.50, one year ago. Hollow tile declined slightly in Philadelphia and Atlanta during month.

Lumber—Output increased 5,016,482 ft.; shipments, 3,298,724 ft. and new business, 6,221,976 ft., for the entire country, during week ended Nov. 24. General price decline in pine, fir, hemlock and spruce. Minneapolis, however, reports rise of $1 per M. ft. in 8-in. Douglas fir timbers.

Explosives—Advance of 1c. in Boston and decline of ½c. per lb. in Atlanta, on 60 per cent gelatin dynamite.

Scrap—No. 1 machinery cast and heavy melting steel up $1 per ton in New York.

Linseed Oil—Raw oil 95c. f.o.b. New York, against 98c. per gal. (5 bbl. lots) one month ago. Declines reported in Chicago and San Francisco; slight rise in Minneapolis.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Dec. 6	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	*$25.05*	$27.55
Northern Basic	*24.00*	30.27
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	*24.00*	30.27
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	*28.00*	35.27
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	*22.00*	24.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25 @ 2.75 sil.)	24 25	31.64
Virginia No. 2 (silicon 2.25 @ 2.75)	28.17	37.17
Basic	*24.00*	27.50
Gray Forge	*24.00*	29.14
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	*24.50*	30.00
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	*27.00*	30.00
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	*25.77*	27.50
Basic	*25.77*	27.50
Bessemer	*26.77*	30.50

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$15 00	$11 50	16@16 50
Stove plate	12 00	12 00	16 00
No. 1 machinery cast	**17 00**	16 50	19 50@20
Machine shop turnings	8 00	4 00	12 50@13 50
Cast borings	9 00	5 50	14 00
Railroad malleable	15 00	12 50	21 00
Re-rolling rails	13 00	13 00	21 50@22
Re-laying rails		30 00	28 00@31
Heavy melting steel	**12 00**	16 00	

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh Dec. 6	Pittsburgh One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43 00	$43 00		$43 00	$43.00
Standard openhearth rails	43 00	43 00	$43 00	43 00	43.00
Light rails, 8 to 10 lb	**45 00**	40@43	2 00*	43 00	43@45
Light rails, 12 to 14 lb.	**45 00**	40@43	2 00*	43 00	43@45
Light rails, 25 to 45 lb.	**45 00**	40@43	2 00*	43.00	43@45
Rerolled Rails	37@**40**	28@32			

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8½ Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1 70	$1.90
Chicago, Hardwood and Red Oak	1 35@1 45	1 50@1 70
Chicago, Empty Cell Creosoting (add'l)	.50	.60
San Francisco, Green Douglas Fir	.84	1 14
San Francisco, Empty Cell Creosoted Douglas Fir	1 70	2 25
St. Louis, White Oak	1 30	1 60
St. Louis (creosoted) (zinc treated)	1 70	2 05
St. Louis, Red Oak, plain	1 20	1.50
St. Louis, Sap pine-cypress	1 05	1.35

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Dec. 6	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, 9/16-in. and larger	$3 15	$2 75	$3 00	$4 00	*$4.85*	$3 72
Track bolts	4 00	3 85@4 50	4 00	5 05	6.20	4 57
Standard section angle bars	2 75	2 75	2 75	4 00	4 00	3.20

PIPE

WROUGHT PIPE—The following mill discounts are to jobbers for carload lots on the latest Pittsburgh basing card

BUTT WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
1 to 3	62	50½	1 to 1½	30	13

LAP WELD

Inches	Steel Black	Galv.	Inches	Iron Black	Galv.
2	55	43½	2	23	7
2½ to 6	59	47½	2½	26	11
7 and 8	56	43½	3 to 6	28	13
9 and 10	54	41½	7 to 12	26	11
11 and 12	53	40½			

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1½	60	49½	1 to 1½	30	14
2 to 3	61	50½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	53	42½	2	23	9
2½ to 4	57	46½	2½ to 4	29	15
4½ to 6	56	45½	4½ to 6	28	14
7 and 8	52	39½	7 and 8	21	7
9 and 10	45	32½	9 to 12	16	2
11 and 12	44	31½			

WROUGHT PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. butt welded	48%	50%	49%
2½ to 6 in. lap welded	44%	47%	46%
	Galvanized New York	**Galvanized Chicago**	**Galvanized St. Louis**
1 to 3 in. butt welded	34%	37%	36%
2½ to 6 in. lap welded	30%	34%	33%

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 15%. Cast iron, standard sizes, 17½% off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	Pittsburgh	New York Dec. 6	New York One Year Ago
4 in.	$53 00	$60@65	*$67 10@68 60*	$59 30
6 in. and over	49 00	56@60	*62 10@63 60*	54 30

	Chicago	St. Louis	San Francisco
4 in.	$60 20@64 20	$61 60	*$63 00*
6 in. and over	57 20@60 20	57 60	*59 00*

Gas pipe and Class "A," $5 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Dec. 6	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45 00	$45 00	$50 00	$62.50	....	$73 00
4	55 00	55.00	50 00	75.00	$76.50	83 00
5	80.00	80.00	85.00	100.00	97.75	108 00
6	105.00	105.00	85.00	175.00	127.50	133 00
8	170 00	170.00	195.00	187.50	212.50	199 00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In.	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3		$0 105	...		$0.15	$0.12	......
4		105	$0 11	$0.1175	.15	.15	$0.15
5		1575	1375	.	.23	.18	.18
6	$0.24	.1575	165	1645	.23	.21	.21
8	.38	245	26	26	.35	.30	.325
10	57	3675	338	.338	.53	.42	.476
12	72	4725	442	.468	.68	.54	.612
15	1.13†	63	65	.78†	.90	.90	.884
18	1 65†	875	85	1 092†	1.25	1.32	1.153
20	1 98†	1 05	1.125	.....	1.50	......	.....
22	2 64†	1 40	1.375	1 456†	2 00	......	1.564
24	2 97†	1 575	1.625	1 872†	2.25	2.16	2.04
27	4 81†	2 795	....	2 95†	4.69†	3.00	3.34
30	5.33†	3 096		3 65†	5.94†	3.60	4.06
33	6.93†	4 14	..	4 45†	6.88†	......	4.99
36	7.91†	4 715	.	4 80†	7.50†	......	5.42

	3	5	8	12	24	36
Boston	$0 131	$0.202	$0.32	$0.612	$2.05†	$6.15†
Minneapolis	....	.....	40	72	2.55	5.66†
Denver	.135*	.18*	27	.47	1.70	.....
Seattle	.13	....	36	.72†	2 60†	.....
Los Angeles	13	.165	275	475	1.65	.....
New Orleans	.145*	.168*	28	476	1.182	.....
Cincinnati	.12	18	28	.54	1 80	4 10†
Atlanta	**.11***	**165***	**.275**	*.425*	*1 625*	.....
Montreal, *delivered*	.68‡	.45†	.70	1 35	4 50†	.
Detroit	.117	.1755	.273	.5265	2 34†	6.15†
Baltimore	.117	.175	.273	.5265	1.755	3.9975
Kansas City, Mo.	15*	.21*	332			...
Philadelphia	.12	18	28	54	1 80	5 225

*4-in., 6-in., 9-in., respectively †Double Strength ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

	Dec. 6	One Year Ago
New York, 45% asphalt (at terminal)	$0.053	$0.06
New York, 65% asphalt (at terminal)	.052	.06
New York, binder (at terminal)	06	.0675
New York, flux (at terminal)	.06	.065
New York, liquid asphalt (at terminal)	.048	.07
St. Louis, 50@60% asphalt	.055	.07
St. Louis, 40@50% asphalt	.053	
Chicago, 40–50% asphalt	.0525	.0525
Chicago, 60–70% asphalt	.055	.055
Dallas, 45% asphalt	.0495	.04
Dallas, 55% asphalt	.0455	048
Dallas, binder	.061	053
San Francisco, binder, per ton	9.50*	9.50*

* F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Texas*..)...	$23 00*	$15.00†
Boston (*Mexican*)........	22 00	*17 00*
Chicago (*Stanolind*)	22 25	16 00
San Francisco, *f.o.b. refinery*, Oleum, Cal.........	17.00	11.00
Dallas (*Texas*)............	27.10	21.10
Seattle, "*D" grade, California, f.o.b. Richmond.* ..	24.75	20.50
Denver (*California*)............	24 00	..
Minneapolis *f.o.b. Twin Cities (Stanolind)*..	25 45	19.10
St. Louis (*Mexican*)........	29 50	24 50
Baltimore (*Standard Oil*)........	18.00	14.00
Montreal (*Imperial*)........	28.00	21.00
Atlanta (*Mexican*).........	*24.00*	*21 50*
Detroit (*Mexican*)........	22 00	18 00
Cincinnati (*Kentucky Rock*)........	17.50	13.50
Maurer, N. J. (*Bermudez*)........	28.00	26.00
Maurer, N. J. (*Mexican*)........	21.50	18.50
Philadelphia (*Mexican*)........	19.00	16.00
Kansas City (*Texas*)........	23.30	27.30
Los Angeles "*D" grade, California, f.o.b. El Segundo Refinery*	17.00	11.00

*F.o.b. Bayonne, N. J.
†F.o.b. Marcus Hook, Pa.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

PAVING STONE—

New York (grade 1)...........	5-in. granite, 30 blocks per sq.yd.	**$140.00** per M.
Chicago........................	About 4x8x4 dressed......	3.60 per sq.yd.
	About 4x8x4 common.....	3.20 per sq.yd.
San Francisco.................	Basalt block 4x7x8........	70.00 per M.
Boston........................	5-in. granite 28 blocks per sq yd.	130.00 per M.
Atlanta.......................	Granite....	2.66 per sq.yd.
Detroit.......................	5-in. Granite........	106.00 per M.
Baltimore.....................	Granite........	2.85 per sq.yd.
Montreal......................	Granite........	104.75 per M.
New Orleans...................	Granite, 4 x 8 x 4........	3.25 per sq.yd.
Cincinnati....................	Granite........	138.00 per M.
St. Louis.....................	4x8x4 dressed...........	3.05 per sq.yd.
	4x8x4 common...........	2.90 per sq.yd.
Kansas City...................	Granite........	.... per sq.yd.
Philadelphia..................	Granite..	3.75@4.50 per sq.yd.
Minneapolis...................	Sandstone	2.74 per sq.yd.

FLAGGING—

New York..............	Bronx, 4 ft wide.........	$0.22 per sq.ft.
	Manhattan, 4 ft. wide..	.22 per sq.ft.
	Queens, 5 ft. wide.....	.24 per sq.ft.
	6x24-in. cross-walk.....	1.10 per lin.ft.
Chicago...............	18 in. wide....No market	.... per lin.ft.

CURBING—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 80c.; 5 x 20 in., Queens, 85c. *St. Louis*: Class "A" straight, delivered, 5 x 16 in., *$1.40* per lin.ft. *Chicago*: 5 x 18 in., $3.35 per lin.ft. delivered.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)..............	3	16	$2.58
New York (*delivered*)..............	3½	16	2 79
Boston..............................	3½	18	**2 72**
Chicago.............................	4	16	3.50
Chicago.............................	3½	16	3.50
St. Louis...........................	3½	16	2 55
St. Louis...........................	4	16	2 90
Seattle.............................	4	16	Off market
Minneapolis.........................	3½	16	2 70
Atlanta.............................	3½	16	1.90
New Orleans.........................	3	16	2 50
New Orleans.........................	3½	16	2.81
New Orleans.........................	4	16	3.15
Dallas..............................	4	18	3.90
Baltimore...........................	3½	16	None used
Montreal............................	4	16	4.50
Detroit.............................	3	16	2.84
Detroit.............................	4	16	3.00
Cincinnati..........................	3½	16	2.38
Kansas City.........................	4	16	
Philadelphia........................	4	16	None used

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. Dec. 6	Gravel 1½ In. One Year Ago	Gravel ¾ In. Dec. 6	Gravel ¾ In. One Year Ago	Sand Dec. 6	Sand One Year Ago
New York..............	**$2 00**	$2.00	**$2 00**	$2.00	$1.25	$1.00
Denver................	1.90	1 90	1 90	1.90	1.00	1.00
Chicago...............	2 00	2.25	2.00	2.25	2 00	2 25
St. Louis.............	2 30	1.45†	2 35	1 50†	2 10	1 45†
Seattle...............	1.25	1.00	1.25	1.00	1.25	1 00
Dallas................	2.38	2.52	2 38	2 52	2 00	1 87½
Minneapolis...........	1.85*	1 75	1 85*	1.75	1.25	1.00
Cincinnati............	1 35	1.40	1.35	1.15	*1 30*	1.15
San Francisco.........	2.15	2.15	2.15	2 15	1 50	1 50
Boston................	1 40†	1 40	1.40†	1 40	1.10†	1 10
New Orleans...........	2 85	2.85	2.85	2.85	1 25	1 35
Los Angeles...........	2 50		2 50	.	1.75	
Atlanta...............	*1 75†*	1 75†	*1 75†*	1 75†	*1 20†*	1 32†
Detroit...............	1 62	2@2 25	1 62	2@2 25	2 02½	2 00
Baltimore.............	1 40	1 40†	1 60	1 60†	0.70†	0.70*†
Montreal..............	1 25†	1 25†	1 50†	1 50†	1.25†	1 25†
Birmingham (Crushed slag used instead of gravel)					1.30†	1.25†
Philadelphia..........	2 00†	1 70	2 00†	1.75	1 50†	1.65
Kansas City...........		2.00		2.00	0 66*†	0 66*†

New York—Grits, $1.75 per cu. yd.; ready mixed, $2 00
Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.
* At pit.
† Per ton.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Dec. 6	1½ In. One Year Ago	¾ In. Dec. 6	¾ In. One Year Ago
New York...........	$1.65	$1.65	$1.75	$1 75
Chicago............	2.00	2.25	2.00	2 25
St. Louis..........	*1.70*	2.10	1.90	2 20
Dallas.............	2.83	1.65	2.83	1.65
San Francisco......	2.15	2.15	2.15	2 15
Boston.............	1.55*	1 65	1.55*	1.65
Minneapolis........	1.85	2.00	2.00	2.25
Kansas City........	1.50	2.40	1.50	2.40
Denver.............	3.50	3.50	3.50	3.50
Seattle............	3.00	3.00	3.00	3.00
Atlanta............	*1.90**	2 10*	*1.90**	2 10*
Cincinnati.........	1 65	1.95*	1 65	1.95*
Los Angeles *delivered*.	2.75	...	3.00	....
Detroit............	1.75	1.90@2.00*	1.75	1.90@2.00*
Baltimore..........	2.50	1.70*	2.55	1.60*
Montreal...........	1.80*	1.80*	1.90*	1.90*
Philadelphia.......	2 00*	1.75*	2.00*	1.60*
Pittsburgh.........	2.85	2.85	2.85	2.85
Cleveland..........	3.25*	3.00*	3.25*	3.00*

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District..........	$1.30	$1.40	$2.00	$1.30
Steubenville District........	1.40	1.40	2.00	1.40
Ironton District.............	1.40	1.40	2.00	1.40
Easton, Catasauqua, Pa.......	0.85	0.90	2.50	...
Birmingham, Ala..............	1.05	1.15	2.05	0.80
Buffalo, N. Y., and Erie, Pa...	1.25	1.25	2.25	1.25
Cleveland, Ohio..............	1.45	1.45	1 45	1.25
Eastern Pa. and Northern N. J	1.20	1.20	2.50	1.20
Western Pennsylvania.........	1.25	1.25	2.00	1.25
Longdale and Glen Wilton, Va...	1.25	1.25	2.50	1.00
Toledo, Ohio.................	1 50	1.50	1.50	1.50

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York..........	$18.20	$13 10	$3.75*	$3.00@3.25*
Chicago...........	20.00	20.00	1.50†	1.50†
St. Louis.........	23.20	20.00	18.75‡	18.75‡
Boston............	*22.50*	*16.50*	4.50*	**2.95***
Dallas............	23.50	...	.	*2.85†*
Cincinnati........	16.80	14.30	....	
San Francisco......	22.00	.....	...	2.10†
Minneapolis.......	25.50	21.00 (white)	1.70†	1.50†
Denver............	24.00	.....	...	2.70†
Detroit...........	20.00	19.00	18.00‡	*18.00‡*
Seattle, *paper sacks* .	24.00	.....	2 80†	.....
Los Angeles.......	.....	18 50	....	2.00†
Baltimore.........	24.25	17.85	2 55	.....
Montreal..........	. ..	21.00	. ..	9.50‡
Atlanta...........	*23.00*	*14.00*	*2 25†*	*1.50†*
New Orleans.......	...	...	2.40†	1.85†
Philadelphia......	23.00	16.00	1 93*	1 24†
Kansas City.......	.....	18 50	2.59*	2.45*
Birmingham........	14 50	13.75	2 00†	1.80†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.80, Sheboygan $1.70. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Dec 6	One Year Ago
Minneapolis (Rosendale)..........	$2.80	$2.80
Kansas City (Ft. Scott)..........	1.50	1.50
Cincinnati (Utica)...............	1.72	1.72
Boston (Rosendale)...............	2 80	....
St. Louis (Carney)...............	*2 25*	1.75
Birmingham (Magnolia) pozzolan cement.....	2.10	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Dec. 6	One Month Ago	One Year Ago
New York, del. by truck.....	$*2.55@2.65*	$2.70@2.80	$2.60
New York, alongside dock to dealers..............	*2 15*	2.30	2 30
Jersey City...........	*2 33*	2.48	2 48
Boston................	**2 92**	2.90	2 85
Chicago...............	*2.10*	2.20	2.20
Pittsburgh............	*2 19*	2.24	2.24
Cleveland.............	*2.41*	2.46	2.46
Detroit...............	*2 37*	2.48	2.47
Indianapolis..........	*2 31*	2.41	2.41
Toledo................	2 48	2.48	2.48
Milwaukee.............	*2 25*	2.37	2.37
Duluth................	*2.19*	2.25	2.14
Peoria................	*2 27*	2.41	2.39
Cedar Rapids..........	*2 38*	2.48	2.45
Davenport.............	*2 33*	2.43	2.43
St. Louis.............	*2 35*	2 45	2 35
San Francisco.........	2 61	2.61	2.71
New Orleans...........	*2.80*	2.90	3.30
Minneapolis...........	*2 42*	2.50	2.39
Denver................	2 84	2.84	2.85
Seattle...............	2 90	2.90	2.90
Dallas................	2 05	2.05	2.25
Atlanta...............	*2 35*	2.60	2.54
Cincinnati............	*2.41*	2.54	2.51
Los Angeles...........	3 16	3 16	..
Baltimore.............	*2 61*	2 65	2.90
Birmingham............	2 80	2.80	2.40
Kansas City...........	2.27	.	2.45
Montreal..............	2 25	2 25	2.88
Philadelphia..........	*2.81*	2.96	2.51
St Paul...............	*2 42*	2 50	2.39

NOTE—Bags 10c. each, 40c. per bbl.; 20c. each in Canada, 80c. per bbl.

Current mill-prices per barrel in carload lots, without bags, to contractors:

Buffington, Ind	*$1 85*	Hudson, N. Y.	*$2.05*
Universal, Pa	*1 95*	Leeds, Ala..	*1.95*
Steelton, Minn	*2 00*	Hannibal, Mo..............	*1.95*
Fordwick, Va	*2 05*	Lehigh Valley District........	*1.95*
Mitchell, Ind	*1 95*	Wyandotte, Mich....	*2.10*
Iola, Kan.... ..	*1.95*	Alpena, Mich	*2.00*
Mason City, Ia	*2 00*	Richard City, Tenn	*2 05*
La Salle, Ill ..	*1.95*	Kingsport, Tenn............	*2.05*

TRIANGLE MESH—Price per 100 sq.ft in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh Mill	Chicago Mill	Warehouse: New York	St Louis	Dallas	San Francisco
032	22	$0 95	$1 02	$1 24	$1.04	$1 12	$1 21
049	28	1 20	1 30	1 58	1.32	1 38	1 52
068	35	1 47	1 59	1 94	1.62	1 67	1 87
093	45	1 89	2 04	2 50	2 08	2 00	2 42
126	57	2 34	2 53	3 09	2 59	2 55	2 99
153	68	2 79	3 02	3 60	3 08	3 15	..
180	78	3 20	3 47	5 22	3.64	3 47	...
245	103	4 22	4 57	4 60	4 66	4 58	....
287	119	4 88	5 28	6 44	5 39	5 26	6 00
336	138	5 66	6.13	7 39	6 25	6 11	. .
395	160	6 56	7 10	8 67	7.25	7.12	....
PAVING							
036P	17	$0 72	$0 78	$0 95	$0 79	$0.76	
053P	24	1 02	1 10	1 35	1 12	1 07	. .
072P	31	1 29	1 40	1 71	1 42	1 39	. .
097P	40	1 66	1 80	2 20	1.83	1 90	. .
049R	24		1 10		1.12	1 07	.
067R	31		1 40		1 42	1 39	.
089R	40		1 80		1.83	1 90	

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft lengths Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27Dia.	2 3	$22 00	$21 25	$20 72	$20 00	$25 50
26 "	2 5	22 00	22 50	22 39	19 11	27 58
25 "	3.0	22 00	25 25	24 93		30 71
24 "	3 4	24 00	27 25	27 10	24 09	33 16
22 "	4 33	27 00	31 75	32 27		35 10

*Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
[illegible] and larger..	$2 40	$2 70	$3 54	$3 20	$3 35	$3 38	$3 65
[illegible]	2 45	2 80	3 59	3 25	3 50	3 43	3 75
[illegible]	2 50	2 90	3 64	3 30	3 55	3 48	3 85
[illegible]	2 65	2 95	3 69	3 45	3 75	3 63	4 05
[illegible]	2 90	3 00	4 04	3 70	4 35	3 78	4 65

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St Louis	Dallas
[illegible] and larger	$2 30	$3 05	$3 08	[illegible] ..	$2 70	$3 30	$3 30
[illegible] in ...	2 40	3 10	3 13	[illegible]	3 30	3 50	3 48
[illegible]	2 50	3 15	3 18				

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Dec 6	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.). .	$22 55	$22.55–23.65	$18 00@18 55	$46 50	$54 00
New York (at dock) ..	19 00	19@20	15@15 50		
Chicago	11 00	11 00	11 00	34 00	42 00
St. Louis, salmon.	16@18	16@18	15 00	38@40	40@42 50
Denver, salmon ..	12 00	12 00	12 00		
Dallas.......... ..	**11 60**	11 00	9 90	33 00	
San Francisco	**15 50**	15 00	15 50		
Los Angeles ..	11 50	15 50		(not used)	
Boston (del.) ..	22 00	23 00	22 00	48 25	56 00
Minneapolis (del.).	16@18	16@18	18@19		
Kansas City .. .	16 50		14 50	(no market)	
Seattle	15 00	15 00	14 00	55 00	
Cincinnati	18@19	18@19	17 00	**45 00**	**50 00**
Montreal	16 50	16 50	16 00	100.00‡	68 00
Detroit (del.) ..	18 25	18 25	17 00	38 50	41 50
Baltimore (del.) .. .	21 00	21 00	20 00	40 00	45 00
Atlanta	11 00	11 00	11 50	40.00	45 00
New Orleans. . ..	18 75	18 75	15 75		
Birmingham . .	12 50 14 00	12 50@14 00	12 50		
Philadelphia	22 00	22 00	20@28	38 00	46.00
Pittsburgh (del.)	16.00	16 00	16.00		
Cleveland	16 00	16 00	16 00		

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively † f o b ‡Imported

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Dec. 6 on Trucks*	One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J. Factory*
4x12x12.	$0 1179	$0 123	$0 0724	$0 125	$0 089	$0 108	.. ..
6x12x12...	1769	1844	0996	.	.122	156	
8x12x12...	2211	2305	1358	.215	162	244	$0 1968
10x12x12... ..			1695	.	186	.	2442
12x12x12...			1937		232	. .	3175

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston..........	$0 13	$0.24	.. ..
Minneapolis (f.o.b. cars)...	07	.12	$0 20
Minneapolis (delivered).......	075*	13	.21
Cincinnati................	0815	153	....
Kansas City................	0965	12	..
Denver..................	065	123	.188
Seattle (delivered)...........	11	.25	.36
Los Angeles	0931	1686	....
New Orleans................	12	23	..
Detroit (delivered)............	1145	2147	.27
Montreal...................	.115	225	30
Baltimore....................	.125	.27	
Atlanta......................	10	167	.....
Dallas......................	11	20	....
Birmingham......	.11	18	.285
Pittsburgh (delivered) . ..	.068	.128	....
Cleveland... .	.08	.164	.179 ......

San Francisco and New York quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburgh and Birmingham, together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh Mill	Birmingham Mill	Warehouse: New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in .	$2 50	$3 00	$3 64	$4 20	$3 45	$3.30	$3.60
Channels, 3 to 15 in..	2 50	3 00	3 64	4 20	3.45	3 30	3.60
Angles, 3 to 16 in., ¼ in. thick..	2 50	3 00	3 64	4 20	3 45	3.30	3.60
Tees, 3 in. and larger...	2 50	3 00	3 64	4 20	3 45	3.30	3.60
Plates, ¼ in. thick and heavier . .	2 50	3 00	3 64	4.30	3 45	3.30	3.60

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Pittsburgh Mill	Warehouse: New York Dec 6	New York One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
¾ in. and larger	$2.65@2 85	$4 40	$3.85	$3.75	$4 15	$5.00	$4 90
CONE HEAD BOILER							
¾ in. and larger	$2 85@3 00	$4 50	$3 95	$3 85	$4.35	$5 20	$5.00
⅝ and ⅝... . ..	3.00@3 15	4 66	4 11	4 00	4.70@4.95	5 35	5.15
½ and 9/16	3.25@3 40	4.90	4 35	4.25	4.9@5.150	5.60	5.40

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire..	$3.00	$3 80	$4 25	$4 55	$3.34	$4 95
Cut ...	.	4 45	5.25	5.75	3.64	5 00

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco Galv.	San Francisco Black	Seattle Black
[illegible]....	$9.85	$7.65	$8.00
[illegible]....	7.80	6.30	7.75
[illegible]..... ...	7.75	6.15	7.70

Pittsburgh base in lots of 200 kegs or more, $3.50

PREPARED ROOFINGS—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2 31 per roll in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5 75 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l c.l., $5.80 per square.

ROOFING MATERIALS—Prices f.o.b. New York, in less than carload lots:

Tar felt (14 lb. per square of 100 sq.ft.) per ton....	$67.50
Tar pitch (in 400-lb. bbl.), per 100 lb	1.62½
Asphalt roofing (in barrels), per ton, f.o.b. plant*.....	38.75
Asphalt felt (light), per ton, f.o.b. plant*..	75.00
Asphalt felt (heavy), per ton, f.o.b. plant*...	75.00

* Delivered in Metropolitan Dist., $3.00 additional.

WINDOW GLASS—Double strength, box list, united inches, 34, "AA" grade, at discount of 85 per cent from standard lists, f.o.b. New York; "A" grade less 84 per cent and "B" grade, 87 per cent.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10......	$3.00	$4 45	$4.00	$5.00	$4.59
No. 12.	3.10	4 50	4 05	5.05	4.64
No. 14....	3.20	4.55	4 10	5.10	4.69
No. 16.............	3.40	4 65	4.20	5.20	4.79
Black					
*Nos. 18 and 20.	3 60@3 70	5.00	4 70	5 60	4 95
*Nos. 22 and 24	3 65@3.75	5 05	4 70	5 65	5.00
*No. 26.	3 70@3 80	5 10	4 75	5.70	5 05
*No. 28.	3 75@3.85	5.20	4.85	5.80	5.15
Galvanized					
No. 10..	3.80@4 00	5 35	4 85	5.50	5.15
No. 12..	3 95@4 10	5 45	4 95	5 60	5.25
No. 14...	3.95@4 10	5 45	4 95	5 75	5.25
Nos. 17 to 21 ...	4 25@4 40	5 75	5.25	5 90	5.55
Nos. 22 and 24	4.40@4 55	5 90	5 40	6.05	5.70
*Nos. 25 and 26......	4 55@4.70	6 05	5 55	6 20	5.85
*No. 28....	4.85@5.00	6 35	5 85	6 50	6.15

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Dec. 6	One Year Ago	Chicago: Dec. 6	One Year Ago
Raw in barrels (5 bbl. lots)	$0 95	$0 90	$0.94	$0.95

WHITE AND RED LEAD—In 100-lb. kegs, base price in cents per pound:

	Dry		In Oil	
	Dec. 6	1 Yr. Ago	Dec. 6	1 Yr. Ago
Red	14.00	13 25	15 50	14 75
White	14.00	13.25	14.00	13.25

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$40.00	$41.00	$42.00	$45.00
3x6 and 8	40.00	41.00	42.00	45.00
4x4-6 and 8	40.00	41.00	42.00	45.00
3x10 and 12	40.00	41.00	42.00	45.00
3x14	42 00	42.00	44.00	46.00
4x10 and 12	40.00	41.00	42.00	45.00
4x14	42 00	42.00	44.00	46.00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft.
6x10	$42.00	$44.00	$46.00
6x14	47.00	49.00	51.00
8x10	42.00	44.00	46.00
8x14	47.00	49.00	51.00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22-24 Ft.	20 Ft. and Under	22-24 Ft.
3x4 to 8x8	*$42.00*	*$43.00*	*$42.50*	*$44.50*
3x10 to 10x10	*47.00*	*48.00*	*48.50*	*50.50*
3x12 to 12x12	*52.00*	*53.00*	*55.50*	*57.50*
3x14 to 14x14	*57.00*	*58.00*	*61.50*	*68.50*
3x16 to 16x16	*62.00*	*63.00*	*69.50*	*71.50*
3x18 to 18x18	*70.00*	*71.00*	*79.50*	*81.50*
4x20 to 20x20	.....	...	*89.50*	*91.50*

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine costs $3 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under.

Other Cities

	8x8-In. x 20 Ft. and Under				12x12-In. 20 Ft. and Under	
	P.	Fir*	Hemlock	Spruce	P.	Fir*
Boston	*$65.00*	$100.00	*$60.00*	*$58.00*	*$83.00*	$125.00
Seattle	.....	29.50	......	......	.....	29.50
New Orleans	28.00	......	......	......	31.00	......
Baltimore	33.50	53.00	53.00	60.00	38.00	53.00
Cincinnati	40.00	75.00	75.00	90.00	44.00	80.00
Montreal	50.00	......	......	......	.....	65.00
Los Angeles	.....	50.00	......	......	.....	51.00
Denver	....	*40.75*	40 75	40.75	......	*41.75*
Minneapolis	42.00	44.75	41.50	......	44.00	45.75
Atlanta	*33.00*	......	......	......	*37.00*	.. .
Dallas	50.00	......	......	......	54.75	.. .
Kansas City	43.25	......	......	......	53.25	......
Birmingham	30@35	.. ..	......	......	40@45	.... .
Philadelphia	*60.00*	59 00	59 00	77.00	*69.00*	70.00
Detroit	43.75	49.75	......	... ..	56.75	52.25
St. Louis	*42.00*	......	......	......	*54.00*	......

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir*	Hemlock	P.	Fir*
Boston	*$50.00*	$80.00	*$50.00*	*$60.00*	$100.00
Seattle	.....	25.00	.	. .	29.00
New Orleans	72.00	......	. ..	31.00	.
Baltimore	60.00	44.00	44.00	34.00	50.00
Cincinnati	76.00	81.00	76.00	35.00	90.00
Montreal	56.00	50.00	45.00	45.00	45.00
Los Angeles	. .	45.00	.	. .	. . ..
Denver	..	*31.25*	*31.25*		*33.25*
Minneapolis	42.00	39.75	39.50	38 25	36.25
Atlanta	*17.50*	.	.	*27.00*	.
Dallas	50.00	. .	....	53.33	. .
Kansas City	. .	46.00	....	36.00	. .
Birmingham	24@28		.	32@36	
Philadelphia	*31 00*	63.00	*45.00*	*50.00*	65 00
Detroit	49 00	38.00	.	41 50	39.50
St. Louis	*38.00*	.. .	. .	*27.00*	.

Birmingham—Quotes carload lots, f o.b. sidings; $4 00 additional per M ft to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f o.b.

Denver—Quotes dealers price to contractors on large projects.

St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M.ft. additional

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M.ft additional

*Douglas fir.

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in	30 to 50 ft	$0.14	$0 18½
12 in.—2 ft. from butt	6 in.	50 to 59 ft	.19	23½
12 in.—2 ft from butt	6 in.	60 to 69 ft	21	25½
14 in.—2 ft. from butt	6 in.	50 to 69 ft	25	34
14 in.—2 ft from butt	6 in	70 to 79 ft.	27	36½
14 in.—2 ft from butt	5 in.	80 to 89 ft	35	.41

MISCELLANEOUS

STEEL SHEETPILING—The following price is base per 100 lb. f.o.b. Pittsburgh, with a comparison of a month and a year ago:

Dec. 6	One Month Ago	One Year Ago
$2.65	$2.65	$2.50

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	20%
Patent flattened strand, special steel wire rope	20%
Patent flattened strand, iron rope	5%
Plow steel round strand rope	35%
Special steel round strand rope	30%
Cast steel round strand rope	20%
Round strand iron and iron tiller	5%
Galvanized steel rigging and guy rope	7½%
Galvanized iron rigging and guy rope	+12½%

California, Oregon, Nevada and Washington Discount: 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ⅝-in., 8 ft., ¾-in., 6; ⅞-in., 4½; 1-in., 3½; 1½-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston	$0.15½@0.17½	New Orleans	$0.17½
New York	*.17*	Los Angeles	.20
Chicago	.18	Seattle	.18
Minneapolis	*.17½*	St. Louis	.19½
San Francisco	.16	Montreal	.22
Atlanta	.25	Detroit	.20
Denver	*15½@16½*	Baltimore	.18
Cincinnati	.19	Kansas City	.20½
Dallas	.21	Birmingham	.20½
Philadelphia	.17		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.295
Boston	.25	.27
Kansas City	.2225	.2475
Seattle	.165	.19
Chicago	.22	.25
Minneapolis	.1917	.2123
St. Louis	.2225	.2475
Denver	.2025	.2275
Dallas	.225	.302
Los Angeles	.1975	.2225
Atlanta	.23	*.2550*
Baltimore	.22	.23
Cincinnati	.225	.25
Montreal	.195	.235
Birmingham, *delivered*	.16	.17
New Orleans	.195	.22
San Francisco	.1625	.1925
Philadelphia	.215	.24

CHEMICALS—Water and sewage treatment chemicals, spot shipments in carload lots, f. o. b. New York:

Sulphate of aluminum, in bags, per 100 lb.	$1.40@1.50
Sulphate of copper, in bbl., per 100 lb.	5.00
Soda ash, 58%, in bags, per 100 lb.	*1.25@1.45*
Chlorine, liquid, cylinders, 100 lb., per lb.	.08½@.09
Hypochlorite of lime (bleaching powder) in drums, per 100 lb.	*1.75*

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.31	Detroit	$0.29
Birmingham	.58	Kansas City	.735
Boston	.365	New Orleans	.67
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.34†
Cincinnati	.29	Philadelphia	.32
Cleveland	.215	St. Louis	.43
Denver	1.27*	St. Paul	.60

* Minimum carload, 40,000 lb.

† Minimum carload, 50,000 lb., structural steel only; 80,000 lb., for other iron or steel products.

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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Write Your Congressman

NO FISCAL proposal of recent years has caught the attention of the country as has Secretary Mellon's tax reduction plan now before Congress. Backed by the President's strong indorsement this recommendation for a kind of taxing that will relieve the middle class directly, and the great body of the untaxed indirectly but no less surely, has become the leading issue before Congress. The soldiers bonus and the desire to penalize the very rich stand in the way of favorable action but Congressmen, after all, want to do what they think their constituents want. Now is the time for every citizen, whether or not he has ever done such a thing before, to write his Congressman and urge upon him the justice and desirability of the Mellon plan. A vociferous minority can only be overcome by an equally vociferous majority.

Remaking the Railroads

THE preliminary reports of the various committees on transportation of the Chamber of Commerce of the United States are most promising of an informing conference next January. When groups of business men in all lines of activity get together on a problem of such common interest an awakening of thought is bound to result and at the present juncture solid thinking by a number of people is the most necessary preliminary to any discussion of the railroad question. The business men of the country can not remake the Transportation Act but they can activate Congress to a sane consideration of any such remaking as will be proposed.

Transit Benefit Assessments

WHILE everyone knows that raising money for public works is frequently more difficult than building them, the emphasis given to this fact in the report of Detroit's rapid-transit commission is decidedly noteworthy. Details such as planning the system of routes or designing structures are boldly put to one side in the report, and the commission asserts that until the basic question of a financial plan is decided there can be only harm in proposing routes or designs. A very large sum of money will be needed to provide Detroit with rapid transit, while the city's available bond-issue capacity is so small that it would hardly build a mile of line. This constitutes the problem. The commission proposes to solve it by assessing the benefits on the property adjacent to the lines. Benefit assessment would have the double advantage of preventing the piling up of a burden of overhead on the taxpayer, and collecting for the public benefit a share of the unearned increment created by the public improvement. As a solution of the bond-limit difficulty the method has immediate interest to many cities besides Detroit. Probably every city that is thinking of rapid transit has the same problem of needing more money than its financial resources can supply; and to a certain degree this remark might be extended beyond the field of rapid transit. If judicious application can be made of the principle of placing the cost of such works on local benefits, the way will be clear to do much badly-needed municipal work at present held in abeyance by lack of funds. The justice of the method—again, where judiciously applied—is its special recommendation. In a very similar and fully as interesting a case, that of the Moffat tunnel, which is also described in this issue, the test of Supreme Court interpretation has been obtained in favor of the method.

Coal Stock Piles Control the Price

THE striking relation between the reserve in consumers' stock piles and the spot price of coal is emphasized by the Geological Survey's report on the economic phases of coal storage. The report presents two charts, one a curve of the spot price of coal and the other a mass diagram of consumers' stocks. Separately the charts do not show much, but when superimposed it becomes evident immediately that every time stocks have fallen below 30,000,000 tons the price has immediately increased and when they have fallen below 20,000,000 tons the market has been thrown into a state of panic. Production in itself is not the controlling factor, for times of high production have frequently been marked by high prices due to consumers' nervousness over their lack of reserve. The lesson is evident. Consumers collectively can control the market. The individual can profit to the full from a policy of storage by storing more coal than his neighbor. Then, when his neighbor is in distress and is bidding up the price to scarcity levels, he can stay out of the market. If he stores less than his neighbor, he will have to enter the market first and will be there when the price is at its peak. Consumers, either individuals or concerns, should not begin to use their reserves while the price is normal. Instead, they should continue to buy for their current needs until prices become abnormal, when they can fall back on their reserves. Such a policy will give them the full benefit of their reserves, and will, at the same time, insure their not having to enter the market until after the peak has passed.

Minnesota Joins the List

MINNESOTA has gone as far as the law allows in disapproving, through its State Board of Health, plans for the direct-oxidation or lime-electrolytic process of sewage treatment submitted by the city of Austin. In this it comes as nearly as it feels it legally can to following the action of the New Jersey Board of Health which has refused permits for the same process to Phillipsburg and Trenton. Ohio is still delaying action on the Lima plans for the direct-oxidation process. The engineering division of the Provincial Board of Health of Ontario has for months past been running

parallel tests of limed sewage passed (1) through an electrolizer and (2) directly to a sedimentation basin. In Pennsylvania it appears that the Allentown plant has been given a conditional approval but that the state health authorities are waiting for enough sewage to reach the plant to permit a full-capacity test of one of three 1-m.g.d. units completed some two years ago. In view of conditions elsewhere the action of the Minnesota Board of Health is not surprising. The opinion of the Minnesota attorney general, noted elsewhere in this issue, suggests to us the question, should not the authority vested in a state board to approve or reject plans for sewage-works be accompanied by power to exclude from the plans any expensive element of undemonstrated value, even though that element may not be detrimental to the end result of the whole process? Whatever the answer may be when viewing the question in its relation to the police power of the state, sound economics demand protection to the municipal treasury. Assuming that any state board of health lacks the power to prevent the expenditure of money on unproved processes then the least that it should do is to point out clearly what the risk is—as the Minnesota board has done.

A Time for Tribute

TWENTY years ago next Monday man made his first successful flight in a heavier than air machine. It will be worth while for every one that day to pause and give thought to those two persistent Dayton shopmen who first flew their little fluttering plane over the Carolina sand dunes on Dec. 17, 1903. The airplane has by no means revolutionized the world but it has removed just so much further man's limitations and whatever does that, whether it be the alphabet, or the steam engine or radio, makes life just that much more worth living. The Wright brothers did not develop the airplane out of nothingness but they had the true inventor's instinct of persistent experiment with those things their predecessors had already made known and the faith in their own ability to do what no man had done before. Those of us whose horizon—both spiritual and actual—has been enlarged by their genius can do no less than pay them the tribute of a moment's remembrance.

No Progress

A LITTLE less than two years ago it appeared certain beyond doubt that a step forward would be made in the long struggle against bad building. The evil results of bad building had just become manifest in shocking manner. The roof of the Knickerbocker moving-picture theater in Washington had fallen down during a performance, crushing nearly a hundred of the spectators to death; only a few weeks earlier half a dozen men had been killed in the collapse of an uncompleted moving-picture house in New York, to be known as the American. There was evidence of flagrant violation of sound practice in the planning and erection of the buildings. Universal alarm and indignation arose over the tragic failures. But these feelings were tempered by the belief and hope that the inevitable judicial prosecution and due punishment of those involved would have the effect of discouraging the continuance of bad building practices. Events of the past few days, however, seem to have finally disappointed this hope. Prosecution of the owner and contractor in the American case failed, the trial judge vacating the indictments for technical defects. Almost simultaneously the trial of several damage suits against the owners of the Knickerbocker theater by relatives of victims reached an equally disappointing end, with verdicts in favor of the owners. Long before this the criminal prosecution of the parties to the Knickerbocker job was ended, when a judge voided the indictments and the district attorney then refrained from attempting to bring new indictments. In the face of such a record it is not possible to feel satisfied with the operations of legal process. But—to think of the future—it is necessary to realize the hard fact that the sacrifice of a hundred dead has not brought us nearer to sound building, and that the fight of past years must continue if we are to stay the arm of the incompetent, the neglectful, and the fraud.

Increased Motor Vehicle Imposts

WHAT should the car owner pay as his share of the cost of highway improvement? Answers range between a moderate charge sufficient to maintain improved roads and the total cost of road construction and upkeep. The dispute wages endlessly.

Meanwhile the people everywhere, through acts of legislature, are adding to the taxes on the car user. This year one state, Utah, has radically reduced motor vehicle license fees and one, New Hampshire, has revised its license fees slightly downward, but in every other state where there has been any change it has been an increase. This year also 32 states have placed a tax on gasoline or raised the existing tax until now 37 states impose taxes ranging from one cent to four cents a gallon. Gas taxes barely failed of enactment, generally by veto, in half a dozen other states.

Two facts are obvious in all automobile legislation, that which failed and will again come up for consideration and that which was enacted: (1) The public has determined that the car user shall pay largely for road improvements and (2) the public is convinced that heretofore the payment has not been as large as it in justice should be. This brings us again to the original question: What is a fair payment?

Recently A. R. Hirst, state highway engineer of Wisconsin, has undertaken to answer this question with mathematical precision. He has evolved a formula, published in another column, for computing the charge against car owners for highway service. According to this formula the charge at present is about half of the amount it should be. This charge, Mr. Hirst proposes, should be made in the form of license fees and a tax on gasoline consumption which is held to be the best measure of road use by motor vehicles. It is not, however, in the character of the imposts proposed by Mr. Hirst that concern will lie but in their magnitude. He suggests a minimum of five cents and a maximum of ten. He will have his critics and they will not be kind.

Fundamentally, however, the question is not rates but whether the automobile should pay a greater share (about twice as much) than it is now paying of the cost of road service. As Mr. Hirst points out we cannot let thought of what has been hamper our conclusions. Roads are improved today for motor vehicles. Not a thought in design or construction of the modern main road is for other than motor vehicle service. It is the user who must pay. And with 14,000,000 motor vehicles being used the payment has to be large.

Another Industrial Message

FEW messages to Congress have had more intrinsic importance than the one President Coolidge has just delivered. As a program which this Congress will follow it has only the force of the executive desire, which this year is not commanding because of the closeness of the party representation in Congress and the uncertainty of the action of the so-called insurgent group from the Middle West. But as an indication of the political faith ot one of the leading candidates in the coming Presidential election the document becomes practically a party platform, besides being a revelation of the mind of one who for excellent reasons has not thought it fitting since he became a national figure to express an opinion on our national problems.

The message is curiously revelatory of the Coolidge psychology. To a people accustomed to the rather turgid rhetoric of presidential messages, this one at first reading seems deadly dull. There seems to be no emphasis, no high spots or clear call to action. It requires a second reading to get the tone of the message, to realize that it is a model of compression with few waste passages and that the mere mention of a subject is in itself an emphasis of that subject. One sentence—paragraphed by itself, and all there is on a most disputed issue—"But I do not favor the granting of a bonus," is more expressive than pages of argument. Unless the character analysts of the press are all wrong this means that those congressmen who think they were elected on a pledge for a bonus will have occasion to vote twice on that question—before and after the Presidential veto.

Reading the message, then, as the framework of an administration policy and a platform for a candidacy, we note the same insistence on industrial problems which has marked the presidential messages of recent years. The old issues, particularly the currency and the tariff, are hardly noted. In their stead are taxes, the railroads, the farmers, national improvements and coal—and all of these are either directly industrial or have repercussions of the greatest moment in industry. In two of these sections, on taxes and the railroads, the message is strong and commendable. On the others it tends too much toward generalization where a definite stand might have been expected.

The President comes out flat-footed for the Mellon plan of tax-reduction and in so doing hammers home the too frequently forgotten axiom that lowered taxes benefit those who do not pay a direct tax quite as much as those who do. In characteristic short sentences he says: "For seven years the people have borne with uncomplaining courage the tremendous burden of national and local taxation. These must both be reduced. The taxes of the nation must be reduced now as much as prudence will permit, and expenditures must be reduced accordingly. High taxes reach everywhere and burden everybody. They bear most heavily upon the poor. They diminish industry and commerce. They make agriculture unprofitable. They increase the rates on transportation. They are a charge on every necessary of life. Of all services which the Congress can render to the country, I have no hesitation in declaring this one to be paramount. To neglect it, to postpone it, to obstruct it by unsound proposals, is to become unworthy of public confidence and untrue to public trust. The country wants this measure to have the right of way over all others." This is sound doctrine, but it is one that needs the strong hand of the executive to back it up.

Concurrent with the demand for lower taxes runs a reiteration of the Harding policy for an adherence to a federal budget and a plea for a constitutional amendment against tax-exempt bonds. The President will probably be able to carry the budget through against the congressional forces who fight any reduction of their prerogatives but the possibility of the states depriving themselves of tax-exemption seems quite remote.

Much is said in the few paragraphs on the railroads and most of it is good. There is a rather timorous defense of the Labor Board, to be sure, but the plea for a continuation of the Transportation Act is excellent. The onus of the complaints against that act lie in the interpretations of the term "value" by the courts and the Interstate Commerce Commission and not in the "fair return" clause of the act itself. The President well says that "unless the government adheres to a rule of making a rate that will yield a fair return, it must abandon rate-making altogether." A government activation of consolidation, as suggested in the message, offers the best promise of general rate relief, though the recommended general reorganization of the rate structures is imperative as a means to early adjustment of unfair conditions.

The message adds nothing to the solution of the coal or of the immigration problem. Both passages are fair enough statements of the issues but on neither does the President indicate a way out. The same might be said of his comments on the great national improvements, though the adherents of the St. Lawrence waterway and power scheme may find some encouragement in his comments on that project. The real Muscle Shoals issue—that is the legality and fairness of the Ford 100-year amortization offer—he avoids entirely though he does intimate that there should be a much more reliable promise of fertilizer manufacture at Muscle Shoals than Mr. Ford has ever made. On all these questions the expressions do not have that clear promise of future policy that would have been welcome.

On several other questions of interest to engineers the message is short but, remembering the general tone of the document, quite satisfactory. The administration favors highway development and reforestation and a proper departmental reorganization, minus the impossible Army-Navy combine. In reclamation, the necessity for some readjustment of charges is recognized but no encouragement is offered for complete repudiation. The only other two major sections of the message, those on foreign relations and on agriculture, have at least a collateral industrial importance for nothing would contribute a greater measure to industrial stability than a settlement of the difficulties in Europe and an alleviation of the depression in agriculture. In discussing both of these subjects the President takes refuge again in the concise statement of fundamentals which may mean much when interpreted by future action but which lacks something as a guide to what that future action must be.

It is clear that the big national problems, as selected by the President of the United States, are mainly industrial. Let the engineers of the country in reading the message note that fact, and in so noting recall the responsibility they have of educating their less interested fellow citizens as to the fundamentals of industrial needs.

Six-Mile Moffat Tunnel Through the Rocky Mountains

Novel Plan to Finance Railway Tunnel Replacing Open Summit Pass—Small Parallel Pilot Tunnel Assists Construction—Excavation Progress to Dec. 1

An IMPORTANT step both in tunnel work and in the development of railway transportation facilities was taken in the recent award of a contract for constructing the six-mile Moffat Tunnel through the Continental Divide, about fifty miles west of Denver, Colo. In several ways this enterprise is of exceptional interest: (1) The tunnel will be of unusual length; (2) intermediate headings are to be driven from connections with a parallel heading or pilot tunnel; (3) the tunnel is to be built as a public work for improving the railway system of the state; (4) funds are to be provided by an improvement district established by law for this purpose and authorized to issue bonds; (5) the pilot tunnel may be utilized for a water conduit giving the city of Denver a new supply from sources on the west slopes of the range. A plan and profile of the line are shown in Fig. 1.

History of Tunnel Project—A tunnel under James Peak was proposed originally by the late D. M. Moffat, promoter and president of the Denver & Salt Lake R.R. This line was intended to be a specially favorable link, with maximum grades of 2 per cent, in a transcontinental route through Colorado, but also to develop a rich agricultural and mineral district far from existing railroads. Pending the construction of the summit tunnel at about El. 9,200, an open line was built having long grades of 4 per cent and numerous curves of 16 deg., with curvatures forming a heavy proportion of the total length. This line crosses the summit in Corona Pass, at El. 11,660.

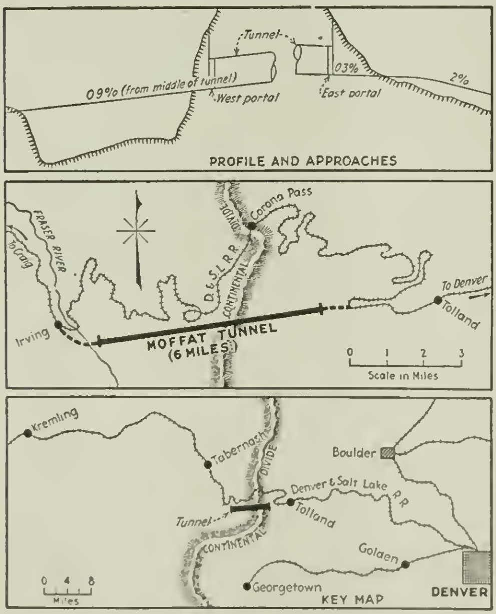


FIG. 1—MAPS AND PROFILE OF MOFFAT TUNNEL LINE

Financial conditions have prevented the building of the tunnel and the completion of the railway to its western connections at Salt Lake City. The present line extends 255 mi. from Denver, El. 5,170, to Craig, Colo., El. 6,175. Its heavy grades, high altitude and snow troubles at the crossing of the Divide are seriously detrimental to operating efficiency and economy. When completed, the Denver & Salt Lake R.R. will give a route of about 565 mi. between Denver and Salt Lake City, as compared with 620 mi. by the Union Pacific R.R. and 745 mi. by the Denver & Rio Grande Western R.R. It has been suggested that in advance of the completion of this new railroad a 40-mile connection from McCoy, on the Denver & Salt Lake R.R., west of the tunnel, to Dotsero on the Denver & Rio Grande Western R.R., would give a combination route of about 600 miles.

In view of the potential importance of a new railroad with a low-grade line across Colorado, both for local development and as a favorable transcontinental route, various attempts have been made to provide public assistance for the tunnel project. In 1913, the city of Denver adopted an amendment to its charter authorizing the issue of bonds and the creation of a commission to build and operate a tunnel. This commission entered into negotiations with the railroad and recommended a bond issue of $3,000,000. The railroad was to pay the remainder of the cost, which was estimated at $4,200,000. The tunnel was to be large enough for a water conduit and was to be available for use by any other railroad on payment of trackage rights and a share of the annual interest on investment. This project was noted in *Engineering News*, Jan. 29 and July 16, 1914, pp. 222 and 156. In February, 1914, the bond issue was carried by a large vote; but in July, 1914, the Colorado Supreme Court decided that the city had no right to issue bonds for this purpose.

The next attempt was to have the tunnel built as a state enterprise to be used by all Colorado railways having transcontinental traffic, since it would provide a route much more favorable than that of any other line across the state. In 1918, the Colorado legislature passed a law providing for a railway commission to study the situation and for a referendum vote on a constitutional amendment to authorize a bond issue for a tunnel. This commission recommended an issue of bonds for $18,550,000 for the Moffat tunnel and for two smaller tunnels on other routes considered to warrant improvement in the interests of the state. It has been suggested that this extension of the original project, with the large sum involved, led to disapproval by public opinion. At any rate, the proposed bond issue was defeated by referendum vote in November, 1920. Particulars of this state-aid project were given in *Engineering News-Record*, April 8, July 1 and Dec. 30, 1920, pp. 716, 44 and 1302.

Plans for municipal and state aid having failed, a new and highly unusual method was then suggested in the way of providing funds by assessments in an "improvement district" benefited by the tunnel. This plan, similar to that of drainage and irrigation districts,

proved successful. Early in 1922 the Colorado legislature passed the Moffat Tunnel Improvement District law, providing for the organization of a district with authority to issue bonds. The law also provided for a tunnel commission and limited the cost of the work to $6,720,000.

This third method, outlined in *Engineering News-Record*, May 18, 1922, pp. 811 and 836, received public approval. Further delay was caused, however, by a dispute as to the constitutionality of the bonds. In a friendly suit to settle this point, the favorable decision of the courts closed the preliminary and promotional stages of the tunnel scheme. Plans were then completed and proposals were invited twice on account of irregular bids in the first case. Finally, in September, 1923, the contract was awarded on terms as noted in *Engineering News-Record*, Sept. 27 and Oct. 11, 1923, pp. 532 and 615.

Description of Tunnel—According to the present plans the Moffat Tunnel will be 32,150 ft. in length, or almost exactly six miles. The east portal is three miles beyond Tolland, on the Denver & Salt Lake R.R., and the west portal one mile from Irving, these two stations being about 50 and 80 mi. respectively from Denver. The tunnel will be on tangent throughout. A grade of 0.3 per cent will ascend from the east portal at El. 9,198 to the summit at mid-length and at El. 9,242; thence on a grade of 0.9 per cent will descend to the west portal at El. 9,085. Maximum grades of 2 per cent are provided on the approaches, which are short and consist largely of fills.

The approximate quantities on which the bids and contract are based are given in the accompanying table:

QUANTITIES FOR MOFFAT TUNNEL

Railroad tunnel:	
Earth	200 cu.yd.
Rock	365,000 cu.yd
Water tunnel, cross-cuts and main headings; rock	157,500 cu.yd.
Open cut:	
Earth	30,000 cu.yd.
Rock	15,000 cu.yd.
Concrete masonry in tunnel	5,000 cu.yd.
Permanent timber lining	1,000 M. ft. b.m.
Timber lining in water tunnel	160 M. ft. b.m.
Dry packing in tunnel	4,800 cu.yd.
Cordwood packing in water tunnel	250 cords
Steel pipe for grouting	200 lin.ft.
Cement	8,000 bbl.
Ballast in tunnel	15,800 cu.yd.

Excavation and Lining—That probably the entire work will be in gneiss rock was stated in a report of the State Geologist of Colorado in 1914. In section the tunnel as now proposed, for a single-track line, will have vertical sides, an arched roof and a flat floor, with a clear height of 24 ft. above subgrade and a clear width of 16 ft. in solid rock and 16½ ft. in timbered portions, as shown by Fig. 2. Complete timber lining includes 2-in. side lagging and 4-in. roof lagging, but in places only roof timbering may be needed, supported by posts or by wall plates. All spaces behind lagging are to be filled with loose rock, which will be grouted if required.

Concrete lining, which is expected to be used only near the portals, will be placed behind the neat line, the lagging being removed for this purpose. This concrete, proportioned 1:7, will be made by mechanical mixers. Pneumatic placing is permitted. If the rock breaks so high as to permit access above the arch after concreting, the arch will be given a definite thickness and the space above it filled with dry stone packing. Otherwise the entire space between the arch form and roof will be filled with concrete. Permanent timber lining will be of Oregon fir or lodgepole pine. This pine

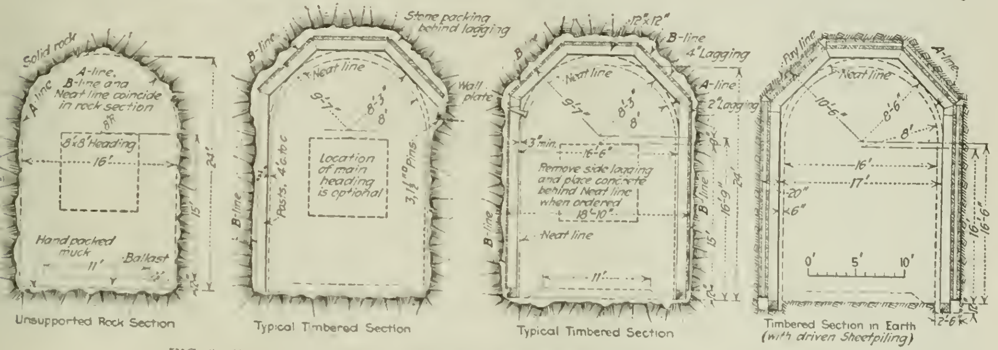


FIG. 2—RAILWAY TUNNEL THROUGH CONTINENTAL DIVIDE IN COLORADO

or other satisfactory timber will be used for the headings and for the pilot tunnel

In the typical sections, Fig. 2, the *A* line is that beyond which no unexcavated material, timbering or support may extend, so that it is the line of minimum thickness of masonry lining or the neat line of excavation where no such lining is used. The *B* line is the limit of excavation to be paid for, and in some cases it is also the payment line for masonry.

Headings 8x8 ft. are planned, as shown, but the location of the heading in relation to the tunnel section is optional with the contractor. The estimated quantities of excavation are 10.83 and 14.95 cu.yd. per lineal foot for lines *A* and *B* respectively in the main tunnel, and 2.37 cu.yd. for the 8x8-ft. headings. It is provided that a planimeter may be used for measuring areas in estimating quantities where the computation of areas by geometric methods would be laborious.

Pilot Tunnel—A special feature of the work is the pilot tunnel or water tunnel, 8x8 ft., driven approximately 75 ft. south of and parallel to the main tunnel, as shown in Figs. 3 and 4. Cross-cuts of the same section will be driven at intervals of about 1,500 ft. and from these the main headings can be driven in both directions. This pilot tunnel will have the same profile and grades as the railway tunnel but will be at an elevation about 7 ft. above that of the latter. The excavation quantity is estimated at 2.4 and 3.3 cu.yd. per lineal foot on lines *A* and *B* respectively. Cordwood packing around the timber sets will be used in the pilot

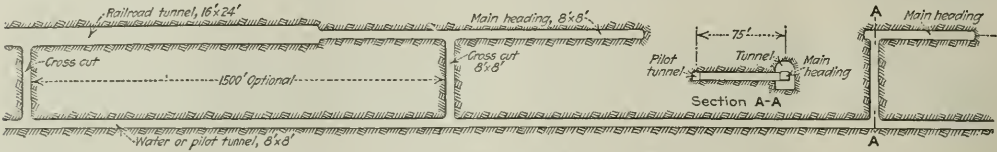


FIG. 3—PILOT TUNNEL INCREASES NUMBER OF MAIN HEADINGS

tunnel and also in the cross-cuts and main headings (see Fig. 4).

The pilot tunnel will serve for ventilation of the main headings and for the handling of materials and muck trains. After the completion of the work it is intended to use this smaller tunnel as a conduit for the supply of water to Denver, but the proposed connection with the Fraser River is not included in the present contract.

Rapid Tunneling—Rapid progress in tunneling is desired and the information given to bidders by the Tunnel Commission contained the paragraph noted below. The specifications also provide that in the purchase of equipment and supplies Colorado products are to be given the preference when quality and prices are equal.

"It is the purpose of the board to build the works in the shortest time consistent with good construction. To this end contractors will be required to use improved methods and appliances for doing the various parts of the work. Complete and well-designed construction plants and effective organization will be insisted upon. Attention is called to the magnitude of the work and to the need for machinery and other equipment of unusually large capacity."

Under the contract, the contractor is to begin work within ten days after a notice to this effect, and within thirty days from such notice he is to have assembled and installed sufficient plant for effective excavation at each portal. The entire work is to be completed within forty-six months from the first notice to begin operations.

Power and Light—The Moffat Tunnel Commission has contracted with the Colorado Power Co. for 1,000

FIG. 4—SECTIONS OF PILOT TUNNEL, CROSS CUTS AND MAIN HEADINGS

hp. of 44,000-volt current, delivered at the east portal. A 30-mi. transmission line will be built, as noted in *Engineering News-Record*, July 12, 1923, p. 77. This contract will be assumed by the tunnel contractor, except as it relates to operation of the completed tunnel. The contractor will provide a telephone system connecting both ends of the tunnel and serving the local offices and the headings. Electric light is to be used, and in portions of the work where men and materials must pass the illumination must be equivalent to one 40-watt lamp for each 50 ft. of tunnel. Adequate special illumination must be provided where tunneling, timbering, concreting and other work is being done. All power machines or tools within the tunnel are to be operated by electricity or compressed air.

Ventilation—Ventilating plants, preferably on the plenum system, are to be of sufficient capacity to deliver at least 24,000 cu.ft. of free air per minute to the several headings. If high-pressure air is used to clear the headings after blasting, it should give at least 1,500 cu.ft. per minute in each heading.

Cleaning and Ballasting—Broken stone ballast of $\frac{3}{4}$-in. to $2\frac{1}{2}$-in. size is to be laid by the contractor to the level of the bottom of the ties. Before this ballast is placed the floor and sides of the tunnel are to be cleared of dirt, loose stone and other material and then washed with a stream of water having a pressure of at least 30 lb.

Sanitary Requirements—Two camps are to be established by the contractor, and the specifications lay stress on enforcement of the sanitary regulations. Since the work is at an elevation of about 9,200 ft., where intense cold and heavy snow prevail during part of the year, pulmonary and other diseases are likely to become epidemic unless great care is taken. Sleeping quarters are to provide for each inmate 400 cu.ft. of air, $2\frac{1}{2}$ sq.ft. of window area and 0.3 sq.ft. of ventilating opening which cannot be closed. The floor level is to be at least a foot above the ground. Houses are to be screened against mosquitoes and flies, and no stable or yard for animals is to be within 150 ft. of a dwelling house. The contractor is to supply blankets and pillows and to keep them clean. Each man is to have a bed or cot, and in single men's quarters not more than two men may occupy one room.

Near each portal and connected to the tunnel by a covered passage is to be a dry room where the tunnel men can change their clothes before and after work. This room is to be kept warm and fitted with shower baths and individual wash-basins. Lunches must be sent to men working so far in the tunnel that they cannot come to the mess room for meals. Hospital facilities are to be provided at each camp, in charge of medical and surgical practitioners, preferably those who have had experience in field and camp sanitation work under army or civilian conditions.

Water supply, drains, sewers and sewage disposal plants are to be provided. Garbage is to be removed promptly and placed in air-tight receptacles. All gar-

bage, refuse, manure, surgical bandages and general dust and rubbish must be disposed of every day by incineration or other approved methods. To facilitate the commencement of work the Tunnel Commission began the construction of sewer and water systems and housing facilities before the award of the contract for the tunnel.

Progress on the Moffat Tunnel—Up to Dec. 1 work had advanced so that the east heading of the 8 x 8-ft. pioneer or water tunnel was 370 ft. underground, in solid granite, while the west heading was 630 ft. in gneiss and pegmatite, which requires timbering. The full installation of compressors, locomotives and other equipment had not been completed at that date.

Engineers and Contractors—All administration and construction work on behalf of the Moffat Tunnel Improvement District is under the Moffat Tunnel Commission, of which W. P. Robinson is president, with offices at Denver, Colo. This commission has appointed a board of consulting engineers composed of D. W. Brunton, L. D. Blauvelt, J. Vipond Davies and J. Waldo Smith. The chief engineer of the commission is R. H. Keays; the resident engineers are V. A. Kauffman, at the west end, and B. G. Coy at the east end; Clifford A. Betts is office engineer. On Sept. 18, 1923, the contract was awarded to Hitchcock & Taylor, of New York and San Francisco. A period of forty-six months is allowed for the completion of the work.

California Court Denies State Can Cancel Road Contract

Highway Commission Cannot Rescind Contract In Order to Divert Funds Elsewhere, Is Supreme Court Decision

BY PAUL F. FRATESSA

Attorney for California Highway Commission

SHORTLY after the present California Highway Commission took office it was deemed good policy to rescind a contract then in effect which had been awarded by the previous commission. The reason for this was that the cost of the work which was being done on the unit-price plan was found greatly to exceed the engineer's estimate and the new commission preferred to stop the work and apply the funds to more urgent work in other parts of the state. The contract in question was held by George Pollock & Co. and covered the construction of a highway along the ocean shore in Monterey County.

The new highway commission accordingly made an agreement with the contractor whereby the contract was to be cancelled and the state was to pay the contractor a stipulated amount, based on the estimated value of the work done on the contract up to that time, and taking into consideration that the contractor had been to the expense of moving in his equipment, constructing camps, etc. The contractor thereupon presented a claim to the State Controller for payment of the amount agreed upon. The controller refused to allow the claim and proceedings were instituted in mandamus to compel its allowance.

In a decision handed down by the Supreme Court of California, Sept. 20, Judge Meyers held that the State Highway Commission has no power to enter into an agreement with a contractor whereby a contract would be cancelled and the contractor paid for his time and trouble. The decision in no wise affected the original contract, and the contractor is now proceeding to complete the work, this being the only apparent way in which he can collect for expenditures he has already made.

No Authority to Rescind Contract—The decision states: "By the execution of an authorized contract the state acquires certain legal rights and incurs certain liabilities which are fixed and ascertained, or ascertainable. Thereafter no one can either increase or diminish the rights of the state or increase or reduce its liabilities thereunder unless he has been vested with authority so to do by express grant or clear implication. The state having directed or authorized the making of the contract contemplates its performance and, as in the case of private individuals, the authority to breach such a contract is not to be implied from the mere grant of authority to execute the same.

"When, as here, the contract has been lawfully executed and has been performed in part, the amount which the contractor is entitled to receive for the work done is fixed by the terms of the contract. For the commission to pay him more than the contract calls for would, therefore, be to make to him a gift of public moneys, unless the commission has the power and authority to first breach the contract."

The court, continuing, recognized the fact that the law has vested in the highway commission a very great latitude of discretion and has given it "full possession and control" over all state highways and all expenditures for highway purposes, but held that the commission was limited in making contracts to follow the formalities specifically laid down by the law. That is, it can only enter into a contract for the doing of work and the expending of money, by advertising for bids or by following some other methods specially provided in the law.

The question as to whether the legislature might have passed an act authorizing the cancellation of this contract and reimbursing the contractor was not presented in this case.

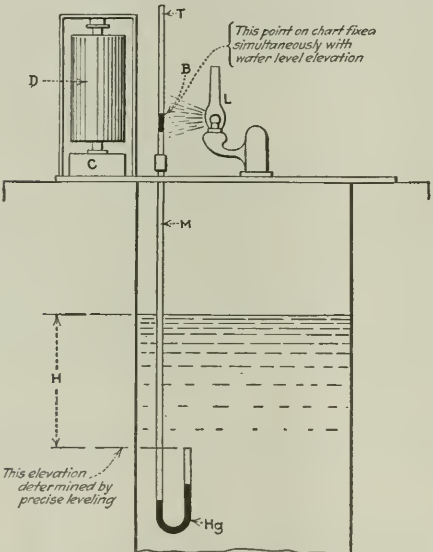
Some Figures on Taxes

The National Industrial Conference Board has issued a comprehensive study of the growth of public expenditures, taxation and tax exemptions of the federal, state and local governments. Some of the significant facts brought out in this careful survey are: Total taxes paid in the United States in 1922 aggregated $7,061,000,000. This amounted to 12.1 per cent or nearly one-eighth of the national income. It meant a cost of $64.63 to every man, woman and child. Each person had to contribute the income of 6¼ weeks to support the government in 1922, as compared with 3¼ weeks before the war. State and local taxes formed 58 per cent of the total taxes. The public payroll included nearly 3,400,000 persons. Every eleven workers, 16 years of age and over, supported one public employee. The cost of salaries of public employees aggregated $3,800,000,000, or $91 for every person ten years of age and over gainfully employed, or $35 for every man, woman and child. Direct and indirect taxes paid by farmers in 1922 were 16.6 per cent of their income. Those paid by the rest of the community were 11.9 per cent of their income. Real and personal property to the value of $54,000,000,000, or about one-fifth of the national wealth, was exempt from taxation in 1921.

Determining Hydraulic Gradient in Chicago Water Tunnels

To DETERMINE accurately the flow of water in the Southwest Lake and Land Tunnel in Chicago and thus learn the maximum that might be removed from it at Seventy-third and State Sts., to supply the new pumping station on Western Ave., a new method of measuring and recording water elevations was devised. By this method the n in Kutter's formula was found to be 0.019 in the 14-ft. section, 0.017 in the 12-ft. section and 0.016 in a 9-ft. section, M. B. Reynolds, acting assistant city engineer, then engineer in charge of pumping station operation, describes in the 1922 annual report to the city engineer the methods used as follows:

In the planning of the work of locating the hydraulic gradient it was at first proposed to use observers at the various shafts along the entire line, but after some study



WATER SURVEY APPARATUS USED TO MEASURE WATER LEVELS IN TUNNELS

and discussion this method was abandoned for the reason that the gages could not be read accurately, because it was usually impossible to place an observer in such a position as to be able to read the water level. Also, the fluctuations in the water level occurred at such short time intervals as to make accurate observations an impossibility.

The second method proposed was the placing of some type of recording gage, such as the standard type of tide gage, or the more recent diaphragm or bell devices that are in use for this purpose, at the various shafts. Experience with recording instruments of the above type proved that they were unreliable, especially where comparatively small differences of elevations must be determined accurately. Their use was therefore abandoned.

Since all available methods or instruments were considered unsuitable for the purpose of determining piezometric heights, an instrument was devised that eliminates all lost motion and will accurately record extremely small differences of elevation. It consists of a manometer M made of ½-in. iron pipe, a glass tube T of convenient length and a Pitometer Co.'s photo recorder, which consists of a lamp L and a drum D driven by a clock C. These recorders are in daily use in connection with water surveys of the division, and were therefore available. The manometers were made approximately 12 ft. long from the bottom of the U to the point of connection with the glass tube.

In use the U bend of the manometer is filled with mercury to about half the height of the short leg; the remainder of both short and long legs is then filled with water. The glass tube is attached and filled with water to a convenient height, depending upon the location of the recorder; and a kerosene bubble B dyed with aniline dye, about 2 in. in length, is placed on the top of the water level in the glass tube.

Due to the irregularities of both glass tube and manometer the instrument is calibrated by placing a long glass tube on the short leg of the manometer and varying the head of water in this glass tube. In this manner an accurate calibration of the movement of the bubble is made.

The instrument is placed in the shaft at such a depth that the short leg of the manometer is always submerged, the glass tube placed in the recorder, a sheet of sensitized paper placed on the drum, and the lamp lighted. From the sketch it can be seen that all variations in the submergence H will be transmitted to the bubble B and an accurate and continuous record of every piezometric height will be recorded.

Four of these instruments were used in making the survey. Precise levels were run from standard benches to the shafts, and accurate elevations of the manometers were determined. Attempts were made to pass correct elevations from the shore to the crib by reciprocal leveling, but due to atmospheric conditions elevations were not considered sufficiently accurate for use. The established elevation of the crib gage was used in locating the manometer elevation of the crib. These four instruments were operated simultaneously, giving the piezometric heights for every instant throughout the 24 hours. During the run tests were made each day to check the accuracy of the indicating bubble by measurement of submergence at each instrument.

The value of Q or flow during each day's run was taken from the station instruments and is probably not more than 2 per cent in error.

The values of n were surprisingly high and some doubt as to their accuracy arose, but subsequent checks proved that the values originally determined were correct.

Half-Year Ocean Passenger Traffic 450,000

The Bureau of Research of the United States Shipping Board in its report on passenger traffic to and from the United States, classified under three heads: overseas, nearby (including Canadian and Caribbean) and non-contiguous United States territory, shows the following: New York leads all American ports in the overseas movement with a total of 208,359 passengers handled in the first six months of 1923. Second for the United States and first on the Pacific Coast comes San Francisco with 19,170, followed by Boston with 11,369 and Seattle with 6,046. The total movement of passengers for the six months in the overseas trade was 249,002, of which 152,436 entered and 96,566 departed. Third-class traffic made up more than one-half of the incoming passenger business, but less than one-third of outbound. Of passenger traffic with the nearby countries, chiefly first-class traffic, there was a total movement of 197,750 first-class passengers, while the entire overseas first-class movement of all coasts was but 56,396. Of the foreign districts the movement between the United States and the United Kingdom amounted to 64,210 passengers. Germany and the Scandinavian nations showed 78,737, while Holland, Belgium, France, and Spain were responsible for 41,770. The Oriental traffic, to China, Japan and the Philippines, totaled 22,679. South American ports handled but 7,939 passengers, of whom 6,265 sailed from or to ports on the east coast of South America and 1,674 from or to ports on the west coast of South America.

What Car Owners Should Pay for Road Building

Formula Proposed for Figuring Vehicle Imposts—Gas Tax Best Measure of Road Use—Five-Cent Tax Generally and Ten-Cent Tax in Some States Proposed

By A. R. Hirst
State Highway Engineer of Wisconsin,
Madison, Wis.

A paper presented before the Annual Meeting of the Michigan Good Roads Association, Lansing, Mich., Nov. 6, 1923.

THE MOTOR vehicle owners of each state should each year pay for their highway service one-half of the total amount made available in that year to pay the cost of the state's highway program, after deducting from said amount the total amount made available to pay the cost of the state's highway program in the year 1904.

The year 1904 is selected as the basing year because quite dependable figures of highway expenditures in all states are available for that year, and because it quite accurately marks the real beginning of the motor era.

Please read the formula again before condemning it and note especially that its terms do not include the expenditures made in any year from the proceeds of bond issues, but only the portion of the cost of bonding paid in that year.

Applying this formula to a hypothetical case: In a certain state there was made available in 1904 to pay the cost of all highway work, $10,000,000. There is to be made available $40,000,000 in 1925. The amount the motor vehicle owners should pay in 1925 is one-half the difference, or $15,000,000.

The formula means that there would be paid by property and from other sources of governmental incomes:

(a) The total cost of highways which they paid at the end of the era of horse-drawn transportation.

(b) One-half of the additional highway cost imposed upon government by the ownership and use of motor vehicles by individuals.

It of course means that the owners of motor vehicles would pay:

(a) One-half of the additional highway cost imposed upon government by his ownership of motor vehicles.

Translated into national figures the formula means that based on total highway expenditures of $200,000,000 in 1914 and of $1,000,000,000 in 1923, the motorist should have paid $400,000,000 in 1923 for use on highways; this does not include the luxury tax and the personal property tax, neither of which is a tax for highways. Compared with the actual payment of $200,000,000, this means that motorists should have paid $200,000,000 more than they did pay in 1923, or approximately $14 more per motor vehicle, on the average.

We expect that many will oppose any proposed application of the formula to specific tax problems. We do not claim that it is perfect. In meeting especial conditions in certain states its arithmetical result would have to be modified by the application of common sense. We do claim, however, that it is of value as a guide to judgment. We do claim that it is the first mathematical formula proposed that recognizes the existence of the fundamental facts which should largely determine the relative part of the cost of highway programs to be paid by motor vehicle owners as such, and by other taxpayers as such.

Let us briefly summarize and comment upon the various common forms of taxation upon motor vehicles.

Motorization and Highways

In 1904 there were in operation in America about 58,000 automobiles. There were practically no motor trucks. In 1914 there were registered 1,711,339 automobiles and motor trucks. In 1919 there were registered 7,530,105 automobiles and motor trucks. In 1923, preliminary figures indicate a total registration of at least 14,000,000 automobiles and motor trucks.

In 1904 the rural highway expenditures of America are reliably computed to have been $59,527,000; in 1914, $240,264,000; in 1919, $389,466,000; and in 1923 they are estimated to be at least $800,000,000. Roughly, the rural highway expenditures per motor vehicle in operation in 1904 were about $1,026; in in 1914, $140; in 1919, $52; and in 1923, $57. The expenditures per motor vehicle in 1923 were 5 per cent of those of 1904; 40 per cent of those of 1914; and 110 per cent of those of 1919.

If we could, through the development of a real system of highways, reduce the operation cost of motor vehicles 1c. per mile (and we can) the annual saving to motorists would be $560,000,000. This capitalized at 4½ per cent would represent an investment of about $12,500,000,000. This could be proved to be a profitable outlay on this one item of saving alone.

We must brush our brains clear of cobwebs, obsessions, prejudices and bunkum, and calmly recognize that when we bought and insist upon operating fourteen million or more motor vehicles, we bought also a highway expenditure of billions of dollars, just as much a part of the cost of these motor vehicles as are themselves, their tires, their engines, and their supplies. They go together, the motor vehicle and the highway on which it must run. All the costs must be paid.

A. R. Hirst.

Valuation Taxes—We believe that there should be a valuation tax upon motor vehicles if there is to be a valuation tax upon any class of property. Of course, if the theory of collecting taxes upon the basis of the valuation of property is wrong, then a valuation tax upon motor vehicles is wrong. Vice versa, if the valuation theory generally held is right, then the collection of a tax based upon the relative valuation of motor vehicles is right.

The more expensive automobiles are owned for the same reason that the more expensive homes are owned: that is, because the owner believes that they repay him for the added investment and the added running expense in style, comfort, economy and convenience, or in the ability of himself and his family to enjoy life. If he really believes these things are true, he should be willing to pay an additional price to own and operate the more expensive house or motor vehicle. It should be recognized, however, that a valuation tax on motor vehicles is not a highway tax but a property tax.

Horsepower Taxes—Many states license motor vehicles upon the basis of horsepower. We can think of no physical attribute of a motor vehicle which bears so little relation to its destructiveness as does its horsepower. Horsepower bears little or no relation to the speed, the weight, the value or the use of a motor vehicle. There are at least thirty-two passenger car models on the American market which have the same or less horsepower than the Ford. These thirty-two models weigh from 1,600 lb. to 3,500 lb. and retail at from $500 to $2,500.

Licensing by Weight—This system somewhat classifies the relative destructiveness of various cars as between themselves, and of motor trucks as between themselves and as distinguished from automobiles. Weight has also some relation to value, but only when the vehicles are new. If there is to be a graduated classification of cars for the purpose of licensing them, their weight is the best factor. We believe there should be such a classification.

"Police Power" Licensing—This is a necessity. The cost of the license plates, licensing and of proper motor vehicle policing should be included in the weight license fee and collected at the same time.

Franchise Taxes, Wheel Taxes, etc.—Some states still permit units of government smaller than the state to make charges upon motor vehicles in addition to taxing them as personal property. We believe that such charges should not be allowed to be made but that the full charge for the use of highways should be imposed and collected by the state. Outside of the debatable federal luxury tax now in effect, we believe that the federal government should not tax motor vehicles.

The amount which the motor vehicle owners should pay for highway service is a thing individual to each state. It should be determined upon by the legislature of the state as a result of the most mature deliberation. Simultaneous increases made by several units of government might, if permitted by law, seriously embarrass the motor vehicle owners and the motor vehicle industry.

The states are the best and should be the only collectors of imposts for highway service made upon motorists. If the division of responsibility for the main highways is such as to make it advisable, there should be distributed to the counties a part of the proceeds. The state and county highway programs in every state should and will consume all that the motorist should fairly pay toward the highway program. The lesser units of government, such as townships, cities, and villages, should be content to see the state and county taxes on property for highways reduced by larger collections from motor vehicles. This will enable them to increase their charges upon property for strictly local purposes, including local highways.

The sum which can fairly be collected from motor vehicle owners has a maximum. If the federal government takes a share and the local municipalities take a share, the state and county share will be so much the less. Necessarily the state and counties must make up the deficit by imposing direct taxes upon property or by taking a larger share of income taxation. This simply complicates the situation without changing the final result as to the total taxes paid by the various classes of property.

Motor Fuel Taxes—The motor fuel tax, commonly known as the gas tax, in our opinion is by far the most scientific impost upon motor vehicles. It meters highway service and the benefits received from the use of highways. It approximates toll gate results without the infirmities of toll gate procedure. The consumption of gasoline varies with the weight, the speed, and the mileage of the motor vehicle. No other factor in the car's domestic economy reflects so closely the benefits received from highway use.

It has been suggested that a tire tax would be just as good as a fuel tax. This might be true if it were not so easy to mail or ship tires, but we fear that if a tire tax were in effect the business of every tire dealer would be with people of other states. This would yield no revenue to anyone. On the other hand, gasoline is bought usually from day to day, is best bought in that way, and can thus be handled more cheaply and more safely than if shipped and stored for individual use.

Objection is made that the worse the road, the more fuel consumed, and the more tax paid. This objection cannot be met by any argument which we can devise except that as highway construction proceeds, the mileage of road that this objection applies to will become less and less. It is the only practical objection ever urged against the fuel tax, and objections equally valid can be urged against any tax ever in effect or ever proposed.

States can adjust ad infinitum license fees fixed by the horsepower, weight or valuation of motor vehicles, or by any combination of these factors. They can probably attain some fairness in the relative fees to be paid by the different kinds of cars and trucks. It can be determined that a Ford should pay so much, a Cadillac so much, a five-ton truck so much. The relation thus established between them may be fair. But how about the relation between the Ford which travels 2,000 miles and the Ford which travels 15,000 miles—the Cadillac which travels 5,000 miles and the Cadillac which travels 40,000 miles—the five-ton truck which travels 5,000 miles, and the one which travels 25,000 miles?

If the relative use of railways by various motor vehicles is to be included as a factor in determining the highway tax to be paid by the motorist, then the motor fuel tax must be in effect as one factor in the total imposts. It is the only practical way to collect impost which marks relative highway use and the relative benefits therefrom.

We believe that many states will find it necessary, at least during the coming heavy construction period, to impose fuel taxes of about five cents per gallon. States which have been extremely backward in highway development may have to collect as high as ten cents a gallon. We believe it will be usual to exempt fuel used other than in highway transport from paying the tax. This will cause some abuses, but there are abuses in every tax system. As soon as motor fuel taxes of quite uniform amount are in effect in every state, practically every objection to the gas tax will have been eliminated, and a method of highway taxation and of highway financing will have become universal which is as nearly in accord with the equities in the case as human ingenuity can devise.

How Chicago's Asphalt Pavements Were Examined

Methods Used in Critical Study—Trucks Carrying Cutter "Gun" Replaced Hand Cutting—More Rigorous Inspection Recommended

By Paul E. Green
Consulting Engineer, Chicago

BECAUSE of widespread newspaper accusations of faulty work the finance committee of the city council of Chicago determined in the spring of 1923 to investigate pavements laid in 1922. The writer was employed to do this work and a fund of $40,000 was provided. Nearly 1,000,000 sq.yd. of 1922 asphalt construction was sampled and laboratory tests were made of the samples. The methods employed in the examination had to be developed and present some points of novelty.

The investigation showed that in general the full amount of material specified was furnished and that there was too great a variation in workmanship and probably some carelessness both in workmanship and inspection. A variation of 33 to 50 per cent was not uncommon in the thickness of the surface and in some cases the variation was 100 per cent. Where such variation was found it was noticed that the surface was not smoothly and evenly rolled. Much of this variation in the top was due to an excess or deficiency in the thickness of the foundation, though it was rare that the thickness of the pavement, both base and wearing surface, collectively and individually was not close to the specification requirements.

The first equipment furnished by the city for the work consisted of a gang of four laborers and a foreman, with hand cutting tools, a team, driver and portable asphalt repair wagon. Samples 12 in. square were taken for approximately each 2,000 sq.yd. of pavement, and for each three samples of surface a test hole was made through the foundation. Observations were made as to the surface of the pavement, the curb, the grading, the drainage and all other items which enter into the construction of this type of engineering work. All measurements as to thickness were made with calipers.

It was soon demonstrated that the taking of complete samples by hand was a very slow process and uneconomical. Nor could the necessary repairs (which were made immediately after the sample was taken) be made to advantage. Too much lost time resulted and not rapid enough progress was made. About the best that could be done per day was fifteen cuts, of which five included the concrete foundation. The average was less. In addition, as the work was started in early spring, the asphalt top was so hard, frequently containing frost, that the cuts chipped badly and in order to get a good sample it was necessary to make a large opening. This meant more material for repairs, more labor in handling the samples to the laboratory and exhausted laborers. Since the cuts were so large, the repair could only be called a temporary one and would later in the season have to be replaced by a permanent patch as part of the regular maintenance program. As all such work was presumably to be charged against the fund provided for the examination it soon became evident that a more efficient method was essential.

Use Cutter "Guns"—The bureau of streets as a part of its regular equipment has several trucks equipped with compressors which operate automatic cutter "guns." Each truck has four guns which work like a riveter. One of these trucks was secured. This outfit immediately expedited the work about 50 per cent and in addition enabled the gang to secure small uniform samples. The principal trouble then was that the repair part of the gang (equipped with a horse-drawn repair tank) could not keep up. Much time was lost in transporting the material for the mix, and in moving from day to day the "camp" or tool box of the gang. It should be kept in mind that the examination included many contracts scattered widely over 200 square miles of territory and that under the best of circumstances much time was lost in moving from job to job. Up to this point all repairs had been made by hand mixing of "black base," or in effect binder, for the foundation cuts, and a crude top mixture for the surface.

Three permanent asphalt plants of large capacity, owned by the city, are located at strategic points to cover the entire city. Only two were operating at the time of the examination. In a territory of this area (200 square miles) with approximately 3,000 miles of paved streets, the location of the plants meant that the haul from the plants to the point of examination might be 10 or 12 miles, an impossible distance with horse-drawn apparatus, but perfectly practicable for a truck. In order then to expedite the tests, it was determined to try the experiment of loading a regular asphalt construction truck with hot top mixture at the plant about 9 a.m., keep it well covered, and hope it would stay hot until the last repair was made about 3:30 p.m. The labor gang, reduced to two men to operate the cutter, would start at 8 a.m. on the street, proceed steadily ahead and the other two men with the asphalt truck would follow, starting about 1½ hours later and catching up by the end of the day. This scheme worked well. The number of cuts made increased to an average of twenty-two instead of twelve per day. The repairs were made in permanent shape and the hard manual labor reduced materially. The "hot stuff" stayed hot, the only difficulty being that on account of the small amount actually used in making the repairs there was considerable excess to dispose of each day and this was not always an easy matter. That part of the problem was solved by putting the mixture in a barrel at the plant instead of taking a load, thus reducing the quantity, but keeping it at a better temperature and eliminating waste.

Base Sampling—Cutting the foundation so as to obtain a laboratory sample suitable for crushing presented many difficulties. It had been determined that the best method of investigation would be to secure small cubes of the concrete, crush them, and from new aggregate to prepare a similar laboratory specimen for crushing after 28 days. This prepared sample would furnish a measure for the field sample, and while it was not the thought to compare field and laboratory samples directly, it was considered that properly plotted curves could be made which would show very clearly the variation in the character of the work. A quantitative analysis to recover the cement was not deemed practical.

Cutting was done with an automatic bull-point drill. It was felt that a large 4-in. core drill would best do the cutting but none could be secured in time for the work. This part of the investigation therefore was not complete and observations could only be secured along general lines.

Much new information was obtained. One of the most important facts observed was that the subgrade was nearly always damp though all the streets were sewered. The foundation was often damp right through to the binder, indicating porous concrete and probably lack of careful mixing. Such a condition of moisture may account for some failures of the wearing surface.

Conclusions—The conclusions reached for Chicago conditions were as follows:

1. Extensive studies should be made of subgrade moisture of our city pavements, even when apparently adequately sewered.

2. The fine grading of the subgrade should be done to a templet to get the best results.

3. The same provision should apply to the concrete foundation.

4. The top surface would be much more uniform and smooth if the recommendations under 2 and 3 were carefully observed, and thus tractive effort reduced and the life of the surface increased.

5. Extreme care must be taken to seal the surface at the gutter, and at manhole openings to prevent the ingress of water. The junction of the concrete gutter used in Chicago, with the asphalt surface should be redesigned to make a more positive seal.

6. A city having a large yardage of asphalt should be provided with a core-drill testing machine and no work accepted until it had been tested by such a machine. The samples should be kept as part of the record.

7. The quality of the work would be improved if samples of the foundation for crushing tests were made at the time of construction. These samples should then be compared with core-drill samples taken under 6.

8. There is danger in large cities of the work and specifications becoming too standardized and inspection too routine. The inspector on the job must be carefully trained and kept "on his toes." At least two daily visits from a supervisor are necessary. Inspectors should be placed with the grading gang and the sewer connection gang and that division of the improvement scrutinized with the greatest care.

Through the Reclamation Country

By F. E. Schmitt
Associate Editor, *Engineering News-Record*

THIS is the eleventh of the series of letters written by Mr. Schmitt during a journey recently made through the West in which he visited irrigation projects, studied developments, and interviewed builders, operators and settlers, in order to present to our readers the actualities of reclamation as revealed to an unprejudiced investigator.

The series of letters began in the issue of October 4.

La Junta, Colo.

A CHEERFUL pessimist remarked a few weeks ago that irrigation finance is a skin game, which in past years cleaned out one or more crops of trustful investors, and since then has been waiting for a new crop to grow up. He also intimated that this new crop seems to be about ripe. Right or wrong, his remark ties up curiously with a number of conditions and developments in the arid West, all bearing on the future of irrigation, private as well as federal.

Future Private Irrigation—The era of public land reclamation as contemplated in the 1902 act of Congress seems to be about over; irrigable public land in bulk is gone. The amount of fertile land in the West far exceeds the available water, but virtually all remaining land is privately owned. This seems to mean private irrigation enterprise, or else a new reclamation policy. The future work will be at a disadvantage, however. While less than half the available water has been used, the rest will be very costly to impound and spread over the land. All the reasonably favorable irrigation projects have been exploited. Land promoters have combed them over, and the federal people have done the same, in some cases even more anxiously, since the law obligated them to find a project in every western state whether or no. In consequence we are now right up against high-cost projects, developments whose per-acre cost goes far beyond even those costs of existing projects which have been declared by the farmers to be impossible of payment.

At present, we are told, those reclamation projects which cost more than a certain sum per acre (say $75; people differ on the figure) cannot in general pay a higher construction installment than 4 per cent; the farmers balk at the 6 per cent installment which under the twenty-year repayment law must be made in all years after the sixth. Since the farmers do not have to pay interest to the government, it follows that private enterprise could never get even its interest. Yet there is a considerable activity in irrigation promotion in the West just now.

The investing public is hard-boiled, of course. It needs to be convinced that irrigation securities are good. Having been taken in on irrigation bonds in past decades, and more recently in other doubtful investments, it now desires to be shown. Means have therefore been provided to show it.

State Endorsement—Most or all of the western states have passed laws providing for state approval of irrigation plans. When a project is approved it is "certified" by the state. This is supposed to reassure the investor. It may reassure him, but whether it gives any real assurance that his money is soundly invested is open to question.

More than thirty years of irrigation enterprise have shown by the loss of many millions of investment that a good design for an irrigation system will not automatically pay interest. Neither will well-built works. Settlers must come and use the works; they must be good farmers and must build up a profitable farming business; and they must keep this business in permanently sound shape, fighting off seepage, blight, and grasshoppers. Unless such a successful farming community is built up, the mere irrigation works are dead property, even if the state built them. It may take many years to build up such a community, and the project meanwhile may fail; yet, blandly disregarding this risk, the states now attempt to say, in effect, that the investor may safely put in his money, on the strength of state examination of the mere plan.

Some states have made the reassurance stronger. Oregon has recently passed a law which permits the state to guarantee the interest on irrigation district bonds for part or all of the first five years, and under this law the state now pays such interest. To the intending investor it will surely seem good to buy bonds whose interest is guaranteed by the state. However, after the first five years he will have to look out for himself. An Oregon land banker expressed decided doubt whether all the new districts would be on a profitable footing after five years—in other words, whether their bonds would be good after that time. Meanwhile the bond broker has further jeopardized the success of the project by pocketing 15 per cent of the bond proceeds. *Caveat emptor!*

Still another step has been taken by Oregon's northern neighbor. Washington has a new law which sets aside a certain amount of money each year for state purchase of the bonds of irrigation districts. This makes the securities still more attractive: they are so good that even the state invests its money in them! But just how such state investment will make the successful agricultural development of a project more certain is not obvious.

Another curious side to the matter of private irrigation development enters the case. Land may be made less valuable by the construction of irrigation works than it was previously, at least as concerns loan values, which in some way are a measure of actual values. This sounds paradoxical, but it is the statement of a land banker, and is explained in this way: Suppose a piece of unirrigated land suitable for at least some use is worth $20 an acre, and on the 50 per cent basis has a loan value of $10 an acre. If irrigation works are constructed at a cost of $80 an acre, which cost is a lien on the land, then the equity or loan margin is still $20 per acre, and again on the 50 per cent rule a loan of $10 might be made. But this loan would be quite unlikely to be made, as the banker would consider the $80 lien so heavy an incumbrance as to make it unsound practice to risk a further loan, the more so as this would be a secondary loan. In other words, the man who could get a $10 loan on the unirrigated land could not get any loan on the irrigated land. The irrigation improvement thus has resulted in a temporary reduction of value, a loss which is restored only when the land is in successful agricultural production. The condition noted, of course, tends to increase the already serious financial problem of irrigation.

State Irrigation—But, to take a more optimistic view, there is a strong hopeful element in the situation. If the state certification and guarantee laws mean anything, they mean that the western states have begun to recognize the fact that there is a state responsibility in irrigation development. For the present this recognition is painfully weak, but in time it may grow to the point where the state realizes that the whole irrigation problem is its own problem, and proceeds to undertake settlement and agricultural development and the financing of the new settler through his starting-up period.

Up to the present we have continued to think of irrigation development as a proper field for private enterprise, just like starting up hat factories or iron foundries. Some of the wisest people in the West seriously doubt whether it is a private function at all. A senator of broad outlook made the penetrating comment on the whole subject of irrigation, "There is no room for a middleman between the farmer and the water." In other words, as hundreds of cases have shown, a corporation that undertakes to supply irrigation water to the farmer and make a profit out of the transaction is very likely to meet disappointment, incidentally getting the farmer into trouble also, in many cases.

Irrigation districts are thriving by virtue of this truth. They represent direct water service, without profit, and they also are a device for bringing the problems of the water user and of the water distributor into direct co-ordination. However, development of vacant land can not well be done by the district method, and this field needs to have some other method devised. Just at present it seems as though the state must supply that method. This statement, however doubtful it might otherwise be, has the solid backing of the success made by California in its development work at the Durham and Delhi settlements. The state showed there that the problem of settling up an irrigated tract with capable settlers, and giving them so effective a financial start that the early operating loss is reduced to very small proportions, can be handled by the state in a way that neither private enterprise nor federal organization could match.

More Reclamation?—There are those who say that federal reclamation ought to be continued as actively as during the past twenty years, and there are those who say that agriculture is heavily over-developed. The latter seem to be in the majority. One authority states that California's irrigated land is 40 per cent vacant, and these conditions are not peculiar to California. Low prices for agricultural products tell of over-production, a supply exceeding the consumption, so that under present conditions, where an elastic market is lacking, the farmer loses in the bad years because he has nothing to sell and in the good years because he must sell below cost. Such conditions do not represent a natural demand for development of more farms at high cost. Above all, they do not afford a very good argument in favor of the wholesale development of farming regions ranging from 100,000 to 1,000,000 or more acres, such as various promoters have been proposing.

Very likely, federal reclamation in its beginning was the answer to an urgent need for making western arid lands fruitful on a basis of sound planning and a square deal. Today there does not appear to be so urgent a need for the nation's intervening in these problems of local development. However, precisely this is the central point of the reclamation policy that Congress is bound to lay down for the future.

Justifiable Cost—If Congress will have to say under what conditions there is an economic justification for the nation to reclaim more western land, it is also partly up to Congress to say how the justifiable cost of irrigation development is to be fixed. At the moment the situation seems to be deadlocked. Reclamation has been carried on with increasing cost of development to the point where the reclamation farmer says he can't pay even the interest on the cost. In fact, this claim is made even on projects where the costs are well below the maximum. How, then, can still more costly reclamation projects be warranted? This question finds no answer. Or, rather, there are three answers, which do not agree at all.

One answer is that by proper methods the conditions can be made favorable for high production, and the operating loss of the early years avoided, just as at Delhi the state of California makes the farmers' business pay even though the land and water alone, without farm development, cost over $200 an acre. Of course, this implies much control, to get good farmers, well developed farms, and efficient farming systems. Men who do not favor such control but prefer the normal go-as-you-please type of development, have a different answer: that the demand for farm products is bound to increase steadily, until in a few years the demand will exceed the supply and agricultural incomes will rise to the point where they can pay even the largest development costs yet contemplated. The third answer is that it does not matter whether the land can pay for the irrigation works; making arid land fit for settling and home development is so inestimable a public benefit that the nation (I have never heard the argument applied to the state) can afford to invest almost any sum in irrigation, even without hope of return.

Whether the national-benefit plea has any force or not, certainly so far as private irrigation development and local development are concerned the question of justifiable cost of development must be answered in convincing figures. The land promoter or the district cannot afford to go ahead without at least a fair chance of getting the money back out of the soil. Perhaps the land promoter does not care so much whether the soil will pay, so long as he can make the prospects look rosy enough to intending buyers so that all his land will sell. But a district, or a state which morally or financially underwrites irrigation securities, must figure more carefully.

So far as the facts give a clue to the answer, they are that much promotion of irrigation development is now in progress which bases on unit costs of $100 and more, though no such developments have yet gone through the financial test; and, on the other hand, that the federal reclamation projects, with lower costs, are claimed to be incapable of paying out. Probably the West will have to take the lead in reconciling these conflicting facts. Congress cannot be expected to do so by decree. But it seems clear that Congress will have to lay down some guiding principle by which any further federal reclamation that may be undertaken can be selected and planned consistently. If this principle is clearly enough stated, it ought to be of great

help in making the basis of private irrigation investment more sound than it seems to be at present.

Many Irrigation schemes—Just why the West should be full of new irrigation schemes under present conditions, when agriculture is not on a paying basis, is not clear. Possibly the general boom spirit of the West, its desire to develop, is the motive impulse. The fact is there are very many schemes for new irrigation, and most of them seem to revolve around the expectation of getting money from the federal government. This makes them of direct interest to all parts of the country at the present juncture.

Some of the schemes concern new developments of ambitious character. Most notable of these, of course, is the Columbia Basin project in Washington, where it is proposed to irrigate 1$\frac{3}{4}$ million acres at $200 an acre (the figure is somewhat in dispute). Nearly as ambitious is a Utah scheme which aims at development of the full possibilities of the Great Salt Lake basin. And there are plenty of others.

Invariably the federal pocketbook is expected to furnish the funds. It is not easy to tell whether this is because the state cannot raise the money, or because the state is unwilling to risk its money and take the chance of loss. If the undertakings can be shown to be profitable, the state ought not be financially timid; and if they cannot be shown to be profitable, is the investment any more attractive for the nation than for the state?

Besides these new schemes, there are many existing irrigation projects that have gotten into difficulties and want government help—"lame-duck projects." A few of these have already been forced on the Reclamation Service and others seem to be going the same way. As a result, there is a chance that reclamation will not be able to make as good a financial showing five years from now as at present. And there are still other cases, such as getting the government to build irrigation works for a Nebraska district that already has plenty of water. In short, the desire to get federal money to put into western irrigation continues to be as strong as it ever was; if anything, it is getting stronger. And as matters stand there seems to be no established principle, whether in the reclamation law or in the western mind, as to how and when an irrigation investment by the government is worth while. Some people seem to think that any federal money that can be obtained for any irrigation scheme is good money.

It would obviously be of the greatest help under these circumstances to have a sound workable basic principle laid down by Congress to guide future reclamation investment—for example, the principle that every project undertaken must be able to pay its keep.

But even before such a principle is established the question ought to be considered to what extent land irrigation is a federal function. The complicating factors of interstate and international water rights affect some cases but not all. Conditions that twenty years ago made the western states unable to do reclamation work of their own are probably no longer present. Reclamation as it exists today seems to be a kind of business, like running railroads or ship lines. It seems to be accepted doctrine that the federal government ought to keep out of business as far as possible. Ought it keep out of reclamation?

Water-Curtain Fire Protection of Union Central Building

A WATER-CURTAIN system for protection against outside fires has been installed on the tall office building of the Union Central Life Insurance Co., Cincinnati. It represents a direct result of the disastrous Burlington Bldg. fire in Chicago, March 15, 1922, when a modern sixteen-story office building of so-called fireproof construction was completely gutted by fire entering from burning buildings on the other side of the street. Pumping tests made of the Union Central Bldg. installation during a two-hour period on Nov. 18 showed it to act very effectively in covering the exposed sides of the building with a flowing sheet of water protecting it further by a curtain of finely divided falling water or mist. A picture taken of the water curtain in operation on the south and east sides of the building is reproduced as Fig. 1 herewith.

Two sides of the Union Central Bldg. front on streets. The west side directly adjoins a seven-story building, while the south side is separated from adjoining buildings by an alleyway (Baker St.). Protection was considered necessary primarily on the west and south sides, but the two rows of windows next the north and east sides were also protected. The installation comprises an open sprinkler or nozzle in the middle of the head of each window, facing down and inward toward the window; the sprinkler openings in the upper part of the height are $\frac{3}{8}$ in., those in the middle part, $\frac{5}{16}$ in., and the lower ones, $\frac{1}{4}$ in. Occasional windows or tiers of windows are omitted. As indicated on the diagrammatic perspective, Fig. 2 herewith, the system extends from the 17th floor to the 3d on the south side of the building, and to the 9th (roof level of adjoining building) on the west side. The two

FIG. 1—WATER-CURTAIN IN OPERATION

South side of building (left) fully equipped; east side of building (right) equipped on southerly two rows of windows.

adjoining rows of windows on the east and north sides are protected from the 17th floor down. The total number of sprinklers is 291, there being 148 on the west side, 93 on the south side, 30 on the east side, and 20 on the north side.

Normally the system is dry. Water enters the

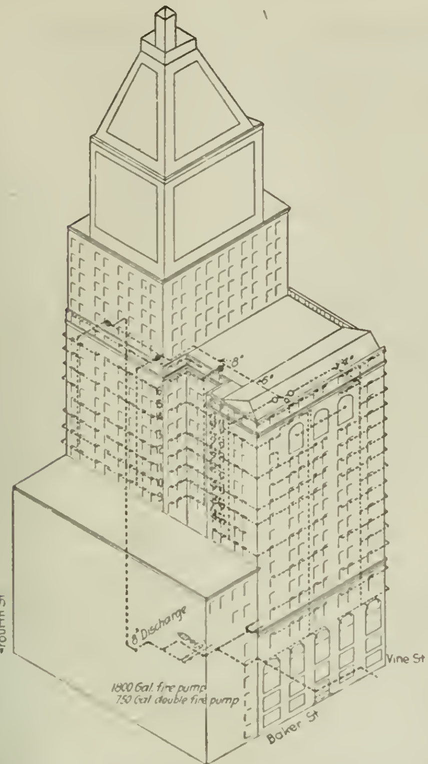


FIG. 2—WATER-CURTAIN EQUIPMENT ON WEST AND SOUTH SIDES OF UNION CENTRAL BUILDING, CINCINNATI

No protection was considered necessary on the north side of the building, which faces Fourth St., and the east side, facing Vine St., except on the two rows of windows adjoining the exposed west and south sides. The south side of the building (right front in diagram) faces a narrow street or alley and is fully protected by water-curtain.

sprinkler pipe system only when the sprinkler pumps in the basement of the building are started. These are a steam pump capable of providing 750 gal. per minute and an electric pump of 1,800 gal. capacity, both working against 150-lb. pressure. The steam pump is the fire pump of the building, and the sprinkler connection is additional to the building standpipe connection. The electric pump serves the sprinkler system alone, and being located 12 ft. above boiler-room level it can be kept in operation even when the boiler room is flooded; however, this electric pump also has a suction connection for draining the boiler room when water enters the latter. Besides the pump supply, the sprinkler system can be supplied by fire department pumpers from two 6-in. steamer connections outside, equipped for eight 2½-in. hose connections. Street connections as well as pumps discharge into an 8-in. riser pipe extending up to the pipe gallery floor (between the 16th and 17th floors), where the water is taken by a header distributing to six 4-in. vertical feed pipes on the outside of the building, supplying the sprinkler branches direct.

The outside piping (5,000 lin.ft.) is extra heavy galvanized wrought iron, with galvanized fittings and hangers; it is held by anchors set into the brick backing of the exterior terra cotta. It weighs 14,000 lb.

In the test the sprinkler system was supplied from the steamer connections. A full supply was obtained at the 17th floor, the highest sprinkler line, 250 ft. above street level.

Separate from the sprinkler system the Union Central Bldg. has three 6-in. risers for fire outlets with a 2½-in. outlet and hose on each floor. These pipes are supplied from a 3,000-gal. tank on the 30th floor (base of tower) and a 5,000-gal. tank on the 18th floor, and also have Siamese street connections. Standpipe and sprinkler systems are independent.

The decision to install this water-curtain equipment was due to the desire of the owners of the Union Central Bldg. to protect themselves against such an occurrence as the Burlington Bldg. fire. The insurance company occupies the 3d, 11th to 17th and part of the 18th floor, the latter housing the company's records. Investigation by Capt. M. W. McIntyre, manager of the building, indicated that wire glass supplemented by a sprinkler system would give the best exposure protection known. Wire glass will stand up until it melts at 1,500 to 1,700 deg. F.; but enough heat would probably be radiated through the glass to ignite combustible material inside the building. This led to the decision to adopt sprinklers for keeping down the temperature of the sides of the building where exposed to a fire and intercepting radiant heat. The installation was planned and carried out by the Grinnell Co., Inc., with check and supervision by the Underwriters' Laboratories. Assistance was given in developing the system by J. A. Hiller, superintendent of water, and B. J. Houston, chief of Fire Department, Cincinnati, and Capt. J. J. Conway, superintendent of the Underwriters' Salvage Corps in that city.

Automobile Accident Deaths Increase

The Department of Commerce has announced that according to the returns of the Bureau of Census there were 11,666 deaths caused by automobiles and other motor vehicles (excluding motorcycles) in the United States in 1922. This represents a death rate of 12.5 per 100,000 population for 1922 as against 11.5 in 1921, 10.4 in 1920, 9.4 in 1919, 9.3 in 1918 and 9.0 in 1917. The following list of cities of a population of 300,000 or over is arranged according to the 1922 rate:

DEATHS BY AUTOMOBILE PER 100,000 POPULATION

Cities	1922	1921	1920	1919	1918	1917
Los Angeles	29.5	27.1	24.1	21.1	16.8	19.8
San Francisco	22.3	18.1	17.2	16.9	15.0	14.9
Chicago	22.0	20.5	17.3	12.3	11.7	12.1
Pittsburgh	20.2	17.8	16.6	16.1	18.1	17.4
Buffalo.	20.1	15.6	20.4	13.5	18.2	17.1
Cincinnati..	18.8	19.6	14.2	16.7	14.8	14.3
Newark	18.8	16.0	18.4	19.9	15.3	15.6
Kansas City, Mo	18.3	19.9	17.1	13.1	20.5	18.4
Detroit	17.7	13.4	17.2	14.4	13.7	18.2
Minneapolis..	17.7	12.5	10.7	10.1	11.9	11.9
Baltimore	17.1	13.3	13.1	14.6	16.7	13.0
St. Louis.	16.9	15.1	13.4	13.7	12.5	9.7
Boston	16.9	13.6	11.8	16.8	14.8	11.5
Cleveland	16.6	17.8	19.2	16.0	22.0	18.6
New York	15.3	15.4	13.6	14.0	12.7	10.2
Washington.	14.6	12.1	11.3	13.4	13.1	12.2
Philadelphia.	14.1	10.2	12.3	10.6	12.8	9.6
Indianapolis..	14.0	12.3	11.3	8.4	8.9	10.5

Of the cities between 300,000 and 100,000 population, Youngstown, Ohio, has the most noteworthy record in having held the record for a high death rate of 30 in 1917 and 31.9 in 1918, and having had a sustained high rate until this year when it dropped to 20.4 per 100,000. Hartford, Conn., and Bridgeport, Conn., and Camden, N. J., have also had a high death rate during these years.

Chamber of Commerce Reports on Transportation

Regulation Through Administrative Agencies—Voluntary Consolidation—Readjustment of Relative Freight Rates—Co-operation Between Rail, Motor and Water Transport

A review of the reports to the Chamber of Commerce of the United States by five special committees appointed to consider various features of the transportation problems of the country. The reports have been issued for consideration in advance of a national transportation conference.—EDITOR.

Public Confidence in Railroad Securities Should be Restored

CONTINUATION of private ownership and operation of railroads in the United States conforms with the American economic system, according to the Committee on Governmental Relations to Railroad Transportation, and the committee thinks that railroad regulation should follow the principle of protecting the public interest and preserving the advantages of competition under fair conditions, while at the same time seeking to give a fair return to capital and fair wages to employees. Both the federal and state governments should consistently follow the principle of regulating the railroads through properly constituted administrative agencies rather than by legislation dealing with specific problems such as rates, practices, and other matters involving railroad operation and management. The committee approves of the recapture clause of the Transportation Act providing for the return of one-half of the surplus above 6 per cent that any railroad may earn upon its capital invested in the transportation service of the country, but it is not convinced that the present requirements which provide for a rate of return of 5¾ per cent upon the value of the railroad property is adequate. It points out that the railroad credit has been so impaired in the last few years that investments in railroads during this period have been mainly in bonds, equipment-trust and other fixed-interest-bearing securities until the proportion of such securities as compared with stocks has become dangerously large. This condition can only be corrected by establishing railroad securities on a basis comparable with like securities in other industries.

The committee points out the importance of restoring public confidence in railroad securities so that they will again be able to sell their stock to raise capital for enlarging and extending their facilities, pointing out that if the method of financing followed in the past decade through the sale of bonds and equipment-trust certificates is continued during the next decade most of the railroads of the country will be in a financial position whereby a sudden period of depression would throw them into bankruptcy. In this connection the committee points out that according to its estimate of the new mileage and capital requirements for the next decade (abstracted in *Engineering News-Record*, Nov. 29, p. 896) the railroads will need to raise $8,000,000,000 new capital, exclusive of the capital required for grade-crossing elimination, automatic train control, and other safety provisions made mandatory by legislation.

As valuation is essential to the successful regulation of railroad rates, the committee recommends that the valuation work being carried on during the past ten years be completed at the earliest practicable date. The committee feels that the arrangement whereby the Interstate Commerce Commission has both the power and the responsibility for rate regulation is a desirable arrangement in that it not only gives the commission power to suspend rates that it deems too high but also to raise rates when they are too low. It does not feel that there should be any change in the labor provisions of the Transportation Act, nor does it feel that there should be any changes in any of the important provisions of the act until it has had a fair trial which, at the present writing, it has not had.

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Graduated Tax on Gross Earnings For Transportation Agencies

RADICAL changes in the method of taxing transportation agencies are recommended by the joint subcommittee of the United States Chamber of Commerce on Taxation of Transportation Agencies. The committee points out that the present method of taxing common carriers by ad valorem taxation is largely an attempt to apply the old general property tax, in use in the early days of this country for the taxation of land and simple personal property, to complex and widely distributed economic units, manifestly in form unfitted for such methods of taxation. As a remedy for this condition, it suggests a graduated tax on gross earnings depending on the relation of net to gross as recommended by the New York State Committee on Taxation and Retrenchment. The committee considers this method of taxation as sound in principle and recommends that it be applied to steam and electric railways and as far as practicable to motor vehicles when used as common carriers. Such a tax has the elements of a sound tax in that it has certainty, reasonableness, and simplicity, while at the same time the state in each case will be assured of at least some revenue from each corporation. The tax as applied to steam and electric railroads should replace the multiplicity of taxes at present levied upon them, including federal taxes on the capital stock and income, and the various state and local taxes, such as franchise taxes (of different form in each state), ad valorem taxes, taxes on gross earnings and on capital stock, annual licenses, special franchises, local real estate and personal property taxes. The committee recognizes that there will be some difficulties in allocating this tax to the various political units, but believes that an equitable method of doing it can be devised. It also recognizes that under the diverse bookkeeping methods employed by the small companies and individuals who comprise the bulk of the highway transport common-carrier operators of today, practical administration of a gross-net tax is impossible. Pending common-carrier regulatory control which will place the earnings of these carriers upon

a comparable basis for taxation, the committee believes that such increase should be made in the taxes now levied against common carrier motor vehicles as will bring the charges to an amount equitably proportionate to those that may be assessed against the other carriers. It recognizes that this recommendation segregates common carrier motor vehicles not only from private cars, which have no gross or net earnings, but also from motor trucks used as private carriers and not subject to public control.

The committee frankly accepts the motor vehicle as an essential addition to the transportation agency required in modern economic life. It follows that improved roads to carry these motor vehicles are equally necessary, but the committee draws attention to the fact that these highways must, of necessity, be free to the general public and built out of general public funds, while in the case of steam and electric railways the investment in roadway is a capital account and returns on this investment are paid out of income. On the other hand, the steam and electric railways have certain franchise rights in the use of their roadway. Since the motor vehicle derives a special benefit from the improved highway, the committee believes that it should bear the entire expense of maintaining these roads in as good condition as when they were built, even where this involves resurfacing or reconstruction of the same type of road. In addition to a maintenance tax, highway transport common carriers should pay a tax in exchange for franchise rights comparable to those owned by the other carriers. By the payment of such maintenance costs the motor vehicle puts itself on an equality with the steam and electric railways which pay for the maintenance of their own roadways through direct charges to operation instead of by taxation. The committee does not, however, believe that motor vehicles should be burdened with a special tax for the maintenance of secondary roads which are not suitable for motor use. Finally, the committee states that it would not be performing its full duty if it did not recommend that all possible influence be brought to bear to eliminate wasteful, extravagant, or unnecessary expenditures from the highway program, which should always be subject to centralized and co-ordinated administration.

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Voluntary Railroad Consolidation is Recommended

THE FIRST step in railroad consolidation would, according to the report of the United States Chamber of Commerce Committee on Railroad Consolidation, appear to require the development of a practical basis whereby the twenty-two systems might merge and absorb their various affiliated leased and operated railroad companies and thereby round out their systems and eliminate hundreds of smaller corporations. This step would need to be carefully safeguarded so as to insure as a final result the proper financing and efficient operation of the large consolidated systems. The purpose of the Transportation Act was to encourage such consolidation, but certain provisions of the act have been interpreted in such a way as to delay such consolidation, while, on the other hand, further provisions enable one carrier to obtain control of other carriers either by lease or purchase of stock and yet specifically provide that such control must not involve merging such carriers into a single system for ownership and operation.

The committee states that the purpose and method of the proposed consolidation of the railroads have been misunderstood by many persons. The mistaken supposition is frequently made that the weak roads are to be saddled upon the strong roads and are to be assisted by the more fortunate members of the railroad family. If this were the aim sought by railroad consolidation, there would be little hope of attaining it, nor would it be a justifiable one. The facts of the case are that the weak and strong roads are to unite upon a common footing—that of actual respective values. This will be done by financial readjustment and recapitalization on the basis of earning capacity. If the factor of net earnings and physical values is taken to determine the values of consolidated railroads, and due consideration is also given to such special circumstances as may obtain in exceptional cases, consolidation can be effected in such a manner as to protect the equitable interests of all the roads and to avoid imposing burdens upon any of them.

As the Transportation Act requires that further consolidations of railroads must be approved by and be in harmony with a complete plan of consolidation to be adopted by the Interstate Commerce Commission, the committee recommends that this plan be completed as early as practicable and every facility to that end should be afforded the commission if Congress adheres to this condition set by the act.

The committee also feels that although some of the advantages to be gained from consolidation have been exaggerated, yet the following advantages will be attained by its operation: (a) Development of a limited number of more uniformly strong and stable railroad systems giving the public better assurance of adequate and efficient service at reasonable rates and fares. (b) Simplified and improved rate regulation made possible through more uniformity in the strength and the traffic characteristics of the several systems in each rate district, and permitting more ready adjustment in accordance with the economic needs of the various sections of the country and classes of traffic affected. This will not, however, adversely affect the existing rate-basing points or the established principles of rate making. (c) Economies in construction, maintenance and operation which, while somewhat exaggerated, will nevertheless be important. (d) Improved car service with wider movement of cars on their own systems, a greatly lessened necessity of car interchange, and the utilization of more direct routes, better grades and shorter hauls. (e) Preservation of competition in rates, subject, as at present, to the limitations imposed by government regulation, and maintenance of competition in service or often the enhancement of competition through rivalry between systems of relatively equal strength.

The committee feels that a full opportunity should be given the carriers to consolidate by voluntary action as compulsory consolidation will involve so many constitutional questions and is such an intricate and involved proposition that it might hinder rather than promote consolidation. It also recommends that the proposed consolidated companies should preferably be chartered by the federal government. It is not, however, necessary to insist upon federal incorporation which might be regarded as undesirable by the states or by par-

ticular carriers that fear to lose certain valuable rights that they possess under their state charters. Indeed, the states themselves might lead the way by enacting liberal and uniform laws removing the difficulties and cost of consolidating the existing railroad companies.

Finally, the committee does not recommend any changes in the consolidation provisions of the Transportation Act at the present time, but it thinks that experience will indicate the need of supplementary legislation in relation to (a) joint ownership of lines, (b) exchange or re-issue of the securities of existing corporations instead of creating new consolidated corporations, (c) authority for dealing with minority stockholders, (d) exemption from taxes on security issues or exchange involved in the consolidations or mergers provided they do not exceed at par the par value of the existing stocks and bonds of the present companies, and (e) the creation of suitable agencies to promote and supervise the working out of consolidation.

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Co-ordination of Highway, Rail and Water Transportation

TWO COMMITTEES dealt with the separate phases of co-operation between the rail, motor and water transport of the country, one dealing with the relation of motor transport and the railroads, and the other dealing with the relation of water transport and the railroads. The report of the committee on motor and rail transport was abstracted in the issue of Nov. 22, 1923, p. 862. Both committees think that if the tran - portation needs of the country are to be adequately met there must be co-operation and not competition between the three principal modes of transportation. In general, they are of the opinion that rail and water transportation can handle bulk freight to best advantage over long hauls and that motor transportation can be used to advantage between rail or water terminals and individual shippers, and for short-haul traffic in areas where there is not sufficient traffic to warrant the operation of a railroad. In effect, the motor transport should be developed as a feeder for the trunk transportation system. The committees also feel that by a proper adjustment of rail and water rates, and by the provision of proper facilities for the interchange of freight, water transportation can be used to advantage for handling bulk commodities over long distances in all parts of the country where navigable streams or artificial channels exist.

Augusta Unlikely to Get Channel to the Sea

Augusta, Ga., long has enjoyed water-compelled rates because of the potential navigation existing between Augusta and Savannah. Recently the carriers withdrew the low rates. This resulted in a visit to Washington on the part of a delegation urging the improvement of the Savannah River to the extent of providing a 5-ft. channel. Such a project was adopted many years ago. Under that project the securing of that depth was to be accomplished by regulating works. It is the opinion of the district engineer, however, that such works would not give a year-around 5-ft. channel. He is convinced that locks and dams will be necessary. The Board of Engineers for Rivers and Harbors heard the arguments of the delegation, but it was evident from the questions asked that they doubt that the volume of commerce will justify the cost of this improvement.

Herbert Hoover on the Railroad Problem

IN HIS annual report as Secretary of Commerce Herbert Hoover discusses the problems of rail rates and railroad consolidation in the following paragraphs:

The difficulties of reorganizing the railway rate structure so as to secure simplification and to give relief in primary products—agricultural, coal, etc.—by a fairer burden upon finished and LCL goods are almost insuperable until the different systems are possessed of more diversified traffic and until the weaker roads have been absorbed. The necessity to establish railway credit and finance on a broader foundation than sole reliance upon the issue of mortgage securities; the necessity of provision for common utilization of terminal and other facilities; the impossibility of providing adequate rolling stock and particularly specialized cars so long as the burden falls solely upon the strong roads; the difficulties of more definite control of car service to meet seasonal demands and routing; the insuperable problems of equalization in car interchange; the slow progress in standardization and maintenance of equipment—all point to the imminent desirability of early progress with consolidations.

The idea of protection against excessive railway rates through the maintenance of competition is now dead. We should therefore secure the largest possible benefits from consolidation into larger systems by securing consolidation in such fashion as will protect and advance public interest.

The urgent importance of the early consummation of consolidation warrants consideration of methods to expedite it. Under the present provisions for wholly voluntary action subject to the Interstate Commerce Commission, many consolidations are likely to be long delayed. The difficulties of negotiation between the members of the groups that will be established by the Interstate Commerce Commission; the complications arising from varying priorities of securities affecting the determination of terms of purchase by one railway line of the property of another; the unwillingness of some lines to acquire or to sell others; the questions of individuality; the difficulties of establishing by negotiation the relative value of one property to another; the necessity of holding capitalization within the limits of the actual property values; the complexities and conflicts of state regulation and laws—all these problems would find a great measure of solution if the consolidated systems were allowed federal incorporation and if after a lapse of some appropriate period for voluntary action the Interstate Commerce Commission were given authority to create definite organization committees for each system including representation from the public and the component roads.

It should be the duty of such committees to develop and perfect a plan of consolidation either through the exchange of securities of the consolidated systems directly with the security holders of the component roads or by some other method. I believe that under such auspices the security holders would be willing voluntarily to make such an exchange. If a minority should refuse, it would be entirely feasible to invoke condemnation and purchase of their securities for the consolidated systems at an established fair value. Such a method would permit the determination of the relative value of the different railways considering both the physical properties and the often lower total of their securities, and due account could be taken of future as well as present conditions.

The ownership of some roads or terminals jointly by two or more consolidated systems could be provided for, as there are cases where such a solution would be most advisable in creating more efficient transportation. The public interest could be safeguarded by limiting the total capitalization of consolidated systems to an amount not exceeding the physical value of the railways as determined by the Interstate Commerce Commission under the Transportation Act as of June 30, 1914, plus actual capital expenditures and deducting abandonments and depreciation since that date. The total capitalization of many of the consolidateed railways would probably be less than the Interstate Commerce Commission physical valuation and certainly less than their present nominal capital.

Federal Land Reclamation: A National Problem

8. Faults of Reclamation Law and Practice, and Their Remedies

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The Eighth of a Series of Articles on the History and Performance of the Great Government Adventure in Irrigation of the Arid Lands of the West

WHEN the Reclamation Act was passed in 1902, irrigation was being practiced in all western states, but in only a few places was it profitable to the builders of the works. In parts of California, in the Mormon settlements of Utah, in Colorado, and in other places irrigation was successful, but on the whole the results were discouraging in the strictly desert areas. Private capital invested in irrigation enterprises had not paid, though the estimated profits were large. In many cases the losses both to builder of works and to farmer were serious. Such were conditions at the time the federal government entered the field.

Accomplishments—The 20th anniversary of the passage of the Reclamation Act occurred last year. In twenty years the government has invested in 26 projects \$136,000,000, and has collected \$13,000,000. The farmers have harvested eight million acres of crops valued at \$528,000,000. In 1921 there were 31,462 farms in operation, covering 1,158,000 acres, producing \$50,000,000 in crops. This briefly outlines the accomplishments; but the measure of success cannot be given in acres or dollars alone.

The Act placed a fund in the hands of the Secretary of the Interior to be used in the construction of irrigation works. The land benefited was to bear a water right charge which was to be returned to the fund in ten annual installments. This revolving fund was expected to provide ample funds for future reclamation projects.

The objects of the Act, to provide homes, have been accomplished. A large area of land has been reclaimed, many farms have been developed and the reclamation projects today represent as thrifty a part of America as is found in any region of the West. The yields of crops and returns per acre are better than the average in the states in which these projects are located. The farmer on the project is a little more successful than the average farmer in his state.

Collection of repayments has been less completely accomplished. Early in the history of the Service it was found that the collection of money in ten annual installments was impractical. The class of farmers attracted to the projects had little capital and that was needed to pay living and development expenses until the farms became productive. Efforts to collect money resulted in appeals to set aside or reduce the payments. Various amendments were made to the Act until now the time has been extended to twenty years. Each extension of time or adjustment was made after an investigation by Congress. In 1922 the Service reported that 85 per cent of the moneys then due had been collected. As the time covered by the records of collections included the period of low agricultural prices following the war it is a record to be proud of. Few business ventures can show better results.

Some Handicaps—Yet there have been many places where more rapid advancement could have been made under different conditions. Handicaps of various sorts delayed the administration of the Reclamation law. Some of these are inherent to government activities, others can be removed by intelligent action by Congress.

The law itself seriously handicapped the progress of reclamation. It was a most general law, containing few details and leaving management in the hands of the Secretary of the Interior. Washington bureaus have for many generations been operated upon the theory that anything to be legal must be specifically authorized in the law, and in the execution of a general law such as this the old officers, who usually advise the Secretary, found it difficult to depart from time-honored customs.

As examples: The Land Office with a hundred years of red tape handled all land matters and was many times a stumbling block in the way of businesslike administration. The Treasury Department, whose auditors were unaccustomed to ordinary business practices, was frequently shocked by being asked to do things in a direct and businesslike fashion. Many other bureaus, whose co-operation was required by the new and vigorous service, were horror-stricken to find an attempt being made to carry out a job in about the same fashion that any business man would do it.

But the most important handicap of all was the Secretary of the Interior himself—the man who is authorized by law to "perform any and all acts and to make such rules and regulations as may be necessary and proper for the purpose of carrying the provisions of this Act into full force and effect." The Secretary of the Interior is a very busy man. He is seldom acquainted with the problems of the West. He was often not in sympathy with the activities of the young organization. He was usually inclined to listen to the man who complained of hardships and to think the hardships were caused by the Service. He seldom knew how to get facts which were unbiased. As a result the incoming Secretary often became convinced that something was wrong with the Reclamation Service and held back his official approval on many activities until he could have time to investigate the condition of affairs. This has resulted repeatedly in delays, and some of the most distressing incidents connected with the Service history are due to this one condition.

Garfield's Vision—One Secretary held a different view from the others. Secretary James R. Garfield, in Roosevelt's administration, had the belief that he was authorized by Congress to accomplish the purposes of the Reclamation Act and that anything required toward that end was to be done, unless it was specifically forbidden by law. His view, so directly opposite to the older departmental ideas, enabled the Reclamation Service to get a start in life and to establish the much needed precedent for later secretaries to follow. Perhaps no one man is more entitled to credit in the early days of the Service than Secretary Garfield.

As an example of his methods: The Land Office had decreed that there was no way of preventing settlement upon any reclamation project before completion of the ditch. The result was that settlers scattered over the whole project and often outside it, requiring the construction of canals and ditches of great length to supply small isolated areas of land. The Service had endeavored to open projects by units, so that settlement could be completed in one area before more distant lands were irrigated. It was only through Secretary Garfield's personal investigation in the field that this much needed reform was brought about. He directed the withdrawal of all land and the opening to entry of only such tracts as were ready for water. No new law was required to do this. The only thing needed was a secretary with the backbone to follow the recommendations of the Director of the Reclamation Service.

The State Apportionment Evil—The Reclamation Act provided for the establishment of projects in all sixteen western states, the intention being to expend the major portion of the funds arising from the sale of public lands within each state, within that state's limits. Within each ten-year period the expenditures were to be equalized to the extent of 51 per cent of the fund among the several states. In the border states in the semi-arid belt—North Dakota, South Dakota, Kansas, Nebraska and Oklahoma—the funds were large, and the opportunities for irrigation small; in an effort to comply with the law the Service spent a large amount of time and money to find feasible projects, but feasible projects have not yet been found.

This allotment of funds by states caused a great deal of political activity. The result is that we have now some projects which, though completed, have never been successfully operated. The pumping plants in North Dakota are examples of this.

"Lame Duck" Projects—Later in the history of the Service many projects which had been started by private capital were forced upon the Service in order to save struggling communities from extinction. In some cases these projects were afterwards made successful, in other cases success has not attended the efforts of the Service. As an example of the former, the Sunnyside tract of the Yakima River in Washington was taken over after fifteen years' effort on the part of the owner, the Northern Pacific R.R., at a time when both the farmers and the railroad were thoroughly discouraged over the lack of success of irrigation; the project has since become one of the most fertile and profitable in the West. On the other hand, in other states, projects taken over when on the road to failure have not succeeded. In these cases the Service was strongly urged to save the community and through political efforts forced to take over the completion and management of the project. There are today many other projects on which the farmers would be fortunate if they could get the Service to do likewise. These "lame ducks" should be regarded as evidence for, not against, the Reclamation Service.

In addition to these handicaps the farmer upon the Reclamation Service project was frequently no great asset. The announcement that the government was going into the business of irrigating lands and that there was a free home for every man in the West attracted the attention of all classes of people. The inevitable result was that many who were failures in other walks of life and many incompetents flocked to the projects to take up land and reap the benefits of this munificent plan. Farming requires energy, skill and perseverance. Irrigation adds nothing to the ease of farming, in fact it requires a higher degree of skill. The quality of the settlers cannot be blamed upon the law; it can only be blamed on the inability of any governmental agency to select its settlers as would any private agency.

Administrative Errors—Handicapped as it was by the law and the precedent of Departmental rule, there is little wonder that the administration by the Reclamation Service was deficient at times. But the successes so far overbalance the failures that a fair-minded man finds little to criticize. It should be remembered that we are looking backward and in the light of events many things now appear clear. We see the reason why some things did not succeed. In other cases a turn in the tide has worked success out of a potential failure.

On the passage of the Act and organization of the Service there was a grand scramble for the money by all the western states. The end of the first year saw a fund of nearly $5,000,000 available. Congressmen and politicians of other kinds besought the establishment of projects in many places. Attempts were early under way to have Congress direct the places where money was to be spent. The engineers were urged by those who knew the results of pork barrel appropriation to make the dirt fly. They did. Preliminary surveys made by organizations in charge of earlier investigations served to outline several possible projects, such as the Salt River dam, now the Roosevelt, in Arizona. Senator Newlands, of Nevada, had caused preliminary surveys to be made at his own expense of what is now the Newlands project. In the latter case a survey was at once commenced. In the Salt River Valley the land was so largely in private ownership that the organization of the land owners was necessary and that took time. Other projects were speedily outlined and the fund was allotted to keep it from being looted by promoters of questionable enterprises.

In its haste to nail the fund down, it is possible that the Service did not select the projects most desirable at that time, but there is no question but that it was necessary to allot the fund, for the mere sight of a pot of unattached money attracted too much attention. Throughout the history of the Service this has been true. At the present time there is an alleged eleven millions in the fund and many hungry eyes are directed toward it. The dismissal of Arthur Davis is in part attributable to the disappointed hopes of certain aspirants for the honor of spending this money.

Great difficulties of other kinds attended the selection of projects. Not so much was known about arid soils as now, hydrographic information was meager, we had little appreciation of the economics of agriculture in certain of our western valleys. Looking backward we now see that there was little chance for the farmer to make a success in certain western projects except by producing feed for cattle. The development of potato growing in Aroostook County, Maine, was a factor in making potatoes unprofitable in Idaho, but who could have predicted that twenty years ago?

The selection of projects was not left to a calm analysis of engineering facts. Influential citizens, big railroads and state senators often were a factor, as well

as soils, climate, water supply and market facilities. Certain Montana projects were strongly urged by Senator Carter while he was Chairman of the Senate committee on irrigation; transcontinental roads liked to have projects on their lines because of the increased revenues it gave them, and many and devious were the ways in which their wishes were made to come true. On the whole, however, the projects selected were such as would be successful. About the only project selected in which a mistake in engineering was made was the Hondo project in New Mexico, where the reservoir site, underlain by limestone and gypsum, was so leaky that it has never been filled.

There has probably never been any large undertaking so free from engineering mistakes. From being a beginner in irrigation the United States has become the world leader, and it is almost entirely the work of the Reclamation Service which has brought about the change. If any criticisms can be offered of the construction work of the Service it is that the work is too well done. There has probably never been any large public work, either governmental or corporation, which received so much for the money spent as the Reclamation Service. One reason for this is that the work has gone on long enough for a competent construction organization to have been built up. The newspapers now announce that the new plan is to go back to contract work. After twenty years' effort to build up an efficient construction organization, that is to be scrapped and a new method tried. Oh well, Uncle Sam is rich!

Faults of Management—Recent changes in the Service personnel by Secretary Work were made because he wished to place the management on a more business-like basis. He replaced a manager of twenty years' experience with one without experience, so far as one can learn from his past record. It is of interest to see what was lacking in the management of the business and what changes for the better are to be hoped for.

The reclamation law places the entire responsibility for the reclamation work upon the Secretary of Interior. He is, as we all know, about the busiest of cabinet officers. He selects the head of the Reclamation Service. Heretofore he has had little to do with the detailed organization, but all matters of policy must be approved by him. The executive head of the organization was the Director.

Under the Director were the appropriate legal and engineering staffs and on each project were engineering, construction, clerical and operating organizations. Administrative headquarters are in Washington, with engineering and operating headquarters in Denver. Management has to do with investigation, construction, settlement and operation of projects. At various times during the history of the Service changes in organization have been made; sometimes as the result of experience of the officers in direct charge, other times by the Secretary of Interior against the recommendation of the Director. As an instance of the latter, Secretary Lane placed management in the hands of a commission of which the Director was a member.

In the investigation preliminary to project construction, the Service has had the assistance and advice of the Department of Agriculture, the Division of Hydrography and other organizations which collect and digest facts. In the early days the information available was less reliable than now and on a number of projects we see the results of this lack of information. For example, on the Newlands project large areas of alkali land were at one time thought reclaimable and ditches were built to water such areas. On the Klamath project an area of marsh land included in the original project was found to be of questionable value. Little money was spent on its reclamation, however. At Umatilla, Ore., an area of very light sand has been difficult to farm, though it is proving very fine land when once in crop.

Land examination was made of the projects early in their development. An effort was made to exclude all land of poor quality. Sometimes this examination failed to reveal the true character of the land and in a few cases the field examiners were overruled and land included which afterward proved worthless. Though mistakes of this kind occurred the area of land thus involved was very small as compared with the whole area, and the amount of money involved is but a small percentage of that spent. Such errors are common in any human endeavor; they occur in every enterprise, whether government, corporation or individual. There is now more reliable information about soils, water supply and agricultural possibilities of western soils, and future projects may profit by past experience.

Drainage—The difficulties caused by lack of drainage facilities are probably as often quoted as evidence of mismanagement as any other feature of our federal reclamation. Drainage problems accompany or follow irrigation nearly everywhere through the world. The reclamation projects have been no worse than most private projects. They should have been better. In the early days of project irrigation the lands seldom showed any signs of needing drainage. In some places the water table rose rapidly and damaged land before any remedy could be applied; in other places drainage was developed as fast as the need arose. The need for drainage arises where more water is applied than the land can absorb or the plants use; the greater the use the more necessary the drainage. Reclamation projects attempt to provide full service of water in all seasons, in other words, water is always available for use. Had the lands not had an abundance of water no end of criticism would have followed.

In order to be fair to the farmer water in abundance is provided. In this respect the Service has sometimes followed the easiest road rather than the best. Too much water is the greatest misfortune which can overtake an irrigated community. In fact what the farmer regards as enough water is generally too much. The greatest blessing to an irrigated community is a reasonable deficiency. With a deficiency the farmer is required to handle his water with more care and the results are better crops of better quality and less damage by waterlogging. It is less work to irrigate with careless methods—easier to apply a large amount than to spread just enough water uniformly. The water user likes lots of water so he can irrigate the easiest way, and as that is the wasteful way he wastes water.

The Service has done a great deal to encourage economic use. It has arranged schedules of prices so that excessive use is costly, and in other ways has tried to encourage economical irrigation, but it did not succeed until much land was already damaged. Many are inclined to censure the officials for this. A knowledge of the inside facts, however, shows the engineers in a constant endeavor to encourage economic use of

water. Lack of co-operation on the part of the water user was nearly complete. Nothing short of a kindly providence bringing dry seasons in a row has ever effectively taught any considerable number of American farmers economy in use of water.

The inevitable result of the wasteful use of water was a need of drainage. Drainage problems arose in many places. Usually the project was completed and the construction cost assessed to the land before drainage problems arose. No method of collecting money from the land was available and there was in some places a delay in getting drainage started. All of this has caused criticism of the Service. Congress could have corrected the matter at any time by appropriate legislation, which was recommended by the engineers of the Service.

Problems of Settlement—The success of an irrigation enterprise rests with the man who farms the land, not with the builder of the works or the operating engineer who delivers the water. The farmer makes success or failure. With good soil, a climate suitable for crops, a regulated supply of water and a market for produce, it would seem that the project could not help being a success. Such is not the case, however. The man who farms must know how to farm, must be diligent, hard working and businesslike. If any considerable percentage of the farmers does not have these qualities the success of the project is endangered.

Money is as essential as energy and experience to the farmer who takes up a reclamation farm. The amount depends upon the individual; it is the rare man who can succeed with two or three thousand dollars. Irrigation farming does not attract the man with money. Too many men without adequate cash have taken up farms on projects. There is no way for the government to select settlers. Any one with his homestead rights and enough cash to make a first payment can take on the responsibilities of making a farm out of a desert homestead. In the early days of government reclamation a land office fee of $8 or $10 was all the cash required. Secretary Garfield was persuaded that it was good business to require an advance payment of a year's water charges. This served to eliminate the man entirely without money, but it gave no assurance of future payments. The projects too often have been settled by men without adequate resources. This condition is not peculiar to government projects; all western colonization in recent years has suffered from this difficulty. This lack of funds resulted in many farms being slowly developed.

The time of payments to the government is set by the Secretary of Interior under the law. The settlers whose payments were due commenced an approach to the Secretary and Congress in hopes of relief. This advance took place in many forms and usually took place regardless of the ability of the farmer to pay. The small politician talked of it, and the larger politician asked votes on the basis of securing help for the poor farmer. The Secretary, hearing all of the noise about inability to pay (the man who could pay kept quiet) usually started an investigation into the real merits of the contention. Congressional committees went through the West to listen to protests from farmers on reclamation projects. In one case a questionnaire designed to bring out all complainants was sent out a few months ahead of the congressional investigating committee. The results of this agitation caused a general feeling that the farmers of the projects intended to try and get out of all payments. There is yet some doubt as to the real intentions or hopes of the average reclamation project farmer.

Farmers have had more help from the government than any other class of people. So many bureaus and experiment stations have been supported by the government in order to teach the farmer how to attend to his daily business that he has become a little self-conscious. Anything affecting his welfare is made the basis of political activity. The farmer on reclamation projects had no more need for consideration than any other western farmers. He had good irrigation works, a better regulated supply of water, and no interest to pay on his water charges. However, he has been led to believe that the money he owes to the government will be remitted or at least his payments will be delayed if he makes enough noise. He has never failed to make a noise.

It is really a wonder, in view of all this array of political, legal and administrative obstacles in the path of reclamation, that anything worth while was accomplished. The results speak for themselves and reflect great credit upon the qualities of the responsible officers of the Service.

A discussion of this sort adds little to our knowledge unless from it suggestions can be drawn for better practices in the future. The following suggestions are offered:

What Can Be Suggested for the Future

First of all we agree with Secretary Work that the reclamation policy must be placed on a businesslike basis. This does not mean the disruption of a valuable *esprit de corps* by the summary dismissal of a valuable man and a belated endeavor at fact-finding to determine why he was dismissed, but it means the following things among others:

1. Projects should be approved on the basis of their feasibility. Neither state lines nor political preferences should have any weight in the selection.

This has been the endeavor of the Reclamation Service at all times. Any departure from this rule has been caused by someone outside of the Reclamation Service.

2. Before final approval of projects, these things should be assured:

a. Sufficient good land to stand the charge.

b. Water supply unfailing in quantity and of good quality.

c. Climatic conditions such that crops of value high enough to both support the farmer and enable him to pay his charges for water.

d. Location such that freight rates permit the shipment of its products to an established market with fair returns to the grower.

e. An economic need for the new agricultural area.

3. The charges for water should be assessed to the land in proportion to the benefits, not on a flat rate per acre as now.

This will permit the inclusion of poorer tracts of land which can be used for pasture or some other such use. The assessing of charges on basis of benefits will remove many of the inequalities which now result in abandonment of land.

4. The construction charge should not exceed a sum which the farmer can pay out of the proceeds of his farming operations. *This charge should include interest* upon the unpaid balance.

The lending of money without interest is the fundamental error of the reclamation law. There are today worthy projects, in regions where agricultural development is needed, which will cost more than the farmer can afford to pay. In such cases Congress should appropriate money for the excess, charging the farmer with the amount he can afford to pay.

5. The time of payment should vary with the project. A California project may be able to pay faster than one in Montana. A period of no payment but interest should be required in the early years while the farmer's resources are required to bring his ranch into full development.

6. Settlers on public land and owners of private land should be required to show financial strength sufficient to place the farm on a paying basis.

7. Sale or transfer should only be permitted when the financial obligation to the government is completed or when the new owner is financially as sound as the former owner.

8. Operation and maintenance charges on unoccupied public land should either be paid by the government or added to the construction charge so no unfair burden be placed on early settlers.

9. All affairs connected with the details of project management should be placed in the hands of the farmers as soon as possible—preferably through Irrigation Districts.

10. Provision should be made for technical agricultural advice and co-operative handling of products through the Federal Department of Agriculture and state organizations. The farmers should help pay for this advice. Free advice like other free things is usually valued at its cost.

11. Endeavor should be made to cause the reclamation farmer to stand on his own legs, fight his own battles and, when hard times come, as they do to men in all walks of life, work out his problems as other men have to do. Blessed is he that doth not bellyache.

Relocation Avoids Large Trestles and Sharp Curves

LINE IMPROVEMENT and elimination of long and high trestles will be effected by a short stretch of relocation now in progress on the Algoma Central & Hudson Bay Ry., near Frater, Ontario. At this point (Miles 103.8 to 104.79) the line is about 750 ft. above Lake Superior and four miles from the shore of Agawa Bay, with two trestles spanning coulees high up on the range of hills which fronts the lake. A view of the big trestle is shown in Fig. 1.

FIG. 1—LARGE FRAME TRESTLE TO BE ABANDONED

Both trestles are of frame construction, built in 1911-1912. The larger one is 1,050 ft. long, and 75 ft. high, on a 12-deg. curve, with a central angle of 139 deg. The other trestle is 520 ft. long, 60 ft. high and mainly on tangent. Relocation for about one mile is being made to avoid the risk of filling such large trestles, but at the same time it will shorten the line by about 500 ft. and eliminate five 12-deg. curves, reducing the curvature by 201 deg. 42 min. This relocation is shown in Fig. 2. The grading will be mainly in solid rock, with three large cuts.

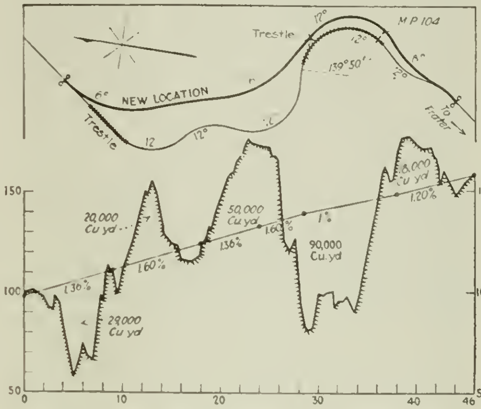


FIG. 2—LINE REVISION ON CANADIAN RAILWAY

The contract for grading has been let to McNamara Brothers & Thornton, Sault Ste. Marie, Ontario. Track-laying will be done by company forces. It is expected to have the new line completed by June, 1925, after which the old track and the trestles will be salvaged. The cost is estimated at $187,000. B. E. Barnhill is construction engineer in direct charge, while the work is under the general supervision of L. C. Maxwell, engineer maintenance-of-way, and R. S. McCormick, chief engineer and general superintendent of the Algoma Central & Hudson Bay Ry.

Irrigation in India

The total area of land irrigated in 1922 by all classes of work in India, exclusive of the Indian states, was approximately 43,125 square miles or 14 per cent of the cultivated area, according to a report issued by the Department of Industries and Labor, Government of India. The irrigation districts are distributed in twelve provinces. Extensions and new works are being made continually and hydro-electric projects are proposed in connection with some of these. Thus the Bhandardara dam to be completed in 1924, with a total height of 270 ft., will provide for 5,000 hp. and the Bhatgarh dam, 190 ft., to be completed in 1926, will provide for 3,000 hp. Both of these works are in the Bombay province. The estimated value of crops on all areas receiving government irrigation was more than double the total capital expended, while the returns on capital invested in productive projects ranged from 7.76 to 14.63 per cent. All of this work, both as to construction and operation, is under the Public Works Department of the Government of India.

Highway Officials Review Technical Activities of 1923

Papers and Discussions at New Orleans Meeting Stress Research and Administration — Construction Practices Get Second Consideration—Maintenance Neglected

Engineering News-Record Staff Report

PROFESSIONAL topics of unusual variety were reviewed in formal papers presented at the New Orleans convention on Dec. 3 to 6 of the American Association of State Highway Officials. These papers are here summarized under the heads of administration turnover, federal-aid, design and research, finance and construction. Incidentally, this grouping indicates the range of knowledge with which the modern highway commissioner and engineer must keep in close touch in directing the work of his department.

Administration Turnover—Charging the fault to highway officials themselves and to the inactivity of the association, H. G. Shirley, chairman, Virginia State Highway Commission, called attention to the dangerous turnover in department administration. In the last two years there had been a change in the directing personnel of 24 state highway departments. Road administration, construction and maintenance had advanced so rapidly that public thought had not kept pace. Failure to recognize this lag in thought and an attempt to force the pace and consequent antagonism of the public were the causes of many changes. Political interference was not a major cause. With ordinary firmness political interference in highway administration could be prevented by the department head. It was important to keep in line with public sentiment—to lead the thinking of the people, but not arbitrarily drive ahead with policies they had not been educated to approve. Once the confidence of the public was secured by leading and not by driving, its support could be had for any reasonable plan of highway development and political interference need not be feared. Education of the public had been backward.

Men who are capable of directing and handling expenditures running into approximately $1,000,000,000 yearly should be of such a type as to command serious thought before any change in personnel was made. To handle so much capital there must be a stated term of office. This permanence of position was necessary to attract able and honest men. A change in the directing heads of 24 state highway departments in two years did not indicate such permanence of position. The fact that this turnover has not been protested indicated that the association was remiss in serving its members. Indeed, the fault lies in the fact that highway officials "have not brought to the attention of the public the great need and importance of continuous services for such offices in keeping with the offices of our railroads and other large organizations."

Interesting statistics of administration turnover were presented by H. K. Bishop, Bureau of Public Roads, in discussing Mr. Shirley's paper. During the eight years of federal aid, or from 1916 to 1923, 48 states have had 117 chief engineers of highway departments. Of these chief engineers 34 served one year, 35 served two years and 13 three years. The average official life of a chief highway engineer is approximately three years. Stated in a different way ten of the 48 states retained the same chief engineer for the eight years, 19 had two chief engineers during this period, 14 had three, three had four and two had five.

Federal Aid—Selecting a federal-aid system of highways was reported to be substantially completed, by Thomas H. MacDonald, chief, Bureau of Public Roads, who gave credit to state road officials for remarkable co-operation. The officially-recorded road mileage of the country is 2,886,000. State systems aggregate 220,000 miles of which 80,000 miles are surfaced. In the past four years more miles have been surfaced than in all previous time. Withal, road improvement is lagging far behind traffic development. Completion of the federal-aid system in ten years calls for 11,000 miles of construction each year. Mr. MacDonald cited the need of extended traffic studies. There were needed uniform traffic regulations, more department testing laboratories, regular reporting of accidents, and better engineering inspection of road construction. Only 36 per cent of all road expenditures was provided by property taxes and only 11 per cent of all taxes were for roads. Only 40 per cent of the expenditures for roads was under state or federal control. Motor-vehicle license taxes and gasoline taxes should be for road improvement alone. Present expenditures, large as they seem, were small compared with the value received. Grade crossing elimination was a vital necessity. Of 753 eliminations on federal aid roads 62 per cent were accomplished by road relocation and 38 per cent by grade separation. Calling attention to troubles already experienced it was urged that no state should accept contributions for road improvement unless entirely without restrictions. For future practice, unstable subgrade soils should be stabilized by adding some material as sand, gravel or cement. The outlook should be for a general raising of standards by research, more strict routine testing, better engineering inspection, better design and construction.

Calling attention to existing federal-aid funds W. C. Markham, executive secretary, noted the necessity for approaching Congress at the current session for action on the future federal-aid program if there were not to be a hiatus in federal-aid appropriations. It was pointed out that failure of states to take up their allotments of federal aid put difficulties in the way of getting Congress to adopt a federal-aid program of much greater size than at present.

Design and Research—Premising that research which which was not applied practically was of scant value, Charles M. Upham, chief engineer, North Carolina State Highway Department, described the development through experiment of the near-macadam roads and sand-asphalt roads of his state, in which there is a large mileage of top-soil or natural sand-clay roads. These roads have great strength, they will carry almost any load without breaking down, but they wear rapidly by abrasion and after traffic exceeds about 400 vehicles per day the maintenance, because of surface wear, becomes excessive. The problem was, when the excessive maintenance stage was reached, to retain the original

strength element and strengthen the surface to resist wear without going to hard pavement—that is, to provide an intermediate road between the original top-soil road and a paved one. Asphalt could not be applied to the old top-soil surface because a dust layer formed underneath and the asphalt peeled off. Also, it was observed that stone embedded in the old top-soil was held rigidly. Asphalt could be applied and would stick to the stone. Experiment was based on the last finding. The old top-soil was scarified and spread with one layer of 3½-in. stone which was rolled until embedded half depth in the loosened top-soil surface. Then asphalt, about 1.6 gal. per square yard, was applied and a layer of smaller stone spread and rolled. Finally, a light dressing of asphalt was covered with small stone and rolled. The result was virtually a bituminous macadam armor over the old top-soil road. These roads are standing up under a heavy traffic and their cost is half that of pavement.

The sand-asphalt construction is the result of another experimental study to utilize local materials. In certain sections there is only sand and no other material to be obtained except by extensive haul. The trial road was built as follows: The sand was graded and rolled with a grooved roller between timber side forms. An asphalt mixture of about 92 per cent sand was laid on the rolled grade and on this a surface of approximately sheet asphalt mixture. The cost of this type of road was less than half that of ordinary black-top roads.

Continuation of the Bates road test, using sections with thickened edges, was described by Clifford Older, chief engineer, Illinois Department of Public Works. These edge-thickened sections showed no failure under legal loads for 9-6-9-in. and 9-5-9-in. slabs, and no considerable damage under 13,000-lb. wheel loads. Several diagrams of repeated load tests 6 lb. per square inch in Illinois clay soils were exhibited.

Observations on tests and materials for concrete road construction by G. W. Hutchinson, of North Carolina, discussed by A. T. Goldbeck, Bureau of Public Roads, were presented in a series of diagrams too extended to be considered in the present report.

Finance—The tendency of recent legislation in regard to financing highway construction was reviewed by J. N. Mackall, director of the Department of Public Works of Maryland.

Salient features of Mr. Mackall's discussion follow:

The alarming thing about the recent tendency in the financing of highway construction and maintenance is the extent to which automobile license fees and the gasoline tax receipts are being used to finance relatively long-term bonds for construction. If the excess of receipts from the motor-vehicle user over the maintenance cost were used annually for construction, certainly it could not be criticised by any man. To do this is the best of business, but to issue bonds running over a long term of years, and set up as the first call on the receipts from the motor-vehicle user sufficient to pay interest and amortization on these bonds is insuring that the proceeds from the current receipts from the motor-vehicle user cannot be used for road maintenance as the need for road maintenance and reconstruction continues.

Many roads, in fact most of the paved roads today, are being built of concrete. The cost of maintenance of these concrete roads is a relatively small amount and will remain so for a number of years, but who will say that bonds running for terms of even 15 to 25 years will be retired before the best of concrete roads will require extensive reconstruction and maintenance. One of the greatest calamities which could befall the transportation program of any state would be to find that there were not sufficient funds from current receipts to maintain in perfect condition roads previously built from bond issues or from current receipts.

It is fundamental that all maintenance and reconstruction be cared for from current receipts, and it is equally as fundamental that no prior charges be made against the prospective current receipts which could in any way prevent these current receipts from coming in sufficient volume to pay the maintenance charges on all the improved roads in the state. Representatives of the automobile industry have argued time and time again for the issuance of long-term bonds for road construction and at the same time have admitted that the responsibility for the maintenance of these roads was and should rightly be the responsibility of the user, but the greatest difficulty in this arrangement is the practicability of financing such a plan. If any community cannot raise with reasonably short-term bonds sufficient money for the original construction of its roads, that same community cannot in 10, 15 or 20 years become sufficiently prosperous to pay for the reconstruction of these roads from current receipts. If reasonably short-term bonds, say, on the serial annuity plan, fully matured in 15 years cannot be financed by a community from its general taxes, how is this same community going, in 15 years, to pay interest and amortization and in addition an annual maintenance cost much greater than this. Yet the automobilist has admitted and the automobilist does admit that it is his sole responsibility to pay for the maintenance and reconstruction of roads, and it can with considerable propriety be argued that this is the full measure of his responsibility.

Construction—Characteristic mid-western practice in gravel road construction was outlined by John H. Mullen, chief engineer, Minnesota Highway Department, as follows:

Gravel surfacing as practiced in the middle west is rather different than the methods of gravel road building prescribed in the text books. Trenching and the placing and rolling in layers of different sized gravel has been found to entail needless expense and a system has been developed which is in reality a combination of construction and maintenance, and consists, briefly, of spreading gravel on the roadbed and compacting it under traffic and maintenance. This sounds rather crude but it is a method which has been found to be the most economical after considerable experience in various systems of handling the work.

Subgrade is the first consideration and when bad sand is encountered a sand-clay crust is first built, or if the grade is composed of muskeg or unstable mucky material, a covering of clay is applied to sustain the gravel wearing course. The subgrade for graveling is bladed to practically a flat section with never more than a 4-in. crown on a 30-ft. roadway. Hauling is usually done with trucks, material being dumped in a ridge at the rate of 22 to 36 cu.yd. per station, depending upon the traffic to be served, the kind of gravel, and the material in the subgrade. The gravel is then spread with blade graders leaving not to exceed 3 in. in thickness on a width of 20 ft., the remainder being left in a ridge on each side of that width. Blading is then continued and traffic turned onto the road, a small amount of gravel being gradually brought in and moved across the roadway until a crust is formed by the traffic. In this way the surfacing is compacted from the bottom up without at any time having enough material in the travelled way to produce a loose driving condition.

On account of the great variation in gravels found in different parts of the state there is not a uniform specification for cementing values, wearing quality or grading of sizes; the only uniform requirement is that the maximum size of the gravel particles shall not exceed 1 in., which means that in practically all cases screening apparatus must be used. This is usually the ordinary rotary or shaker screen fed by a conveyor, but in the larger gravel hauling projects the material is generally loaded by a dragline or steam shovel through a "grizzly" or grate screen. To prevent oversize being hauled on the road it is required that the shaker or rotary screens have openings not more than 1 in.

in size but when grizzly bars or grates are used it is required that the bars or grates be spaced not more than ¾ in. apart.

The state buys or leases the gravel pits, preferably on an average basis but when impossible to secure acreage the gravel is paid for at so much per cubic yard as measured in the trucks delivered on the road. Contracts are let on competitive bidding at a unit price for loading, screening and hauling to the first mile point and a unit price per yard-mile for additional haul beyond the mile point. There is also a unit price bid for shaping and compacting at so much per hour for men and teams but generally this work is turned over to the state maintenance forces. While most gravel hauling is done in the Summer it has been found that a considerable saving can be effected by doing this hauling after the ground is frozen, especially when long hauls are involved, for that enables the contractor to use heavy truck equipment at a greatly reduced price per yard-mile. When such hauling is done in the Summer it is required that pneumatic tire equipment be used in order to protect the subgrade from damage caused by heavy trucks with solid tires.

Stating that 25 per cent of the land in Louisiana was undrained, J. M. Fourney, state highway engineer, indicated the problem which confronted the state in the large mileage of swamp road to be planned and now under construction. Generally the swamp land was wooded and consisted of a top-soil of vegetable character overlying clay at various depths. The top-soil was generally only about 12 per cent solids. Construction consisted in clearing and then removing the top-soil. Then dredges dug a borrow canal parallel to the road fill and built an embankment of the clay subsoil.

Reviews the Coal Commission's General Recommendations

IN SUMMARIZING the recommendations of the United States Coal Commission Edward Eyre Hunt, speaking before the American Academy of Political and Social Science in Philadelphia, brought out the following points:

(1) The commission recommends that the government continue its fact finding and publicity work in both the bituminous and the anthracite coal industry and that the government regulate the industry through the use of its power over interstate commerce. (2) That an administrative agency through which these powers can be exercised be created as a coal division in the Interstate Commerce Commission. (3) Federal licensing of those who buy and ship coal in interstate commerce. (4) A federal tax on royalties and differential profits. (5) The adoption of a uniform standard of either the long or short ton. (6) A re-examination by the Interstate Commerce Commission of the differential railway rates with a view to the promotion of coal movement by water and the discouragement of long haul by rail. (7) A modification of the rules governing distribution of railroad cars in periods of shortage so as to give consideration to the ability of the producer to sell coal rather than to mere ability to produce and load it into cars. (8) That contract coal be given preference over spot coal delivery. (9) That the government as administrator of 50,000,000 acres of coal lands amend the leasing laws so as to restrict the opening of new bituminous mines. (10) That Congress designate an agency to unite with the industry in studies of unemployment and the wage structure, which agency will serve as a medium of publicity for rate information and will be prepared to make special compulsory investigations whenever there is a threat of failure to renew a wage agreement. (11) Continuous publicity as to labor relations with the possible resort to mediation at the instance of the President of the United States. (12) The commission does not recommend nationalization of the mines, compulsory arbitration, compulsory incorporation of the unions, nor price fixing by the government. (13) The commission recommends the consolidation, grouping or pooling of bituminous mining operations, under such restrictions as are prescribed for railroads in the Transportation Act. (14) That state and federal governments co-operate in inspection, revision of mining codes, supervision of compensation insurance, and safety education. (15) That communities license retail coal dealers, organize co-operative associations, open municipal fuel yards or in other ways deal with the problems of local distribution of coal.

The commission recommends to the industry (16) a number of improvements in management methods and the development of efficient mechanical devices to improve the general mining operations. (17) Attention is drawn to the British wage plan which provides that miners and operators share the profits of the business. (18) Better living conditions for the miners. (19) Co-operation with the miners in the study of unemployment and the rate structure, and in setting up boards of conciliation and voluntary arbitration. (20) Improvements in personnel management, training of foremen, and centralized responsibility in labor relations. The commission also recommends the appointment of district and national labor commissions to work out a national labor policy. (21) Collective bargaining to work out a system of national negotiation with district agreement is recommended. (22) The check-off and complete unionization are not recommended.

To the individual coal consumer the commission recommends (23) the buying for regular delivery on contracts and the storing of coal, as well as wider use of technical information regarding methods of fuel economy. (24) Wider use of substitutes for anthracite.

Revaluing Power Properties from Old Records

Under a decision rendered Oct. 27 by Chief Justice McCoy, the District of Columbia Supreme Court is to revalue the properties of the Potomac Electric Power Co., using as a basis the valuation data gathered in 1916-17 by the Public Utilities Commission. The litigation has been before the courts several years, and meanwhile a fund which now exceeds $4,000,000 has accumulated through impounding of the difference between the rate for electric current collected—10 cents—and the rate fixed by the commission, varying from 8 cents to nearly 9 cents. The Public Utilities Commission fixed a valuation on the company's properties for rate-making purposes and announced its decision in 1918, reducing the rates, whereupon the company appealed to the courts, alleging that replacement values had not been allowed by the commission on existing prices, and also that some items had been excluded erroneously. The District Supreme Court denied the injunction; the District Court of Appeals reversed this, and the United States Supreme Court refused jurisdiction last spring, thus allowing the reversal of the Court of Appeals to stand. The company then contended that the entire valuation work must be done over, while the commission contended that the District Supreme Court had the authority to make a revaluation from the old records.

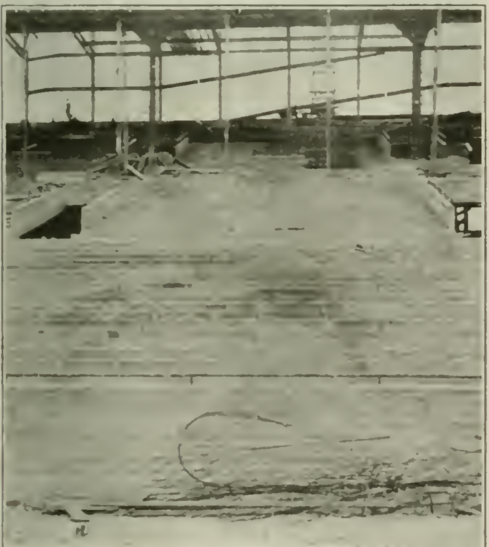
From Job and Office

Hints That Cut Cost and Time *For the Contractor and the Engineer*

Filtered Sprinkling Water Used To Avoid Iron Stains in Concrete

By G. C. Habermeyer
Engineer, Illinois State Water Survey

CONCRETE placed in the University of Illinois stadium was to be kept wet for 21 days before forms were removed. Water applied to the lower tiers of seats by sprinkling continuously, using a common type of lawn sprinkler, caused an objectionable stain where the water flowed along one course for any considerable time, due to an iron content of 2 p.p.m. in the water. To improve the appearance of the structure a



STADIUM STAINED BY IRON IN SPRINKLING WATER
No stains show between portals where water used was filtered and applied evenly by hand.

pressure filter was installed to remove the iron. The pressure available to wash the filter was not adequate and at times an appreciable amount of iron was left in the water. Further improvement was effected by sprinkling parts of the structure by hand thus securing a more uniform distribution. During the latter part of the work, the seats were covered with sawdust or sand which reduced the amount of water needed.

The view shows stained seats below the portals, which were placed before the filter was installed, and seats between the portals with comparatively little stain which were placed after the filter was installed.

W. A. Slater is in charge of the concrete work for the athletic association of the university and the State Water Survey assisted in plans and installation of apparatus used to reduce the iron stain.

Count of Football Crowds Gives Hints on Stadium Design

By Clyde T. Morris
Professor of Structural Engineering, Ohio State University, Columbus, Ohio

WHILE preparing plans for the stadium at Ohio State University, the writer was impressed with the lack of information as to the number of people which could be accommodated through entrances of various dimensions, on ramps, and on stairways. During the past football season some data have been gathered on this subject at the Ohio stadium which may be of interest.

The design and construction of the stadium was described in *Engineering News-Record*, Oct. 19, 1922, p. 640. The seating capacity is approximately 62,000. There are 39 arch openings on each side of the stadium, provided with iron gates, and turnstiles for taking tickets may be placed at as many of these as necessary. This year 23 turnstiles were used. After the game, all gates are opened, which leaves the sides practically unobstructed for the crowd to pass out.

After the tickets are taken at the turnstiles, the crowd finds its way to the seats by means of 12 portals on each side to the 4 ft. 6-in. level near the bottom of the seat bank through which the lower 32 rows are fed, and six ramps which feed the upper 14 rows of the lower deck and the 22 rows of the upper deck.

At the dedication game, Oct. 21, 1922, there were 70,000 people packed into the stadium, but due to the newness of the structure and the inexperience of both ushers and ticket takers an exact count of the various entrances is not available.

During the season just closed the turnstile counts at the five home games were: Wesleyan, 25,294; Colgate, 27,819; Dennison, 17,247; Iowa, 40,202, and Illinois, 36,877.

The gates were opened at 12:30 p.m. and the games called at 2. The maximum number of people handled through one turnstile was 3,069 and the average of the four next highest was 2,575. A count of persons passed through a single turnstile for 10 successive minutes averaged 46 per minute. There were two men at each turnstile, one taking tickets and the other operating the turnstile. At the student gate, where the tickets had to be torn from books, the best average for 10 successive minutes was 25 per minute.

Observations during the passing of crowds revealed the following facts:

Portals—There is no congestion of people at any point preceding the game except before the turnstiles, and at these the lines are seldom long. Due to this fact no data are available as to the number of people who could enter the seat banks by the various portals and ramps. The crowds always flowed through these freely. The count showed that averages of 20 and 21 persons per minute passed up a flight of eight steps and through a portal 6 ft. wide. At an average pace

of 90 steps per minute and people two steps apart and three abreast, these openings would accommodate 135 persons per minute.

Ramps—The ramps which feed the upper part of the lower deck and the upper deck have short flights of steps at the bottom and top which limit their capacity. The stairs are 9 ft. 3 in. wide and the ramps are 8 ft. 2 in. wide with a slope of about 15 per cent. These ramps accommodate an average of from 50 to 55 persons per minute while the capacity, figured on the same basis as the portals above, and counting five persons abreast, would be 225 persons per minute.

Exits—After the game the exits from the seat banks would be crowded for a period of from three to five minutes. Various exits showed the following actual count of persons passing out: Lower portals, from 100 to 112 persons per minute as compared with the theoretical 133 given above; and ramps 210, 240 and 190 persons per minute during six minutes of count, as compared with the theoretical capacity of 225 given above. The capacity of these ramps is limited by the stairs at the top and bottom.

This Is Not a May-Pole Dance

PICTURED above are Chinese coolies tamping an earthen dike thrown up as part of a flood-protection development carried out to keep the Yellow River, China, under control. Work was done by the Asia Development Co. Your guess as to what the device is made of is as good as ours.

Conveyor on Sewer Job Saves Labor of Four Men

DIVERSITY of use to which elevating equipment may be put is not usually fully understood by many contractors who may rely too greatly upon manual methods where economy would seem to demand installation of machinery for materials handling. A good example of the economy of mechanical means is to be found on a Milwaukee sewerage job, Wenzel & Hennoch being the contractors.

For concreting below ground, two surface plants have been arranged, the conveyor and bin system having been decided upon after two other methods had been tried. A bucket elevator was discarded because it was not fast enough, and the use of a dump car running to the mixed skip from storage piles in the street, used too many men. From a gang of seven by this latter method installation of a belt conveyor reduced the number to three. One man only is required at the conveyor and he is available half the time for other work. At 60 cents an hour per man the monthly saving

From Job and Office

Hints that Cut Cost and Time

in labor by the installation of the conveyor amounts to around $500. It is therefore easy to see that the equipment would soon pay for itself through the economies that it effects. Then when the job is finished the conveyor will have been paid for and can either be used on other work, or turned in for resale with profit to the contractor.

The bin shown in the accompanying view holds 30 cu.yd. of stone and 15 yd. of sand. From this bin the

BELT CONVEYOR USED ON MILWAUKEE SEWER JOB

material is proportioned for a mixer below. The conveyor loads the bins in the morning, being shifted so as to discharge into either the sand or stone compartments. It has unloaded ten large trucks of 4-yd. capacity in 50 minutes. The regular hopper has been built up on each side, the width of the track. A wooden ramp enables the truck to get to the proper dumping height above the hopper.

The information contained in this article was secured from the Barber Greene Co., East Aurora, Ill.

14-Story Reinforced-Concrete Hotel Built in Winter Months

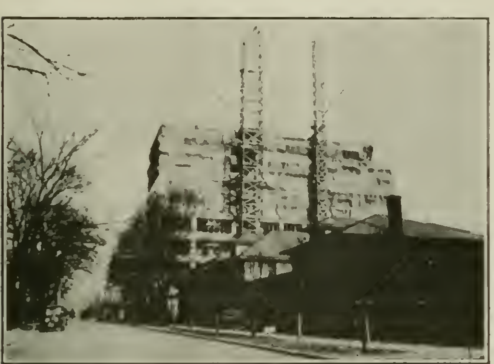
EXTENT to which cold weather concreting may be carried if adequate protective measures are provided is illustrated in the construction of the Keenan Hotel in Minneapolis during the winter of 1922-23. The contract for the building was not let until late in the fall and excavation did not start until Dec. 1, 1922. The ground floor of the building was concreted on Dec. 26, 1922, and the last floor of the 14-story structure on March 2, 1923. This means that all stories were concreted in three months' time—an average of more than a floor per week.

Instead of materials being exposed to cold weather and then heated just before use, they were kept in an inclosed building at the rear of the one under construction. This materials building was kept at the same temperature as that in the portions of the building under construction, or 50 deg. F. As concreting materials were needed, they were conveyed in proper amounts from the storage room and dumped into the mixer, which was placed in a pit below the first floor. Concrete was then hoisted to a level about 20 ft. above the floor being concreted and then chuted into the forms.

Heating was accomplished by salamanders whicl

From Job and Office

For Contractor and Engineer



FIVE FLOORS PROTECTED DURING WINTER CONCRETING OF HOTEL

Canvas was fastened at the top and bottom of each floor so that only one floor had to be uncovered at a time. Thus, protection was offered each floor from four to five weeks before being exposed to the cold weather.

burned coke. One salamander was assigned to 750 sq.ft. of space, or 6,750 cu.ft. From fifty to sixty salamanders were in use during construction.

Owing to the fact that concreting was carried on so rapidly, five floors were covered at a time. The canvas used was of a heavy quality. It was so placed that it could be removed from any one floor independently of the rest of the floors. Inasmuch as five floors were thus offered protection, the newly placed concrete in any given floor was kept under cover for a period of four to five weeks. Since the temperature was maintained at 50 deg. or higher, the concrete had ample opportunity to cure before it was exposed to cold weather.

The record time for concreting one floor was three and one-half days and most of this time was taken up in the building of forms, placing of steel, etc. The actual time for placing the concrete in one floor (approximately 200 cu.yd.) was 7½ hours.

The hotel was built by the Fleisher Construction Co., Builders Exchange, Minneapolis, Minn. Cost of the completed structure was in the neighborhood of $1,000,000.

Reinforced-Concrete Piles Fitted With Shoes and Jets

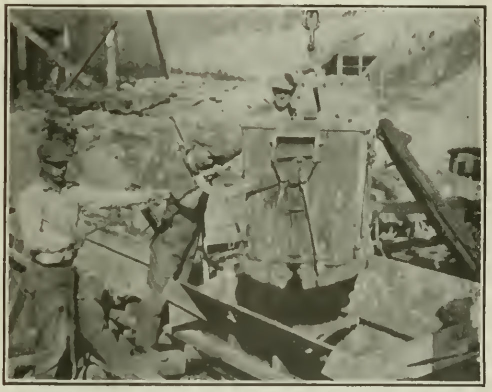
By Harry J. Finebaum

Resident Engineer for Clarence W. Hudson, Hill-to-Hill Bridge, Bethlehem, Pa.

ONE OF the piers of the Hill-to-Hill bridge at Bethlehem, Pa., situated between the tracks of the Lehigh Valley R.R., was founded on reinforced-concrete piles. One hundred piles were successfully driven to rock or refusal, through an overlying bed of sand, gravel and boulders. Twenty-five piles were 25 ft. long while the other 75 were 32 ft. long, these lengths being determined by three reinforced-concrete test piles previously driven. The piles were not all driven their full length, because of the hard driving encountered, but the driving was materially aided by two special features: a cast-iron shoe integrally built with the pile; and an internal jetting pipe with twin outlets also integrally built into the pile.

The shoe is shown in Fig. 1. The part in contact with the concrete was of the same shape and cross-section as the point of the pile, and from there on it tapered down to a 2-in. tip. The areas of the tip of the shoe and the foot of the pile proper thus bore a close relationship to their respective crushing strengths. In order to hold the shoe securely in the concrete of the pile, four holes about 2 in. deep were tapped and threaded in the head of the shoe. Into these holes were screwed four ⅝-in. diameter steel bolts about 2 ft. 6 in. long. After the rods were inserted in the shoe, they were bent so that they all crossed each other as shown.

Pouring Concrete from Dump Buckets



DEFORMATION of formwork is liable to result if care is not exercised in dumping concrete when it is placed by dump buckets. To obviate form distortion J. D. Miller, carpenter foreman on Anderson & Bros.' contract at the Tipton dam, Pennsylvania, devised the method herein illustrated of controlling flow of concrete from bottom-dump buckets. The device is merely a light rope with a hook fastened on one end. The hook is placed over the top edge of the bucket and the rope is passed under the bucket and two turns of it are taken around the bail. The doors can then be held to the desired opening.

The whole thing was set at the end of the pile form thus acting as an end form when the pile was cast.

The jetting pipe is shown in Fig. 2. It consisted of three parts: the twin outlet, the tube and the elbow-nipple inlet. To cheapen the cost of these pipes, the twin outlet and the tube were made of light-gage galvanized sheet metal with soldered longitudinal and transverse joints, while the inlet was made up of standard 1½-in. iron pipe fittings.

The jetting pipe was held in the center of the form by wiring it to the radial ties of the reinforcing system in the piles.

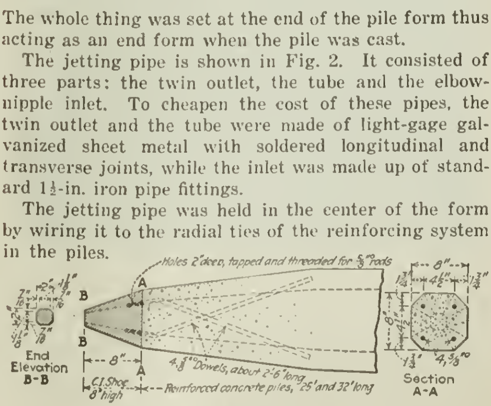


FIG. 1—DETAILS OF SHOE FOR CONCRETE PILE

From Job and Office

Hints that Cut Cost and Time

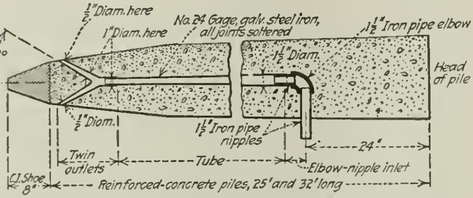


FIG. 2—JET PIPE AIDS IN PILE PENETRATION

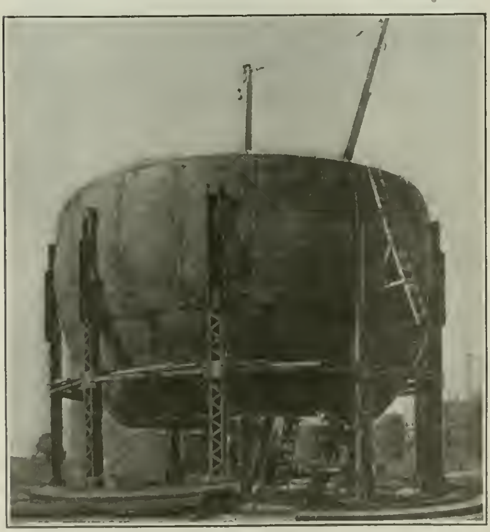
The two ends of the twin outlet were reduced to ½-in. diameter so as to produce a high nozzle pressure, and were located immediately above the head of the pile. These ends were cut to be parallel to the sides of the pile form.

When they did not snugly fit against the sides of the form small wooden plugs, ¾ in. square, were inserted between them and the form so as to form a seal against the entering of mortar into the pipe. These plugs were removed after the forms were stripped from the concrete piles.

Before driving the piles, a steam hose was attached to the nipple of the jet inlet and live steam forced through the jetting pipe, to insure a clear passage.

Spherical Steel Tank Is Novel Structure

SPHERICAL tanks represent a new development in tank design in order to meet the requirements for storing oil products of high volatility. The first of several such tanks, designed and built for the Texas Co. at Tulsa, Okla., by the Chicago Bridge & Iron Works, is shown in the accompanying views. It is 48 ft. in diameter, with a capacity of 10,000 bbl. or 420,000 gal.



BUILDING A SPHERICAL TANK FOR VOLATILE OIL PRODUCTS

In the storage of casing-head gasoline and other highly volatile refined products of crude oil it is necessary to keep them under pressure. Otherwise such products will boil at ordinary temperatures and pass into vapor, much of which is lost when the tanks are opened or when the pumps are started to remove the liquid from the tank. If sufficient pressure is maintained inside of the tank, the casing-head gasoline will be maintained as a more or less stable liquid.

Until about two years ago refined oil products of this kind were stored under pressure in small cylindrical tanks, but as the manufacture increased, attempts were made to store them in larger tanks. The oil men naturally turned to the flat-bottomed storage tank commonly used for the storage of oil and ordinary gasoline, but found that this type did not lend itself to pressure storage. It was evident that the expense of building foundations and anchoring a flat-bottomed tank thereto would practically prohibit the use of this type of tank. As a first step, therefore, H. B. Murphy, manager of the Dallas office of the builders, adapted the design of an elliptical-bottom elevated steel tank to withstand pressure by adding a roof with the same shape as the bottom and designing it for a working pressure of 15 to 20 lb. per square inch. The first tank of this nature, of 10,000 bbl. capacity, was built for the Phillips Petroleum Co. at Bartlesville, Okla. While it was found successful in operation there was doubt as to whether the design was the most economical.

That a spherical tank would make a better design to meet the conditions was suggested by George T. Horton, president of the Chicago Bridge & Iron Works, and the original design was changed to fit this idea. The "hortonsphere," as this spherical tank has been named, is said to have proved a complete success. As far as the detailing of the "hortonsphere" is concerned, it is very similar to the standard practice developed by the company in the construction of elevated steel tanks.

From Job and Office

For Contractor and Engineer

Job and Office Notes

In Connection With an Abstract of the Report on "Renewing Railroad Culverts" heard at the recent convention of the American Bridge and Building Association, and printed in these columns recently, Leonard M. Sandston, consulting engineer of Middletown, Ohio, and associated with the Armco Culvert & Flume Manufacturers Association recalls renewals which have been made by the use of corrugated culvert pipe. "P. F. Jones, reported in *Engineering News-Record*, Aug. 24, 1922, p. 321," writes Mr. Sandston, "how he solved the problem of carrying the south branch of the Davis-O'Connor drain under the main line of the Southern Pacific R.R., and underneath a paved highway without any interruption to traffic by using an Armco corrugated culvert pipe as a tunnel shield to bore through the embankment, with an ordinary screwjack supplying the motive power. The pipe, although unprotected on the driving end, was quite uninjured at the end of the job. Other instances of this kind have been reported from time to time, as follows: R. V. Merkle, engineer to the Turlock Irrigation District, Stanislaus County, Calif., successfully jacked a 36-in. diameter corrugated culvert pipe through a fill of stones and hardpan, under a concrete paved road without any damage either to road or pipe. At Ingalton, Ill., in 1911, 120 ft. of 48-in. diameter corrugated culvert pipe was jacked under the main tracks of the Chicago Great Western R.R. through a fill 35 ft. high. Where it is at all possible to use this method, especially on railroad work, it would appear to have a distinct advantage in that no interruption of traffic is entailed."

When the Compania Hidroelectrica a Irrigadora del Chapala. S. A., of Guadalajara, Mexico, installed their new Las Juntas power house they were confronted with a difficult problem in getting heavy equipment to the site of the power house. There was no railroad reaching the site of this plant and, moreover, a typical Mexican mountain intervened between the nearest railroad and the power site. The solution of this problem was the installation of a wire rope incline 4,370 ft. in length. The total difference in elevation between top and bottom of this incline is 1,722 ft., and the greatest degree of inclination is 39 degrees. It is equipped with a Lidgerwood hoist having a 105-hp. G. E. motor. The car is lowered by a 1⅛-in. patent flattened strand Hercules (red-strand) haulage wire rope. Loads weighing up to 15 tons are handled. This incline was installed in about the middle of 1922 and is still in use. Eight round trips is the average daily mileage of the car.

Building a Reinforced-Concrete Structure without formwork may sound like a peculiar process, but it has been done by a farmer in the construction of a small storage cellar, says a recent issue of the house organ published by the Alpha Portland Cement Co. The spot designated as the location for the cellar was marked on the ground by means of chalk lines accurately squared. The area so marked represented the lines formed by the inner wall and was 8 ft. wide and 12 ft. long. The center of the space was crowned with clay, the center being raised about 12 in. or more from the side. After this crown had been placed it was tamped thoroughly with a wooden mallet and finally smoothed off. Trenches were then dug for the four walls. Care was taken during the digging to see that the inner wall of earth was kept as near true and unblemished as possible. The trench was made wide enough at the top for the digger to work in easily. Walls were 8 ft. high. Before any concrete was poured a door frame 3 ft. 4 in. was made of 8-in. boards and braced. This was then set against one end of the cube of earth, centered and made secure. Concrete was then dumped in about the bottom of the trench until about a foot high whereupon 1-in. boards were placed on the outside of the concrete and earth shoveled on the outside of the board. As soon as the concrete reached the top of the board, the board was raised and loose earth fell against the wet concrete wall, keeping it from spreading. In this way the four walls were built up. Reinforcing was used in short lengths at the corners. When all the concrete was in and had properly set the interior of the cellar was excavated. Hand shoveling and a team with a slip scraper accomplished the excavation. Interiors of walls were found to be almost as smooth as though wooden forms had been used. This method is prescribed as being satisfactory only in walls of unusual compactness—in other words, either heavy clay or soils.

In Connection With the Installation of a new pumping outfit at Tully, New York, recently, it was found necessary to cut a section about 8 by 12 in. through the side of a steel basin ¼ in. thick in order to admit the suction pipes, writes Louis Mitchell, dean of the L. C. Smith College of Applied Science, of Syracuse University. The top of the steel casing was flush with the ground so a trench was opened about 6 ft. deep at the point where the pipes were to enter. In order to obviate delay in cutting the opening with a drill or torch (the latter not being available in the village), the plant attendant who is an expert rifleman brought out his rifle and shot holes around the section to be removed. These holes were made from ½ to ¾ in. apart and the section was then chiseled out, taking only a couple of hours to complete the work. A No. 303 "Featherweight" Savage rifle was used with soft nose bullets. The attendant stood about 20 ft. away from the tank and as the trench was darkened by the building over the basin, a lantern was set by the side to light the section exposed. The shots were fired at an angle so that after piercing the steel shell they entered the water and did not damage the other side of the tank.

An Application of the Welding Process which illustrates the value of oxy-acetylene welding in the fabrication of steel structures as well as the possibilities offered for reclaiming used material has recently been demonstrated by a midwestern concern which has designed and built a well drilling driver constructed of reclaimed pipe and fabricated by welding and cutting. This driver has been used to drill a number of artesian wells, and has very satisfactorily stood up under the severe usage to which it has been subjected—according to the Linde Air Products Co. The drilling driver is built of 2-in. pipe and other material reclaimed from the scrap pile. It consists of two uprights 25 ft. high with a cross-bar 5 ft. long, all of 2-in. pipe; these forming a rectangular structure open at the bottom. The crossbar is joined to the uprights at the two corners by welding. The uprights rest upon two base plates 12 in. square and ¾ in. thick, and are welded to these plates. The frame is braced by welding two pieces of 2-in. pipe from the crossbar to the two uprights. Eye-bolts are welded to the top and about the middle of the frame on each side and guy wires are attached to these. When the driller is in use the guy wires run from these eye-bolts to iron stakes 15 in. long and 1 in. in diameter which are driven into the ground. A collar welded to each of these stakes prevents the guy wire from slipping off. The hammer is made of a section of 14-in. pipe to the bottom of which a round piece of 1-in. plate has been welded. The hammer is weighted to give it a total weight of about 150 lb. and a piece of ⅜-in. plate is welded to the top. An eye-bolt is attached to the center of the top plate by welding, this being the point of connection for the cable by which the hammer is raised. The cable runs through a pulley which hangs from an eye-bolt welded to the top cross member and from this pulley the cable runs to the cable winding drum. Extending laterally from the hammer and welded to it are two arms. These are in turn welded to sleeves which slide up and down on the uprights and serve as guides for the hammer.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Help for a Federal Contract Law

Sir—I read with interest the editorials in *Engineering News-Record*, Nov. 1, pp. 203 and 205, one entitled "Function of Contracting" and the other, "For a Federal Contract Law." Both the subjects covered by these well-considered articles are pending before the Inter-Departmental Board of Contracts and Adjustments of the United States.

In the latter article, the sentence which especially attracted my attention was: "If the board follows its procedure in drafting the standard contract form to invite aid in arriving at decisions from the whole construction industry, engineers and contractors can play a useful part in formulating the general federal contract law. There are few employers of which they have more loudly complained in the past. Let them be as ready to help put away the causes of complaint."

The last sentence is good advice and I believe far more important than even you realize. I hope that you can see your way clear to make this exhortation stronger and clearer, and to accomplish this you may have to emphasize it by repetition. When I organized this board, I realized that contracts had to be fair and equitable to both parties. It was true that in the past high-class contractors and men who sold supplies to the government had in many cases just cause for complaint against the contractual procedure of the United States Government, including its form of contracts. In performing the task assigned of simplifying and standardizing as far as possible contract procedure and contract forms, I knew our work would not be of benefit unless we considered both parties to the contract. Not knowing or being able to know the other man's viewpoint without consulting him before the contract was drafted, I adopted the policy of inviting suggestions and constructive criticism of contractors, engineers, architects and others who might be directly or indirectly interested in government contracts. (All taxpayers are indirectly interested in this subject as in the long run they have to pay the cost.) Accordingly, I sent out several hundred copies of a tentative form of contract, accompanied by a questionnaire, and I can assure you that our board has carefully considered every constructive criticism which it has received. Some changes we would like to make are prevented by federal statutes which have been passed from time to time, not by the contracting officers of the United States Government, but by the congress elected by our citizens. Many of these statutes are unduly restrictive in the interest of the government against the contractor, and there are other objections well set out in your articles.

The subject of the new federal contract law, while important, is not a sensational subject to attract attention or throw the spotlight on any politician who might wish to advocate it or oppose it. Therefore, it is most important that thoughtful people, organizations and publications should continue the advocacy for such a law and show their congressmen and senators the necessity for the enactment of a non-political, non-partisan bill in the interest of the government and its citizens, whether they contract with it directly or not. I can assure you that the principle of consulting the other party in advance is being followed in relation to the new federal contract law, as I have written many letters asking for suggestions regarding this law, and I will appreciate any suggestions I can get from you as to how this matter can be brought forcibly before the largest number of your readers.

I also hope that you can further assist by having other suggestions sent in regarding the new standard form of contract which is now being considered by the board. Again quoting you, "Let them be as ready to help to put away the cause of the complaint" by taking a little time to send in some constructive criticism. GORDON A. RAMSEY,

Chairman, Inter-Departmental Board of Contracts and Adjustments of the United States.

Chicago, Ill., Nov. 14, 1923.

Aluminum Paints Reduce Radiation

Sir—Reference is made to the article in *Engineering News-Record*, Sept. 27, 1923, p. 522, entitled "Radiation Reduced by Aluminum Paints." While the radiation from a surface bronze painted is greatly reduced, the transmission of heat by convection is not correspondingly reduced. In total, an aluminum or "gold" bronze coated radiator will give off about 76 to 83 per cent as much heat as an unpainted radiator of the same size and shape, with other conditions equal (*cf.*, Bureau of Standards *Technical News Bulletin* No. 77 of Sept. 15, 1923, Art. 18). Radiators coated with ordinary oil paints and enamels give off from 97 to 103 per cent as much heat as an uncoated radiator.

New York, N. Y., Oct. 26, 1923. G. S. BURRELL, Commander, (CEC), U. S. N.

Vibration in Water Wheels

Sir—It is possible that another contributing cause to the troublesome vibrations in the runners of hydraulic turbines, mentioned on p. 764 of your issue of Nov. 8, 1923, is that the frequency of the fundamental note of the individual vanes of the runner agrees with or is a simple multiple of the frequency of the pressure changes. A number of years ago I found that this was the case with the rotor of a steam turbine, the plucked tone of a single (small) blade having a frequency almost identical with that given by the r.p.m. of the rotor. The substitution of thicker blades, having a lower fundamental, did away with the steady breaking of blades that had nearly prevented the sale of the product.

In the case of the runner that produced the record given in Fig. 3, p. 764, there were about 150 vibrations per second, or a vibration each time a runner vane, at 450 r.p.m., passed each one of the twenty guide vanes. The fundamental note would be not far from D in the bass clef, not unreasonable for a piece of metal of the size indicated. The cutting away of the strips on the edges of the vanes would not only muffle the pressure changes and decrease the efficiency by increasing the thickness of the water ring, but the change would also increase the frequency of the fundamental note of the runner vane and so prevent it from synchronizing with the pressure changes.

H. S. S. SMITH,

Stroudsburg, Pa., Nov. 14, 1923. Emeritus Professor of Civil Engineering, Princeton University.

Publicity for Proposed Laws

Sir—Regarding your editorial in the Nov. 15 issue of *Engineering News-Record*, p. 788, entitled "Power and the People," which referred to our recent election and the proposed constitutional amendment covering water power development on state lands in the Adirondacks, you do not mention the cause, which, in my opinion, had more to do with the defeat of this measure than any other. That is the practice of the majority of the voters in voting No on general principles on all propositions which they do not understand. I know that was the case in this city, where the people do not take a great deal of interest in the public parks in the Adirondacks. Questions like this are decided largely according to whether the proponents or opponents put forth the better grade of propaganda. There was so little agitation on this question previous to election that it is not surprising the amendment was lost.

Let those who are materially interested in having such an amendment pass do a little advertising and educate the voters regarding the wisdom of passing the measure, and possibly it will have better success next time.

Jamestown, N. Y., Nov. 17, 1923. WALTER F. SHAW, Consulting Engineer.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

All Missouri Road Construction Records for the State Highway Commission were broken during November when $1,907,461.94 was actually paid to contractors for completed work.

Voters of Aberdeen, Wash., on Dec. 1 passed Wynooche power project bill involving the expenditure of $2,000,000 to provide additional water supply and hydro-electric power for the city. The mayor and city council are pledged to secure complete cost data before proceeding with actual work.

At the Annual Convention of the American Society of Mechanical Engineers held in New York City last week, John R. Freeman, past-president of the American Society of Civil Engineers, was awarded the A. S. M. E. medal. The award was made for his service to industry through his activities in fire prevention.

The Temple Bill, Providing for the completion of mapping the United States in twenty-five years, will have the endorsement of Secretary of War Weeks and Secretary of Interior Work, assurances to that effect having been given recently by these officials to L. W. Wallace, executive secretary of the Federated American Engineering Societies, who explained the need of this legislation to the two secretaries.

City Planning and Zoning at Nashville, Tenn., has been made the subject of study of the Engineering Association of Nashville, which recently submitted a brief report on the subject to the city authorities. The local situation was reviewed and a number of recommendations made. A paragraph in the report of broad general interest is one advocating that the association assist "the city engineer in bringing the public and the city government to a due appreciation of adequate municipal engineering practice and work." A. F. Ganier is chairman of the committee named.

To President Coolidge Has Been Addressed a letter by Dean Hugh Miller of George Washington University protesting against the removal by Secretary of Interior Work of A. P. Davis, former director of the U. S. Reclamation Service and an alumnus of the Corcoran Scientific School, predecessor of the George Washington University Engineering School, the protest being made "because Dr. Work's action is so detrimental to the technical work of all departments of the government." The letter requests the President to take official cognizance of the matter and to have a thorough examination made of all the events leading up to this action of the Secretary of the Interior.

State Highway Officials Hold Annual Convention

Constitution Revised—Organization Plan Laid Before Members—Department Turnover and Legislation Leading Topics

Engineering News-Record Staff Report

With representation from all but two states among the 200-odd state officials present, the American Association of State Highway Officials carried through an extensive program of technical discussions and committee work in the four-day meeting at New Orleans, La., Dec. 3-6. Development of committee work was the prominent feature of the meeting. With the exception of the annual message of Thomas H. MacDonald, chief of the Bureau of Public Roads, one full day was devoted to sessions of the 12 committees and sub-committees, and a large part of two sessions was occupied in considering the reports of these committees. It was clearly indicated that, as the committees developed their plans and as research studies now well begun are completed, the technical activities in annual convention will consist largely in the reading and discussion of committee reports.

Constitution Revised

Three classes of members, active, associate and honorary, with dues of $10 for active and $6 for associate members, or dues of $200 for an entire state department, were agreed upon. Only active members can vote and they must be chief directing officials of state road departments. The associate member classification provides for subordinate officials. Honorary membership provides a place for "former state and territorial highway officials and the professors of highway engineering in accredited universities," and for others who "shall be proposed by a member and elected by the executive committee." It is provided further that in case the president, who must be an active member, shall retire from official connection with state highway administration or shall leave the office vacant by other reason, the vice-president shall act as president in the interim between annual elections.

In the new organization, a president and executive committee act through bureaus of administration, special assignments, general office, publications and standards and through such committees and sub-committees as may be necessary.

Committee Work

Few of the committees have proceeded far enough to do much more than report progress. Publication will soon be made of the report on methods of conducting tests and of standards for metal bridges and culverts. The association journal, *American Highways*, is being issued quarterly. At present the committee funds are too limited to permit of any extension of its publication work. Recent organization of a committee on administration has permitted it to get no further than to adopt a plan of operations. A definite report at the next annual meeting was forecast.

The most active progress has been made by the committee on standards working through its sub-committees on plans and surveys, on design, on specifications, on traffic control, and on bridges and structures. No changes in the Bureau of Public Roads standards for making surveys and plans were considered now necessary by the com-

Federal Budgetary Provisions for Engineering Services

Washington Correspondence

In line with the desire of the administration to cut federal expenses so that there can be a substantial decrease in the national debt in the coming fiscal year engineering services have been given few increased appropriations in the report of Director of the Budget.

The budget which just has been submitted to Congress provides $130,000 to enable the Bureau of Standards to co-operate with government departments, engineers and manufacturers in the establishment of standards, methods of testing and inspection of instruments, equipment, tools, and electrical and mechanical devices used in the industries and by the government. This includes the practical specification for quality and performance of such devices and the formulation of methods of inspection, laboratory and service tests. This will permit of some expansion of this work. The amount appropriated for the current fiscal year was $100,000.

For the investigation of standards of practice and methods of measurements of public utilities, such as gas, electric light, electric power, water, telephone, central station heating, and electric railway service, the budget carries $105,000. This is an increase of $10,000.

For technical investigations in co-operation with industries upon fundamental problems involved in industrial development, with a view to assisting in the permanent establishment of new American industries, the budget carries $180,000. This is $30,000 more than was made available for use during the current fiscal year.

Britain Given Turbine Contract

The Newfoundland Power & Pulp Co. has awarded the contract for the seven Francis type turbines of 14,000 hp. each, or 98,000 hp. total, to Armstrong-Whitworth & Co., Ltd., England. The company is building on the Humber River in Newfoundland.

mittee on plans and surveys. Announcement of prog.ess was made by the committee on transport. The committee on specifications called attention to the standards for contract and bidding forms reported last year and urged their greater use and recommended substitution where desired of negotiable securities for guaranteed bonds.

Design and construction received more definite consideration than any of the other committee subjects. The committee on relations with contractors reported only moderate progress in advance of the general principles laid down last year. Special effort was made by the contractors' unit of the joint committee to obtain definite action for bonding reform but action was limited to decision to hold a further meeting, with the bonding companies represented, to seek an agreement on policy practice.

The committee on design recommended the limiting of vehicle loads to 800 lb. per inch-width of tire and to 19,000 lb. on one axle. It limited vehicle length including trailer to 65 ft., overall width to 9 ft., height to top of load 12½ ft., minimum axle spacing 5 ft. and wheel gage to 54 in. The maximum rim of solid tires was limited to a thickness of 1½ in. Subgrade testing was recommended and also the use of a sand layer in unstable soils. The usefulness of tile drainage was considered to be undetermined. In slab design the formulas reported by the Illinois Bureau of Highways for edge thickness, $T = \sqrt{\dfrac{3W}{S}}$, and for center thickness, $t = \dfrac{7T}{10}$, were recommended. The report favored modulus of rupture tests instead of crushing tests and longitudinal tongue-and-groove joints with dowels.

Following the extensive report last year in construction organization and management the committee on construction advocated these practices in detail: (1) Separate contracts as grades, surfacing, structures; (2) developing the use of local materials; (3) payment of materials in stockpiles; (4) fills to stand one year before surfacing; (5) use of 1-in. maximum size gravel without rolling; (6) longitudinal joints in concrete paving; (7) care to avoid segregation in stockpiles; (8) proportioning concrete by weight; and (9) the use of calcium chloride for curing.

Business Action

Perhaps the most important business action was the discussion to promote actively in the present Congress a federal aid program calling for an appropriation of $100,000,000 yearly from July 1, 1925 for three years, and in addition $10,000,000 for forest roads, 70 per cent of which should go to routes forming links in the federal-aid system. In his report the executive secretary called for active aid in advancing this program before Congress. In reporting a practice in financing road work the executive secretary gave the following figures of the sources of income in percentages:

Source	Construction	Maintenance
Tax levies	51.8	15 9
Auto licenses..........	35.8	55 7
Gas taxes	9.5	16 4
Other sources.	2 9	2 0

Officers for the ensuing year were elected as follows: President, F. R. White, chief engineer, Iowa Highway Commission; vice-president, F. F. Rogers, state highway commissioner, Lansing, Mich.; secretary, C. M. Upham, state highway engineer, Raleigh, N. C.; and treasurer, F. T. Sheets, superintendent of highways, Springfield, Ill.

Sir William MacKenzie Succumbs

Sir William MacKenzie, Canadian railroad financier and builder, died in Toronto on Dec. 5 after a long illness.

He was born in Kirkfield, Ont., Oct. 30, 1849, was educated in the public schools and later attended the military school at Toronto. He taught school for a short time after leaving that institution and then went into business. When the Toronto and Nipissing line of the Grand Trunk was being built he went into railway contracting.

In 1886 he met Donald Mann and went into partnership with him, a partnership which resulted in the construction of the Canadian Northern Ry. as a transcontinental line, a work that brought knighthood to both men. Sir William MacKenzie served as president of the Canadian Northern Ontario Ry., and of both the Winnipeg and Toronto street railways and numerous other smaller public utilities.

A fuller biography of Sir William MacKenzie will be given next week.

Lord Shaughnessy Dies

Thomas George Shaughnessy, more familiarly known as Sir Thomas Shaughnessy, and recently as Lord Shaughnessy, chairman of the board of directors of the Canadian Pacific Ry., died suddenly of heart trouble at Montreal on Dec. 10, aged 70 years.

Lord Shaughnessy was born in Milwaukee, Wis., on Oct. 6, 1853. He attended the public schools of that city and when 16 years old entered the employ of the Chicago, Milwaukee and St. Paul Ry. In 1882 he went to Canada with Sir William Van Horne as general purchasing agent for the recently organized Canadian Pacific Ry. He continued in the service of that railway company during the remainder of his life, becoming assistant to the president in 1889, a vice-president and director in 1891, and president in 1899, retiring to become chairman of the board of directors in 1918. It was largely through his efforts that the Canadian Pacific became the great rail and water transportation system that it is today. His services to his adopted country were recognized by knighthood in 1901, by the rank of commander of the Victorian Order in 1907, and in 1916, for his distinguished services to the empire in the war he was elevated to the peerage.

Drainage Congress at St. Louis

The National Drainage Congress has selected St. Louis for the annual meeting, to be held Jan. 16 and 17. The Levee and Drainage Contractors Association will hold its meeting at the same time and place. C. S. Gannon, St. Louis, is secretary of both organizations.

Harbors Congress Debates Chicago Water Diversion

Strong Argument Counters Opponents' Claim of Navigation Damage, Treaty Contravention, Etc.

Engineering News-Record Staff Report

A debate on the diversion of Great Lakes water through the Chicago drainage canal into the Mississippi River was a leading feature of the nineteenth National Rivers and Harbors Congress, held at Washington, Dec. 5-6. W. G. Bruce, of Milwaukee, and C. A. Maguire, mayor of Toronto, Ont., attacked the diversion, while G. S. Williams, Ann Arbor, and R. I. Randolph, Chicago, defended it. No decision was rendered.

Mr. Bruce raised the question whether one region shall be permitted to injure another and persistently defy the law and violate government orders. He stated that Great Lakes shipping suffers a yearly loss of $750,000 per inch of decrease of navigation depth, or for the 6-in. decrease caused by the Chicago diversion a total of $4,500,000 per year. He questioned whether compensating works such as have been proposed by the Chicago Sanitary District would effectively compensate, and held it doubtful whether Illinois could legally spend money on works in other states.

Mr. Maguire stressed the international phase of the question and criticised sharply the Chicago claim that it cannot dispose of its drainage without polluting waters that are a common possession. He asserted that Chicago is the only large city that continues to dispose of its sewage in raw state and he pointed as an example to the requirement placed upon Toronto by the government authorities of Canada that it purify its sewage and refrain from discharging it raw into Lake Ontario.

Proponents of Diversion

Gardner S. Williams denied categorically and in detail that the Sanitary District diversion of 10,000 sec.-ft. is contrary to law or to federal authority, that the primary purpose of the diversion is power development, that the diversion contravenes the 1909 treaty with Great Britain, and that the diversion damages navigation. Mr. Randolph reviewed a considerable number of arguments presented against the Chicago diversion. He showed that Chicago is now spending great sums of money for sewage purification, this, however, applying only to the sewage flow exceeding the diluting capacity of the 10,000-sec.ft. drainage canal flow. He countered the charge that the lower rivers are polluted, by referring to the dismissal of the St. Louis suit and to the fact that all the river cities discharge raw sewage into the rivers. He answered the charge of navigation damage on the Great Lakes by describing the lake-level fluctuations due to other causes, and claimed that the magnitude of these fluctuations robbed the lowering due to the Chicago diversion of all real effects.

He also denied with detail argument the charge of violation of law and violation of treaty obligations, and stated on the question of violation of law that the case is still in court. He asserted that Canada is now drawing a large amount of water in excess of its treaty allowance, and charged that the violation is so flagrant as to lead the International Joint Commission to appoint commissioners to determine the amount.

Founder Societies Discuss Power Development

Mechanical Engineers, Closing Annual Convention, Meet with Civil and Electrical Societies

Engineering News-Record Staff Report

As a part of the program at its annual meeting the American Society of Mechanical Engineers held a joint meeting with the civil and electrical engineering societies to discuss the development of hydro-electric power. The meeting was held in the Engineering Societies Building, New York, Dec. 5 with Lewis B. Stillwell, past president of the A.I.E.E., presiding.

John R. Freeman, a consulting hydraulic engineer, and past president of both the civil and mechanical societies, opening the meeting with a paper on the principles underlying hydro-electric development, reviewed the improvements in the use of water power during the past fifty years and sketched some difficulties which have made many projects either poor paying or failures. Mr. Freeman foresees possible extensive changes in long-distance power transmission, making possible the economic development of isolated power sites, but he also feels that such improvements may have their present advantage largely offset by improvements in heat engines. Dissipation of the "propaganda and fog" which now surrounds the question of hydro-electric development and education of the public to understand that much of our power which now is "running to waste" cannot be developed, transmitted and distributed in our great centers of population at a cost necessary to compete with steam power, he believes. He takes the case of the St. Lawrence as typical, enumerating how some engineers claim that this power can be developed and sold in competition with steam power at great population centers, while other engineers are equally positive that it cannot be developed. In conclusion, Mr. Freeman said that our fundamental problem in the development of these resources is to determine how soon we need it, what it will cost, how much we can pay for it, and how much is needed.

Other Speakers

John P. Hogan, a member of the civil engineering society and a consulting engineer on hydro-electric developments, gave an exposition of the pitfalls which face unwary designers of hydro-electric projects, summing up causes of such failure in the phrase "over-estimation of the amount of water and under-estimation of the cost." He stressed the fact that over-estimates of flow are due to our short-duration runoff records, none of which is long enough to give a true value for the minimum flow. Under-estimates of cost are due to the lack of complete preliminary studies of the power site, its accessibility, its surface features, and particularly its subsurface conditions.

Col. Hogan was followed by George A. Orrok, a member of both the mechanical and civil societies and a consulting engineer for the New York Edison Co. In his paper on water power costs vs. steam power costs. Mr. Orrok pointed out that the present low cost of coal, particularly in the great coast cities, and the high cost of transmitting hydro-electric power to those cities, gives steam power the advantage. According to his figures, hydro-electric power will not be able to compete successfully with steam power until the price of coal reaches $10 or $12 a ton.

The last paper of the evening was presented by Harold W. Buck, of the electrical engineers, on the interconnection of power systems. Its value lay in its clear statement that the major problem lies in the proper correlation of the two sources of power so that full advantage can be had of both systems of water and steam power. With diagrams Mr. Buck showed how, by the use of small blocks of steam power, the continuous output of a hydro-electric plant on a steam of variable flow could be largely increased. He mentioned the Cohoes plant on the Mohawk River as a typical example, wherein a steam reserve of 10 per cent made it possible to double the installation of hydraulic machinery. He does not think that a superpower system will reduce the general cost of power, but he does think that it will benefit manufacturing plants in isolated localities and will make it possible to develop water-power sites otherwise valueless.

The meeting was closed by some brief discussions and a general summing up by the chairman, in which he emphasized the necessity of standardizing the frequencies of our water and steam power plants so that a superpower system can be built up without excessive cost for changing machinery.

Subway to Replace Elevated Ry.

A proposition to replace the 6th Ave. Elevated Ry. in New York with a 4-track subway has been put forward by a large number of property owners along the avenue. The plan calls for five miles of subway to be paid for by a property assessment.

Reclamation Advisers Hear News-Record Editor

In his weekly news statement on the work of the Committee of Special Advisers on Reclamation, Governor Campbell, chairman, last week announced that the committee had taken testimony of F. E. Schmitt, associate editor of *Engineering News-Record*, concerning facts and views gathered on a two months' trip over a number of reclamation projects during September and October. Governor Campbell stated that Mr. Schmitt had contributed a large amount of valuable information and had apparently come to the conclusion that reclamation as a general policy is sound; that it would have rather violent ups and downs, but that it should be continued. Former Secretary Garfield expressed the opinion that much good would be done by the articles on reclamation published in *Engineering News-Record* in drawing greater attention to the problems of reclamation on the part of engineers.

Senator Gooding, who appeared before the commission during the week, laid chief blame for the troubles of the reclamation farmers at the door of the railroads. He advocated a five-year moratorium, reclassification of land and repayment on a forty-year plan.

Governor Campbell announced that the commission is gathering full information in regard to freight rates and other transportation matters.

D.-O. Process Permitted for Austin, Minn.

However, State Board of Health Classes Plant as Chemical Treatment and Explains Position

Faced on the one hand with the conclusion that the electrolytic element of the direct oxidation process of sewage treatment adds materially to lime treatment alone except through the mixing of the paddles used in the electrolizers and on the other by the opinion of the Attorney General that lack of proof of the efficiency of any portion of a proposed sewage-work is not sufficient to warrant disapproval of plans for the whole plant unless the questioned element is considered to be detrimental to the satisfactory working of the plans, the Minnesota State Board of Health has approved plans for the treatment of the sewage at Austin, Minn., by the direct-oxidation process, but as a chemical precipitation plant only, and with the distinct understanding that the "electrolizers cannot be considered as more than devices for additional mixing of the lime with the sewage until it can be demonstrated to the satisfaction of this board that the electrolytic portion of the process is of material value in the treatment of sewage."

The plans in question, at least in general outline, were submitted to the State Board of Health on Aug. 16. They included screens followed by lime treatment and the passage of the sewage through electrolizers into settling tanks equipped with Dorr thickeners, the tank effluent to be discharged into the Cedar River. The sludge is to be pumped to a rotating filter then passed to a dryer. At a meeting of the board held on Nov. 6 a report was submitted to the board and action taken along the general line already stated, with the proviso that detailed plans and specifications should be submitted to the board in duplicate. On Nov. 16 the plans were submitted and approved.

Chemical Precipitation Reviewed

The lengthy resolution adopted by the board on Nov. 6 includes in its preamble a review of the general status of chemical precipitation, in which it is pointed out that, aside from the very few direct-oxidation installations in use, the cities of Providence, R. I., and Worcester, Mass., are the only ones in this country where chemical precipitation is now in use, and that works which will permit the abandonment of chemical precipitation at Worcester are now being built. The preamble also expresses the opinion that while chemical precipitation in itself is satisfactory and produces an effluent that will be satisfactory, with ample dilution, so long as the "causticity due to the excess lime" continues, yet there is always the possibility of offensive decomposition when certain conditions arise. Should this happen at Austin it might be necessary to abandon a large part of the proposed plant, the preamble points out, since "caustic sewage cannot readily be treated" biologically.

It is understood that the City of Austin has not yet signed a contract for the proposed direct-oxidation plant but is to delay action until information can be had on the outcome of the tests of the process being made at Toronto under the direction of F. A. Dallyn, engineer, Ontario Board of Health.

Report on Rapid-Transit Lines for Detroit

Local Benefit Assessments Proposed to Pay for Most of System—Alternative Plans

Reporting on rapid transit in Detroit, the city's rapid-transit commission (Daniel L. Turner, consulting engineer) has just advised the Mayor that the cost of a complete system will be so great as to make the solution of the financial problem the primary consideration, but that a complete system should be built, rather than individual lines as piecemeal items of a system, since the latter increase congestion and unbalanced city growth. The commission presents a plan for financing construction which would provide the larger amount of the required capital by local-benefit assessments, a smaller part by general taxation, and the capital for equipment by a bond issue. It indicates that either an underground system or a system largely elevated with short underground portions near the center of the city might be built, and states that a decision of which kind of system is to be built should be reached before a plan of routes is developed. The underground system would be more costly that the elevated but is otherwise preferable. The report does not in terms recommend either system. It says:

"The routes of the initial rapid-transit system for Detroit are dependent to some extent upon the type of structure. An underground system may be constructed along any street without injuring it. Elevated lines should be confined to the outlying sections of the city, but if such construction must be carried through the business centers the principal thoroughfares should be avoided and less important streets traversed."

Underground System

For the underground system, a new method of construction is recommended, called the "tunnelway" system. This would have its main portion constructed by tunneling, at sufficient depth to avoid service structures near the surface, but the stations would be placed at summits of the line and would be constructed by excavation direct from the surface. Such a system is estimated to cost $3,200,000 per mile of double-track structure, and $1,500,000 per mile for equipment, a total of $4,700,000. The financial plan recommended would raise $800,000, or one-fourth of the cost by general assessment on the city, and $2,400,000, or three-fourths of the cost, by local assessment. The $1,500,000 equipment cost would be met by mortgage bonds. An elevated system, with underground construction in the center of the city could be built for $3,500,000 per mile, it is reported, $2,000,000 of this amount being cost of structure. "Detroit can have a tunnelway system," the report states, "if it wants to pay the price. Otherwise it must accept an elevated system, with all the disadvantages that such a system means.

The present bonding power of the city is said to be not over $30,000,000, and of this amount only a small part would be available for rapid transit construction. This is the basis for the financial plan proposed by the commission. Local benefit assessments, the report recommends, would be spread over the land a half-mile either side of lines.

Cleveland Names City Manager

At its meeting called especially for the purpose, city council-elect of Cleveland, Ohio, last week elected William Rowland Hopkins as the city manager for that city. Mr. Hopkins will take office on Jan. 8 next. Meanwhile council will meet to fix the manager's salary, which is unofficially quoted as being near $25,000 a year.

Mr. Hopkins, who is best known as an attorney interested in engineering development and municipal problems, is 54 years old. He was born in Johnstown, Pa., but went to Cleveland with his family as a child.

He is a graduate of Western Reserve University. His chief work for Cleveland has been in promoting the belt-line railroad.

Cornell to Hold Highway Conference

A conference on highway engineering is to be held at Ithaca by the Bureau of Highways of the New York State Department of Public Works, Dec. 18-20, under the auspices of the school of civil engineering of Cornell University. The program for the conference includes papers upon all phases of highway engineering and transport.

During the first day speakers will include Col. Frederick Stuart Greene, New York, H. E. Hilts, Pennsylvania State Highway Department, Clifford Older, chief engineer of the Illinois Bureau of Highways; Harley C. Dunbar, assistant engineer of the New York State Bureau of Highways, and A. T. Goldbeck, of the Division of Tests of the U. S. Bureau of Public Roads. The first day's program will end with a smoker at which speakers will include Dean D. S. Kimball of the College of Engineering at Cornell, Dean W. A. Hammond of the University Faculty and Lowell Grossman, Commissioner of the Bureau of Highways in New York.

Traffic studies and regulation, and pavement maintenance will feature the second day's session. J. Gordon McKay, chief of the Division of Highway Economics and Transport, U. S. Bureau of Public Roads; John A. MacDonald, commissioner of highways, of Connecticut; Julius Adler, deputy engineer of the Bureau of Highways of Philadelphia; William A. Van Duzer, transport engineer of the Pennsylvania Highway Department; A. W. Brandt, second deputy of the New York State Bureau of Highways and Paul M. Tebbs, field engineer of the Pennsylvania Highway Department, will be the speakers.

The feature of the third day's session will be the conference of division and county engineers of the New York State Bureau of Highways. This conference is usually held at Albany. Previous to this conference, which will be held the afternoon of Dec. 20, "Essentials of Highway Construction" will be discussed by Theron M. Ripley, division engineer of the Bureau of Highways, New York; "Proper Relation Between Engineers and Contractors," by Roy Hall, division engineer of New York Highway Department, and "Snow Removal," by Frank F. Rogers, commissioner of highways of Michigan.

Random Lines

Explaining Osteopathy

Osteopathy is a new kind of therapeutics, separate from, and independent of the system of medicine. It covers in its comprehensive view the whole field of practice, including surgery and obstetrics, in which it has had signal success. It is more than manipulation. It is really adjustment. While the hands are used, it is not this alone and chiefly that constitutes its method of operation. *It is engineering, in the highest sense.* It is above the plane of "movements"—for there are no movements—no more than in bridge-building. The great principles of construction and production, the efficient action of multitudinous parts dependent on construction, the establishment of complicated processes in an interminable circle of causes and effects, all issuing in one united result—health—all these underlie the osteopathic idea of adjustive manipulation. — From "Osteopathy as Explained by The Encyclopedia Americana."

* * *

The Latest Batch

"The Magnetic House Cleaning Engineer"—Advertised in the Satevepost.

"Surface Protection Engineers"—Frederick J. Cadmus, Jr. & Co., painters and cleaners of Detroit.

"Social Engineers"—Dr. Henry Jackson, formerly pastor of the Swarthmore Presbyterian Church, at Swarthmore, Pa.

"Milk Engineers"—Majonnier Bros. Co. in the Chicago classified telephone directory.

"Feed Plant Engineers"—S. T. Edwards & Co., also in Chicago telephone directory.

* * *

More Polar Determination

Sir—The instance of animal magnetism which you give in this column in your issue of Nov. 22 is very good. There is another instance, however, but no date is attached. Three Scotch sailors were caught in the fog off the coast and could not get their direction. Finally a piece of canvas was smoothed out, each man holding a corner. Then the national bird was produced from the bared breast of one patriot. It was flung onto the sail cloth, landing on its back, but it soon righted itself, crawled about in a circle and then struck off to port. Jock pointed in that direction and said: "Well, I'll no be for telling the north but there's the direct route to Scotland."

C. R. C.

* * *

The New Botany

ST. CLAIRESVILLE, OHIO, Oct. 26.—A deed sent here for recording the sale of a farm near Bridgeport gives the starting point for the surveyor's description of the acreage as a "mahogany tree." (Press Clipping.)

Private Capital to Develop Falls of the Ohio

Washington Correspondence

Following the recommendations of its engineers that private capital be allowed to develop the power in the Falls of the Ohio near Louisville in preference to having it developed by the city of Louisville (*Engineering News-Record*, Aug. 30, 1923, p. 362), the Federal Power Commission has issued a preliminary permit to the Louisville Hydro-Electric Co. covering this site. In line with this action, the commission has also denied the application of the City of Louisville for a preliminary permit covering proposed developments on the Cumberland and Green Rivers. The decision in the Falls of the Ohio case has been pending for a long period, while the commission considered the priorities which are allowed to municipalities under the water power act, and while it carried out an investigation as to whether municipalities are in a position to conduct the distribution and sale of power in areas outside of their jurisdiction.

The engineers in their report pointed out that in order to make this development effective, the municipality would have to construct a steam plant and distributing system as an auxiliary to it, which plant and distributing system the Louisville Hydro-Electric Co. already has available.

Last Section of Hetch Hetchy Tunnel Holed Through

The last section of the 18-mile tunnel on the Hetch Hetchy project, San Francisco's future source of water supply, was holed through on Nov. 26, 2,180 ft. east of Second Garotte shaft. This section is three miles long and extends from Second Garotte shaft to Big Creek shaft, from which points the two headings were advanced. The headings met with a grade discrepancy of 0.94 ft. and a difference in alignment of 0.25 ft.

At present the concrete lining of the Hetch Hetchy tunnels is being placed at only one point, but lining will be under way with two complete equipments at an early date. With one plant pouring two 8-hr. shifts and moving plant the third, the present progress is about 120 ft. per day, pouring sides and arch which contain a total of about 1½ cu.yd of concrete per lineal foot.

On Dec. 1 the construction crews in the mountain division on the Hetch Hetchy project totaled about 1,200 men.

Canadian Institute to Meet

Announcement has just been made that the annual meeting of the Engineering Institute of Canada is to be held in Ottawa, Wednesday and Thursday, Jan. 23-24. The general meeting is to be convened at Montreal on the morning of Jan. 22, but the session there that day will be merely for the purpose of appointing officers and nominating scrutineers to count the officers' ballots. The regular sessions start the next morning at the Chateau Laurier in Ottawa. Wednesday will be devoted to reports of committees and to papers, with a banquet and smoker (somewhere in Quebec) in the evening. Thursday morning will be devoted to professional meetings with a visit to the Rideau Canal in the afternoon and a ball in the evening.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 10-11, 1924.

AMERICAN ROADBUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 14-18, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York, Jan. 16-18, 1924.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Chicago, Ill., Jan. 21-24, 1924.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 22, and Ottawa, Jan. 23, 24, 1924.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

The Engineers' Society of St. Paul has voted to enter the Federated American Engineering Societies. Grover H. Wilsey, editor of the bulletin of the Affiliated Architectural and Engineering Societies of Minnesota, has been elected representative of the St. Paul society.

The Municipal Engineers of the City of New York had an illustrated lecture by Philip P. Farley, consulting engineer, New York City, on the Coney Island Public Beach and Boardwalk Improvement at their meeting Nov. 28.

The Engineers' Club of Kansas City, Mo., will hold its annual meeting Jan. 31, with a dinner dance as the social feature. A. C. Everham is president of the club, and Fred Johnson is secretary.

The Montreal Branch of the Engineering Institute of Canada at its meeting Dec. 6 enjoyed an illustrated lecture on "Irrigation in Brazil," given by Ira W. McConnell, vice-president of Dwight P. Robinson & Co., Inc., of New York City.

The Scientech Club of Indianapolis announces the nomination of the following officers for 1924: Earl Carter, president; D. J. Angus, vice-president; J. L. Wayne, secretary; and Arthur Hood, treasurer. The date of the annual election is Dec. 17.

The Albany, N. Y., Society of Engineers at its annual meeting Dec. 18 will have an illustrated talk on "Siphon Spillways" by George F. Stickney, consulting engineer, Albany, N. Y. Walter N. Mansfield is president of the society, and John W. Henry is secretary-treasurer.

Personal Notes

THOMAS H. MEANS, consulting engineer, San Francisco, and a member of the firm of Cope Rand Means Co., has been appointed consulting engineer of the Banta-Carbona Irrigation District in San Joaquin County, California. Mr. Means, after graduation from Columbia University and service in the U. S. Department of Agriculture in irrigation and drainage study in France and Africa, was connected with the U. S. Reclamation Service, and later in private practice. He was engineer in charge of maintenance and operation on the Truckee-Carson project, consulting engineer of the Anderson-Cottonwood Irrigation District, and engineer on many soil surveys and irrigation investigations.

HENRY Z. OSBORN, Jr., who has been chief engineer of the Board of Public Utilities, Los Angeles, Calif., has opened an office in the Pacific Finance Bldg., Los Angeles, for consulting engineering practice. Mr. Osborn was formerly engineer of the street planning department of Los Angeles and chief deputy in the city engineer's department.

FRANK A. RAVEN has tendered his resignation as superintendent of public works of Albany, N. Y., a position he has held for two years, in order to return to consulting engineering work. Mr. Raven for many years has been consulting engineer for the Albany Felt and Ludlum steel companies.

R. STUART MCKENZIE, of Montreal, has been appointed consulting engineer to the Dominion Engineering & Inspection Co. of Montreal. Mr. McKenzie graduated from McGill University in 1901 and joined the engineering staff of the Canadian Pacific Ry. as chief draftsman in the bridge department. In 1910 he was appointed assistant engineer of bridges for the Grand Trunk Pacific Ry. At the end of two years he entered private practice as a consulting engineer, specializing in foundations and hydro-electric work. In 1920 Mr. McKenzie became associated with the Dryden Paper Co. as construction engineer, and designed, and built the hydro-electric plant at Eagle Ruin, Ont. Later, for the Manitoba Power Co. he was field engineer on the 168,000-hp. hydro-electric development at Great Falls, on the Winnipeg River. Mr. McKenzie has been a member of the council of the Engineering Institute of Canada.

LOUIS BROWNLOW, for several years city manager of Petersburg, Va., has been appointed city manager of Knoxville, Tenn., and will take up his new work Dec. 15.

C. C. COTTRELL, manager of the Good Roads Bureau of the California State Automobile Association, has resigned to become chief engineer of the Western Willite Co., paving contractors, and will make his headquarters in Los Angeles. Mr. Cottrell has given valuable aid in promoting highway progress in California, having urged the conclusion of the controversy between the Victory and Lincoln highways and the designation of the Victory route in southern California, which also assures the completion of the Wendover cutoff. He was active in securing road revenue legislation abolishing the horsepower tax and substituting a nominal registration fee and two-cent gasoline tax. Mr. Cottrell was superintendent of highway construction and maintenance for the state of California from 1913 to 1917, assistant state highway engineer of Nevada for a time and state engineer of Nevada from 1918 to 1920. In Nevada he was responsible for the construction of 225 miles of highway.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Interviews with Industrial Executives—3

Service Policy Aims at Proper Selection and Use of Steel Forms

This is the third of a series of "Interviews with Industrial Executives" in which Albert C. Lehman, president, Blaw-Knox Co., Pittsburgh, relates how the contractor is helped before work starts and while it is in progress.

The fourth interview will appear in an early issue.—*Editor*

As a means of enabling contractors and engineers to get the best results from the construction plant they purchase the Blaw-Knox Co., Pittsburgh, manufacturer of steel products including forms for concrete, portable buildings, storage and measuring bins, and clamshell buckets, has set up a policy of service both before and after the sale of its equipment. This means, first, studying the work to be done and adapting the equipment to it, and, second, making the equipment function on the job to produce the best results. The details of this twofold obligation which the company has assumed are set forth in the following notes based on information *Engineering News-Record* has secured from Albert C. Lehman, president of the manufacturing organization:

"All the men who represent the Blaw-Knox Co.," Mr. Lehman explained, "sell service first and equipment second. We feel that service has the same large value to our customers as to ourselves. Consequently our service begins prior to the sale, continues while the equipment is being manufactured, and does not cease until the customer has practically finished his work."

Plant Layout Studied

Mr. Lehman was asked to amplify his statement concerning service prior to the sale of equipment.

"In the construction field," he replied, "our company supplies contractors not only with steel forms but also with overhead material-measuring bins, known as batcherplants, and clamshell buckets. In approaching a customer, therefore, our sales engineer is concerned not with a single detail of plant but with the contractor's general plant layout and the possibility of adapting our equipment to his needs. We often find it possible to make useful suggestions regarding the best combination of equipment for handling the work at the least cost and in the minimum time. The service-before-the-sale, therefore, may take the form of revamping the contractor's ideas about his general scheme of construction.

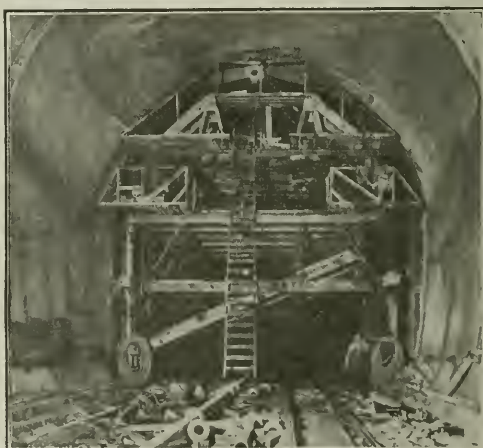
"In most large engineering projects there is, as a rule, no initial consideration given to the steel forms the contractor will use in his concreting work. There are in his mind, however, very definite ideas as to the results expected from the forms. This condition makes it necessary for the manufacturer's sales engineer to be able to analyze the customer's specifications, and, in consultation with him, plan equipment which will absolutely meet the conditions of the work to best advantage."

After the sale has been consummated, Mr. Lehman explained, the company renders service to its customers by erecting the equipment in its own shop prior to shipment. In this way the field work is reduced to a minimum and there is no question as to shop workmanship. This is a service, it is claimed, which the average purchaser of steel forms or similar equipment which is dismantled and shipped knocked down, does not usually appreciate. This is true particularly of equipment designed to meet special conditions and where substitution for parts that do not fit is impossible.

Advice on Form Erection

At the time of delivery of steel forms to contractors the Blaw-Knox Co. furnishes complete erection drawings. An experienced erection engineer is also sent to the job to give the contractor such assistance as he may require in setting up his forms and getting proper results from them. This service man is kept on the job until the steel forms are performing in a manner satisfactory to both purchaser and manufacturer.

"As construction progresses," Mr. Lehman continued, "we revisit the job from time to time to see that the contractor's workmen are handling the plant economically and safely. We check up on the number of men working on a job and sometimes are able to point out to a contractor that his costs are higher than they should be. Our interest in the steel forms for concrete work does not cease until the job is completed."



To Insure Perfect Operation on the Job Large Steel Forms Are Erected at Company's Shops Before Shipment
Traveling forms for concreting 32-ft. tunnel, Niagara Falls Power Co.

Accessory Equipment

The same sort of service that is given on steel forms for concrete construction is rendered for clamshell buckets and batcherplants. In the case of the buckets, the company stresses the importance of proper rigging in order to secure smooth working and maximum capacity. In the case of the batcherplants it is essential at the start to have the equipment erected properly.

"From a purely selfish standpoint," Mr. Lehman concluded, "it is profitable to any manufacturing company to give

Japan Will Be Heavy Buyer of Equipment and Materials

American Manufacturers Urged to Prepare Sales Campaigns for Demands Under Permanent Reconstruction Plans

Active buying of materials and engineering equipment under the Japanese permanent plan of reconstruction is expected to start early next year according to Luther Becker, chief of the Iron and Steel Division of the Department of Commerce, who urges American manufacturers to prepare their sales campaigns now "if they are to reap the full advantages of the opportunities offered." Next spring should see unusual activity in the Japanese trading market says Mr. Becker and these precautionary measures are urged in view of the keen interest and active preparation of our foreign competitors, noticeably the British and German.

"American manufacturers," said Mr. Becker, "are strongly intrenched in the minds of the Japanese trader and consuming public because of the good-will established during the war when their products for the first time gained wide recognition and approval. Our modern steel and ferro-concrete buildings proved their worth when they came through unscathed in the recent catastrophe at Tokyo, and to the Japanese people will stand as monuments to the fame of American practice and quality. It therefore obligates the American producer to back up this well earned reputation and come forward at this time of urgent need to co-operate with the Japanese in restoring their cities and factories,"

Reconstruction Program

The reconstruction program for Japan involves two distinct phases the temporary and the permanent, the first of which has gotten underway. Because of the necessity for quick action in housing the homeless community during the coming winter the Government, through its Reconstruction Board, authorized the purchase of building materials that can readily be converted into cheap temporary buildings. In accordance with this plan the Japanese government has placed several orders in America and England for lumber and steel products and it is believed that additional orders will be placed in the United States.

Out of the deliberations and conclusions of the Diet Dec. 10 will come a permanent program which in interest and from the standpoint of trade value of the requirements for materials and plant equipment for reconstruction will far surpass, the Department of Commerce predicts, what has already been accomplished towards providing temporary relief. A permanent building code will have been evolved which will determine the types and size of buildings, kinds and quality of materials, more economical and efficient methods of construction, and fire-preventive measures.

For the larger buildings—government and municipal, office, hotel, bank and theater—use will be made, according to the Commerce Department, of the steel-frame and reinforced-concrete types of construction, which best withstood the unprecedented shocks by earthquake on Sept. 1 and the fires which followed. The relative high costs of steel and concrete construction in Japan will prohibit the adoption of these types for the ordinary native house.

the best it has in the way of information and guidance to its customers. The equipment manufacturer wants the user to make money; it wants him to use his equipment properly. The reaction from a policy of this sort is bound to be favorable to the company following it. In addition, the manufacturer benefits by bringing in from the field, through visits of his service men, ideas that may be utilized in future designs of equipment. By rendering service to contractors, therefore, we ourselves are taught real lessons in construction work and in the design and operation of the equipment with which it is carried on."

More Bidding Time Needed

Manufacturers of equipment endorse C. G. Richardson's complaint (see "Engineering News-Record," Nov. 8, p. 783, and Nov. 22, p. 866) against necessity of hurried preporation of estimates on proposed work.

Elevating and Conveying Machinery

By F. E. Van Slyke

Jeffrey Manufacturing Co., Columbus, Ohio

IN MANY CASES we have to refuse to quote on municipal equipment due to the short time allowed in which to prepare a proposal. Municipal engineers usually work out very elaborate specifications which do not always correspond to standard equipment supplied by various manufacturers. This often means alternate proposals, one in accordance with the engineer's specifications and one in accordance with the manufacturer's specifications. Then again, these proposals usually have to go through certain routine and a certified check must be furnished in every case. This all takes time and the four weeks mentioned could be extended, with advantage to all concerned, to six or eight weeks from the time the bids are mailed until the proposal is to be closed.

From the manufacturer's viewpoint a hastily prepared proposition can not be absolutely accurate in all details and a lot of guessing has to be done in arriving at a final price unless ample time is provided to figure out all of the details. On the other hand, the short time sometimes allowed prevents many manufacturers from even submitting a bid, as it is considered hardly worth while in view of the time limit.

From the purchaser's viewpoint a too short time means that they may not get the best possible equipment, as only a few bidders will go into the proposition. If the time had been lengthened they would probably have two or three times as many propositions, with ample time to give them all consideration.

Filter Plant Equipment

By H. W. Hosford

Norwood Engineering Co., Florence, Mass.

OUR attention has been called to Mr. Richardson's article in your Nov. 8 issue (p. 783) in reference to the shortness of time allowed manufacturers to prepare bids for municipal waterworks equipment. We wish to endorse Mr. Richardson's views in this matter.

We manufacture and install equipment for mechanical rapid sand filtration plants. In a great many cases the engineer specifies that prospective bidders are to furnish detail drawings of their standard equipment, properly arranged to fit the proposed lay out. Many times the time between the advertising of the bids and the date set for receiving them is so short that it is impossible to do this. As stated by Mr. Anderson of the Chapman Valve Manufacturing Co. (see *Engineering News-Record*, Nov. 22, p. 866), there are many cases requiring special equipment on which we have to obtain prices from other manufacturers, which we are unable to do for the reason stated above.

Only recently we had occasion to bid on three different plants located in widely separated parts of the country, bids for two of which were received exactly the same day, and the third one on the following day. We had less than ten days to prepare all three bids. Needless to say, we were unable to bid on all of these jobs.

We believe that the engineers as well as the municipalities are desirous of obtaining as many competitive bids as possible on their work, and we cannot urge too strongly the advisability of allowing the different manufacturers more time in which to prepare their bids.

Last Call!

MANUFACTURERS: Preparation of "Engineering News-Record's" Annual Editorial Review of Machinery and Materials—to appear in the first issue of the New Year—has begun.

If you have not already sent us a brief statement covering the outstanding improvements made in your products during 1923, it is requested that you do so at once. Otherwise the Review may omit adequate mention of your organization's contribution to the year's progress.—Editor.

Business Notes

Pawling & Harnischfeger Co., Milwaukee, manufacturer of excavators, cranes and machine tools, has recently appointed R. P. McCormick as Eastern sales manager with offices at 50 Church St. New York, and Stephen-Girard Building, Philadelphia.

National Steel Fabric Co., Pittsburgh, has appointed H. D. Beaton Eastern manager, with headquarters in the Harrison Building, Philadelphia. Other recent appointments are those of W. L. Whitman as district manager, with offices at the Philadelphia address above referred to, and of C. S. Reno as district manager in charge of the company's office and warehouse at 523-5 West 33rd St., New York.

B. F. Sturtevant Co., Boston, announces the opening of its new plant in Camden, N. J., to which the former Philadelphia division has been transferred. The new works include modern daylight shop buildings for the manufacture of sheet metal work involved in heating and ventilating equipment.

PORTLAND CEMENT ASSOCIATION, at its annual meeting in New York Nov. 21, elected the following officers: President, F. W. Kelley, Helderberg Portland Cement Co., Albany, N. Y.; first vice-president, Blaine S. Smith, Universal Portland Cement Co., Chicago; second vice-president, L. R. Burch, Atlas Portland Cement Co., New York; treasurer, John W. Boardman, Huron Portland Cement Co., Detroit. W. M. Kinney continues as general manager of the association.

FRANK H. DEWEY, for two years sales engineer of the Wood Hydraulic Hoist & Body Co., Detroit, has been made assistant general manager. He was connected with the Horizontal Hydraulic Hoist Co., Milwaukee, until that organization was absorbed by the Wood company.

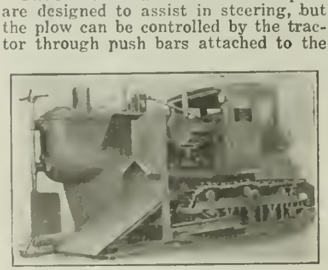
Equipment and Materials

Twin Rotary Snow Plow

For clearing snow from highways, Monarch Tractors, Inc., Watertown, Wis., is manufacturing from designs prepared by its chief engineer, A. C. Webb, a twin rotary plow mounted on the front end of a tractor, as shown in the accompany photograph. With other types of plow, the manufacturer states, there is a tendency, under certain conditions, to build up a wall of snow on either side of the roadway, forming a canyon out of which it becomes difficult to plow snow as winter progresses. The rotary plow, however, is designed not only to move the snow from the highway, but to throw it far to one side by means of a pair of revolving three-vane fans.

The Monarch rotary snow plow weighs about 4,500 lb., is 8 ft. in width, and is a self-contained unit powered by a Beaver heavy-duty industrial motor. The two heavy steel fans shown in the illustration are chain-driven at a speed of 350 r.p.m. Each fan can be disconnected independently by means of a twin-disk clutch. The fans run on Timken roller bearings.

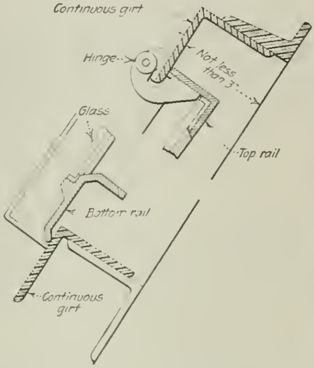
The front shoe and rudder of the plow are designed to assist in steering, but the plow can be controlled by the tractor through push bars attached to the



crawlers. Movable guide vanes around the fan control the height and distance to which snow is thrown sideways.

Steel Sash Improvement

A recent improvement in continuous sash for factory and industrial buildings has been introduced by the David Lupton's Sons Co., Philadelphia, in the form of a new section of bottom rail for the Pond type of sash. In this new construction the bottom rail has its



outer face flush with the glass, so that water will run off freely when the sash is open. In the earlier design the rail had a horizontal flange on the outside and drip holes in this flange were depended upon to prevent pocketing of water when the sash was open and the flange therefore inclined downward. These drip holes would clog occasionally, retaining the water so as to cause corrosion of the steel. This condition is avoided in the new design.

One-Man Earth Mover Has Power Supplied by Tractor

Designed for use with a shovel, a ditcher or a crane attachment, the earth-mover shown in the accompanying

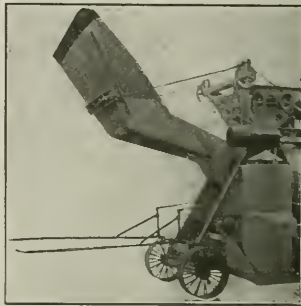
illustration has just been announced by the Insley Manufacturing Co., Indianapolis, and will make its initial appearance at the Good Roads Show in Chicago next month. The equipment is powered by a Fordson tractor and is intended as a one-man machine of low first cost as compared with other types of excavating equipment employed by road contractors, quarry operators and material-handling organizations.

By varying the attachments the machine may be made to serve as a ⅜-yd. shovel, a ½-yd. ditcher or a ⅜-yd. clamshell bucket outfit.

Skip-Guard on Paving Mixer Prevents Accidents to Loading Crew

To prevent accidents to the crew on the loading end of mixers for concrete road construction the Chain Belt Co., Milwaukee, has developed an automatic skip-guard for its Rex pavers. Most of these accidents have been due to the lowering or falling of the loaded skip which, in the case of the 21-E machine, has a weight when loaded of 2½ tons.

The automatic guard, illustrated herewith, consists of a strong pipe framework securely fastened to the lower main frame of the paver and completely encircles the loading skip. It is automatic in its action. When the skip is on the ground this guard rests on the ground and in no way interferes with the loading of the skip. As the skip is elevated the guard rises with it until



the guard attains a breast-high position, or a distance of 3½ ft. from the ground. At this point it stops and prevents any workmen around the skip from inadvertently getting under the skip while it is in its elevated position. As the skip returns to the ground for the next batch it lowers the skip-guard with it.

An effort is now being made to secure from liability insurance boards a reduction in premiums to users of the safety skip-guard.

Publications from the Construction Industry

Electric Motors—RELIANCE ELECTRIC & ENGINEERING CO., Cleveland, in a 32-p. vest-pocket size illustrated booklet, offers some useful suggestions on how to select, install, and use electric motors.

Tractors for Snow Removal—HOLT MANUFACTURING CO., Peoria, Ill., has published a 16-p. illustrated pamphlet featuring the applications of its caterpillar tractors, equipped with plows, for removing snow from rural highways and city streets. The tractors are shown operating both with blade and with wing type plows. A point is made of the all-year-round usefulness of the tractor. It may be employed for snow removal in winter and for road building and general industrial haulage at other times.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Production and Materials Stocks in Ten Cities

Drop in Iron, Steel, Brick and Lumber Output—Cement Production Increasing—Dealers' Stocks Ample

Iron and Steel—Over 2,894,000 tons of pig iron were produced during November, against approximately 3,125,000 during the preceding month. The present rate is about that of the corresponding period in 1922.

The steel ingot output reached 2,969,012 tons during November, according to the American Iron and Steel Institute. October production totaled 3,382,986 tons and September 3,161,964, compared with 4,000,695 tons during May, which was the heaviest month of the year.

Lumber—The trend of the lumber movement of the country indicates a decided drop in production and shipments and a slight falling off in demand. The lumber movement, according to the National Lumber Manufacturers' Association, is shown in the following table:

	Four Weeks Ending	
	Dec. 1 ft. b. m.	Nov. 3 ft. b. m.
Cut	1,032,746,118	1,071,142,679
Shipments	939,826,553	986,126,293
Orders ...	903,601,237	920,159,103

Production is now about 2 per cent above normal, with orders 98 per cent and shipments 92½ per cent of normal output. Production, shipments and orders for the four weeks ending Dec. 1, show declines compared with the preceding four weeks, and heavy gains over the corresponding period last year.

Cement—Production during the first ten months of the current year totaled 114,366,000 bbl., against 93,850,000, for the corresponding period in 1922, according to the Geological Survey. With a gain of 22 per cent in production and 17 per cent in shipments, compared with a year ago, a total of 4,597,000 bbl. were available, as a reserve stock for the nation, on Nov. 1, as against 4,149,000, on hand one year ago.

Brick—The report of the Common Brick Manufacturers' Association of America, as of Nov. 1, shows 306,922,000 burned brick on hand at yards throughout the country, compared with 307,633,000 for the month preceding. Many plants are closing down owing to seasonal conditions and during October the output was 163,000,000 brick with shipments at about 145,000,000. Stocks are being accumulated with the expectation of an active demand at the resumption of greater building activities in the spring. Aggregate orders on books have decreased about 8 per cent during the last thirty days, while actual increases in demand are noted in the East and Middle West. The shrinkage in orders is confined to the smaller centers, especially those in agricultural territories.

San Francisco—Stocks of building materials fairly large, with the exception of structural rivets and blue annealed steel sheets.

Los Angeles — Dealers behind on sewer pipe orders. All cement and lime plants active. Brick and tile demand steady and well supplied. Great quantities of lumber arriving at harbor from North Pacific coast. Supplies of all other materials sufficient to meet requirements.

Denver—Hollow tile and sewer pipe stocks low; other materials plentiful.

Minneapolis — Dealers report stocks of building materials ample in all lines, either as in local yards or warehouses or readily obtainable on short notice from nearby mills.

Detroit—Sewer pipe stocks decreased slightly during month; ample supply in local yards for present needs. Small stocks of hollow tile on hand; large deliveries require several days.

Chicago—Sewer pipe production just enough to satisfy small current demand. Stocks of all other materials ample.

Cincinnati—Sufficient dealers' stocks to take care of present demand.

New Orleans — Pine lumber stocks light; demand slow. Supplies of other materials fair; demand good.

Philadelphia—Small but ample stocks of sewer pipe. Hollow tile mill deliveries prompt, although dealers'

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Common brick, Denver, 9,000,000); time required for delivery of carload lots to city job, example: (Lumber, Chicago, 30 @ 60 days); and stocks on hand in general terms, example: (Hollow tile, Cincinnati, plenty.)

	San Francisco	Los Angeles	Denver	Minneapolis	Detroit	Chicago	Cincinnati	New Orleans	Philadelphia	New York
Sewer pipe............	Stocks in good shape	Dealers behind with orders	Supply low	Ample	Stocks decreased slightly	Production sufficient to meet small demand	Stocks large	Fair; demand good	Small, but ample	Sizes 15 to 36-in., double strength scarce
Cement..............	Fairly well supplied	All plants active	Enough	Plenty in local warehouses	Plenty at mills	Very good supply	Sufficient to take care of demand	Plenty; demand good	Sufficient	Plenty; dealers' stocks small but mill del. prompt.
Lime..........	Stocks in fair shape	All plants active	Sufficient	Enough	About 15 to 20 carloads in warehouses	Plenty	Enough	No shortage	Plenty	Market well supplied
Common brick.......	Large reserves	Demand well supplied	9,000,000	Plenty in local yards	Ample supply in local yards	Del. nearly on par with mid-building season	Ample	Sufficient	Well supplied	Del. nearly on par with mid building season
Hollow tile............	Stocks large	Meeting demand	Stocks low	Obtainable on short notice from nearby plants	Stocks small; large del. require several days	Slight drop in demand; stocks good	Plenty	Enough	Small stocks carried; del. prompt	Supply good; water deliveries prompt
Lumber	Plenty fir	Heavy shipments from North Pacific coast	15,000,000 ft.	Ample; demand kept up well	Moderate stocks in local yards	Del. take 30 to 60 days	Dealers' stocks sufficient to meet demand	Stocks light, demand slow	Yards well stocked	Mill del. very good; take 4 to 5 wks. from mill
Asphalt	Unlimited native reserves	Supplies meet steady demand	Sufficient	Enough	....	Plenty	Ample	No market	Small demand; supply ample	Heavy reserves in N. J.
Structural steel... ...	Plenty structurals; rivets and b. a. steel sheets scarce	Sufficient for requirements	Warehouses well stocked	Warehouse stocks ample	No shortage of local warehouse stocks	Fabricators' stocks of plain materials low	Demand small	Fair; good demand	Practically no dealers' stocks left; mill del. good	Structurals comprise bulk of demand

stocks are small. Warehouse stocks of structural steel very low; mill deliveries good.

New York—Brick deliveries in New York nearly on par with the mid-building season. Pine lumber mill deliveries very good; take only four to five weeks from mill. Hollow tile plants competing effectively with Western manufacturers on deliveries. Domestic building materials manufacturers have thus far been able to hold their own against foreign competition, by reason of a greater knowledge of the requirements of the local builders.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for, in Construction News, pp. 321 to 333, are the following:

Lock, Weston, Ky., U. S. Engineer, Louisville.

Factory, Toledo, O., Libby-Owens Sheet Glass Co., $1,000,000.

Disposal plant, Canton, O., $500,000.

Large Contract Let During Current Week

Among the week's announcements of contracts awarded in Construction News, pp. 321 to 333, is the following:

Factory, Amcelle, Md., to Austin Co., Philadelphia, Pa., $2,000,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Dec. 6; the next, on Jan. 3.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb.	$3.64	$4.00	+$4.40	—$3.30	$3.55	$4.20	$3.60	$4.10	$4.25
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.25	5.30	5.00	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.38	3.20	3.45	3.85	3.65	4.10	4.00
Steel pipe, black, 2½ to 6 in. lap, discount	44%	40%	43%	47%	53–5%	36%	33.2@42.2%	35%	47.43
Cast-iron pipe, 6 in. and over, ton	—61.60@63.60	54.75	61.00	57.20@60.20	60.50	69.00	59.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.55@2.65	2.35	2.05	2.10	2.42	2.84	2.61	2.90	2.25
Gravel, ¾ in., cu.yd.	2.00	1.75	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.20	2.00	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	57.00	37.00	54.75	55.50	44.75@45.75	41.75	41.00	29.50	42.00
Lime, finishing, hydrated, ton	18.20	23.00	—20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	1.85	1.50	1.50	2.70	2.10	2.80	9.50
Common brick, delivered, 1,000	22.55	11.00	11.60	11.00	16@18	12.00	15.50	15.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.10	.11	.0724	.075	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1179	.10	.11	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.95	—.95	+1.05	.94	+1.01	1.07	1.03	1.15	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.50@.55	.35@.50	.50	.62½	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on white pine lumber, free on cars at mill. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.47). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in., $119.

Changes Since Last Week

Unevenness continues to be the chief characteristic of the general market, particularly during the present inventory season. Few buyers are purchasing beyond immediate needs, and stocks of materials are being kept as low as possible. Production has fallen off in several of the basic commodities, particularly pig-iron and cotton goods. Increased activity, however, is noticeable in certain branches of the leather industry. Continued heavy car loadings indicate the handling of a vast amount of merchandise.

Few price changes occurred during the week in the basic building materials. Dallas reported an increase of 20c. per 100 lb. in steel structurals and 2c. per gal. in raw linseed oil. Minneapolis also quotes a rise of 2c. per gal. on linseed oil, due to lighter flaxseed receipts, the year's crop being about marketed. Chicago, however, reported a drop of 10c. per 100 lb. in structurals; Dallas, a decrease of $3.50 per ton in hydrated finishing lime and Atlanta, a decline of 1c. per gal. in linseed oil.

The iron and steel situation is briefly outlined as follows: Pig-iron sales smaller. No. 2 foundry iron $21@$22 per gross ton, Birmingham. Coke higher. Finished steel prices firm. Mills receiving inquiries involving large tonnages. Improved railroad demand for steel plates. Oil-storage tank plate requirements small. Structurals continue at $2.50 base, with $2.40 quoted on exceptionally large tonnages; bars, $2.40 per 100 lb., Pittsburgh. Unfilled steel tonnage of the U. S. Steel Corp., Nov. 30, totaled 4,368,584 tons, against 5,035,750, Oct. 31, and 7,403,332 on Mar. 31, 1923. March showed the heaviest unfilled tonnage of any month this year.

A Consolidation of Engineering News and Engineering Record

McGraw-Hill Company, Inc.—JAMES H. MCGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

Volume 91 NEW YORK, DECEMBER 20, 1923 Number 25

Good Will Toward Men

ONCE MORE Christmas comes. Once more we do service to that spirit of good will which is the essence of Christmas. In its material form that spirit is strong in the American people. Never was there so charitable a people; never was there so charitable a period. Out of our great abundance we give freely and the hungry and the stricken of the world can bear witness to our good will toward men. In the Christmas time when this material evidence of good will is so strong may we not consider the need for another kind of good will that is just as surely a part of the Christmas and Christian spirit as the open purse and the generous hand. Are we in danger of becoming intolerant? Are we forgetting that respect for our fellows' opinions and beliefs becomes us and helps them just as much as do less irksome aids for the needy and succour for the hurt? We should be a tolerant people. The founders of our nation fled from the intolerance of their fellows to set up here a government where any man might believe as he would and where the majority should rule. On this principle we have prospered. Let us beware lest we forget. In private difference and public quarrel the Christmas time is a good time to take stock of prejudices and to weigh motives. Good will toward men! Charity in act, yes; but more, charity in thought.

A Chapter Closed

IN TAKING over the plant of the Proprietors of the Morris Aqueduct, Dec. 15, Morristown, N. J., closed a chapter in water-works history. Morristown was one of the sixteen municipalities in the United States which had a public water supply at the close of 1800. At that time 15 of the 16 works were privately owned, the single exception being Winchester, Va. One by one 14 of the 15 cities changed to public ownership until from 1896 to a few days ago Morristown was the sole example to the contrary. Why Morristown should have clung so long to private ownership after the other fourteen municipalities changed we cannot say unless its part was to be the exception that proves the rule or unless it was well satisfied with the service rendered by the Proprietors of the Morris Aqueduct. However this may be, four years ago the people of the town voted decisively for municipal ownership, which seems to have been achieved on unusually favorable terms for the public, as may be seen from the statement of the engineer-mayor of the town printed elsewhere in this issue, together with some data regarding the sixteen water-works of the eighteenth century.

The Chicago Typhoid Outbreak

BOIL-THE-WATER notices in Chicago bring back old days. A recent outbreak of typhoid has been confined to the Hyde Park section of the city. It has no adequate explanation as yet. The Health Department declares that the water supply is the cause, specifies the overflow of sewage at one of the Sanitary District pumping stations, a reversal of flow in the Calumet River, outward winds, and recent offshore bacterial studies in support of its conclusion. But on Aug. 11, the whole Chicago River was in reverse flow for six hours, sweeping into the lake many times the volume of sewage that's alleged to have escaped from the pumping station about Nov. 1 but without notable effect on the city's typhoid. Moreover, supposing mass infection in marked degrees resulted from the relatively minor pumping station overflow, how explain why of intakes two hundred feet apart the water from one alone should carry typhoid to the district it supplies? Chlorination and, it seems, water sampling and tests, are done by the Health Department. In the light of present confusing theories and inadequate data, Chicago should make an immediate and searching study, by means of competent experts, to determine whether it is not imperative that immediate steps be taken to join the other cities on the Great Lakes in providing water filtration.

The Roll of Shame

STATISTICS of the motor car killings in the big cities of the country in 1922, just issued by the Bureau of the Census, show that the evils of excessive traffic are increasing. For the 72 cities over 100,000—counting each borough of New York City as a city—the average deaths from automobile accidents per 100,000 population was 16.2 in 1921 and 16.9 in 1922. In fifty-two cities the number of deaths increased and in twenty they decreased. The worst offender continued to be Los Angeles, which not only topped the list with 29.5 deaths per 100,000 but exceeded its own record killing of 1922 by 2.4, dropping only slightly below its rate of rise of 3.0 for each of the preceding three years. Two smaller cities, Camden and Memphis, came next but they apparently had bad years for their prior records were not so high. The same is true of Atlanta and Baltimore which are fourth and fifth, with the same rate of 24.7. Low rate cities—below 14.0 and consistently so—are Albany, Fall River, Indianapolis, Jersey City, Milwaukee, New Orleans, Bronx and Queens

boroughs in New York, Omaha, Philadelphia, Portland, Ore., Richmond, Va., Seattle, and Spokane. There is something more than coincidence in the continued high or low rate of automobile killings in a city. A visit to the two cities and a knowledge of their people tell in themselves why Los Angeles is the biggest killer and Philadelphia among the smallest. Fair traffic rules honestly observed and rigidly enforced may not save all the lives that are being lost from the coming of the automobile but they will save many. The cities who top this roll of shame must sooner or later come to see it.

Train Spacing or Engine Signals

FAILURE of the engineman of the 20th Century Limited to observe and act upon the automatic signal indications in last week's accident at Forsyth, N. Y., is being used, and rightly so, to emphasize the need of automatic train control, but in so doing it is quite possible that another important feature of the accident will be entirely overlooked. It is the evidence of how insufficient was the space interval between the sections of the train. The flagman was only a short distance from the rear of his train when the following section passed him, so short a distance that any effort he could make was fruitless.

The lack of such space interval between trains is not peculiar to the Forsyth accident; it is common to all of our railroads which handle a heavy passenger traffic and is the result of the more crowded railroads' inability to handle the peak load passenger traffic with their present trackage without running passenger trains in sections close to each other or causing the passengers considerable delay and inconvenience. The operation of regular trains in sections is not inherently wrong. In fact it is safer than running extra trains. The wrong lies in operating the sections close together in order to increase the peak capacity of the trackage and to satisfy the demand that all sections of an advertised train reach their destination as close as possible to the schedule time.

The result is that we have trains traveling at 60 miles an hour only four or five minutes apart, *sometimes less!* Under such conditions no amount of human or mechanical vigilance will prevent a repetition of the Forsyth accident. Automatic train control will reduce the number of such accidents but will not prevent them. Moreover such a system of train control is bound to decrease the vigilance of the enginemen and to increase their dependence on a mechanical device that by its very nature will not be put to the test of operation until the very time that it is most needed. The existing automatic train control devices are largely new and untried. Legislation making their use obligatory before they have been given severe tests under actual operating conditions might easily result in increasing rather than decreasing the number of rear-end collisions or similar accidents.

The road to accident prevention lies in so increasing the space interval between passenger trains that when a train is delayed or stopped there will be sufficient *time* for the crew to protect their train against the failure of the following engineman to observe, or of the mechanical devices to respond to, the danger. And that means some reduction in peak-hour track capacity and some inconvenience to those passengers who do not buy the early reservations on the popular trains.

Reclamation's Trial Balance

IN THIS issue appears the concluding one of a series of nine articles begun Oct. 25, in which men of special knowledge have reviewed the great enterprise of federal arid-land reclamation. The preceding articles outlined its development; this week Congressman Addison T. Smith of Idaho, himself a settler on irrigated land and now chairman of the House committee on irrigation of arid lands, sketches some future needs and possibilities. Together, the articles direct the reader's thoughts to the present problems of reclamation and the broader problem that lies just ahead.

A large responsibility confronts the American people. Reclamation of land by national enterprise has reached the end of an epoch. The easily irrigable lands, the readily available waters and the eager settlers of prior years are no longer at hand. Much land still awaits reclamation, but it presents new and far more difficult conditions. Are we to go forward? And are we to do so by the methods of the past? The people must decide. The issue involves the sound growth of the nation.

Hitherto the subject has not received much attention from the men in the eastern half of the country. Most of them have thought of it hazily as the building of great works somewhere in the West. Nor for that matter has the average Westerner been adequately familiar with it, for land reclamation is vast and complex. A wise policy, however, must root in sound public opinion. It is our hope that the articles now concluded may help to disseminate the information from which such opinion may be formed.

The future attitude of the country toward reclamation involves questions of great moment, which we hope to discuss briefly later on. Our present concern is whether the past twenty years' work in reclamation has been successful or not. Has the enterprise been mismanaged, as the Secretary of the Interior claims? This must be answered before it is possible to think constructively of future policies. The answer is found in the facts set forth in the articles, and in supplementary field observations reported in a series of letters written from a staff survey, which also closes in the present issue.

Reclamation is shown to be an over-all success. It has developed thousands of farms and homes, and produced hundreds of millions of dollars worth of food supplies. It has enriched the West in values and in money by an amount many times greater than the sum invested by the nation. It has done its work at moderate cost, and by processes of high efficiency and virile honesty. It faced extreme difficulties, and dealt with conditions and problems incomparably greater than those of private irrigation. Federal reclamation took up those developments that were too difficult for private enterprise; it watered the land at no greater construction cost than private undertakings, at equal or lower operating cost, and with even-handed fairness and efficient service to the thousands of farm families for whom it was undertaken. Seen at large or in detail, the facts consistently show that planning was farsighted and able, that construction was of high quality and low cost, and that operation was efficient and economical.

This is the broad showing of reclamation's trial balance. There have been those who impugned the record

on the ground that some structures were too costly and others not good enough. There have been those who pointed with reproach to a leaky reservoir bottom in gypsum, to a canal or a dam damaged by landslips, to valves and conduits which wore out rapidly while serving under unprecedented conditions, to wells which did not yield the expected amount of water, to unforeseen gas and water troubles in driving a tunnel, or to occasional cost figures exceeding anticipations based on different conditions. Fair consideration of all the facts, we are sure, will lead the impartial observer to dismiss many of these reproaches as unfounded, and to accept the others with feelings of relief and surprise that so few mischances, errors and unforeseen obstacles should mark the history of a great pioneer undertaking.

The facts also show that both the operation and the construction phase of reclamation are permeated with engineering requirements to a degree that makes engineering direction essential to good results. This conclusion applies throughout, from project management to direction of the Service as a whole. Herein will be found one of the important lessons for the future, and a damning reflection on the course now pursued by the Department of the Interior in resorting to politician management in the guise of "business administration." Political exploitation of farm development spells destruction.

Reclamation has had its troubles, however, and has them today. When it invited the pioneer to take up its lands, it failed to remove from his path the traditional hardships and often miseries of pioneering; and all the curse of those hardships and miseries has been visited upon it. On the urgent plea of land owners and promoters who desired the government to better their fortunes it went out into the West and built dams and canals, only to find itself drawn into a struggle against the cupidity of the owners, who seized upon the increase in land value without paying for the works. It not only lost the struggle but in addition it made enemies of those with whom it fought. Reclamation was planned to subsidize the settler seeking a home on the land; in a large measure it has subsidized the money-lender and the land speculator instead.

Moreover, weakly or sympathetically reclamation went far outside its field. Though intending to do no more than build irrigation works, it soon became a retailer of water; and, unlike a public-utility company, it was burdened by its governmental character and by interference from Congress and the executive department to the degree that it was unable to collect its water charges regularly. Thus it fell into the part of philanthropic guardian of the irrigators. It was wholly unequipped to deal with a hundred thousand obstreperous wards, who would not operate their water-supply, would not drain their lands, and would not co-operate in developing the farming methods needed to suit the special conditions of their situation. And, while still in this guardian position, it encountered an agricultural crisis of unparalleled severity, all of whose evil effects were charged against the sins of reclamation. Normal governmental mechanism is not constructed to cope with such difficulties.

At the bottom these evil results are chargeable to reclamation itself. To carry out its purposes under the conditions that had to be met it needed to apply a more fatherly care of its wards, coupled with effective control. Neither was provided for in the law or in the administrative policies based on it. Departmental government along conventional lines is not adapted to paternalistic functioning. Now that we may look back at the experiences of a generation it seems clear that in undertaking to assure the growth and good fortune of far-spreading pioneer communities as it did, without co-operation of local government, the federal government engaged in what was really a colonial adventure, one to which ordinary administrative methods were wholly unsuited.

The faults back of this condition are not due to engineers, however. They were committed by the government itself, by the statesmen and officials of administration after administration. If what was done is an indictment, it indicts the governmental principles on which reclamation has been built up. It indicts bureaucratic and Secretarial management, and demonstrates that technical control must be supreme if so great an enterprise is to make consistent progress. For many reasons, therefore, a new reclamation policy is called for. To spend the nation's wealth for further reclamation development until such new policy is established would invite disaster.

In the meantime it is gratifying to observe that the present reclamation projects have largely worked through their difficulties, and as a whole no longer constitute a problem. It is true that the reclamation farmer is not in a comfortable position, but he is only in the same plight as other farmers, and for the same reasons; the general farmer needs help but he cannot be helped by tinkering with reclamation debts. The difficulties and hardships due to reclamation itself have been overcome. There are, however, detail problems in the various projects. Most of these problems will work out successfully under present laws and administrative methods. Others may be relieved by improving the present law and strengthening or broadening the local administration accordingly.

Such adjustments as these are required: Individual deferment of the government debt of some farmers is called for as a matter of sound and fair business. Blanket deferment such as legislated in the past two years and again proposed in Congress has been shown to be thoroughly unsound, and in the present juncture would be little short of calamitous; but Congress should authorize individual extension of payments for cause, on businesslike terms. Provision should be made for removing serious injustices now existing, by giving authority to adjust the debts according to variations in land quality and climate. Authority should be given for writing off certain lost investments that have been made in the course of the reclamation development, in order that the clouded title of some of the projects may be cleared. Finally, agricultural promotion work is needed on the projects, to support the government's desire that the projects become prosperous farming communities and its demand that the loans be repaid.

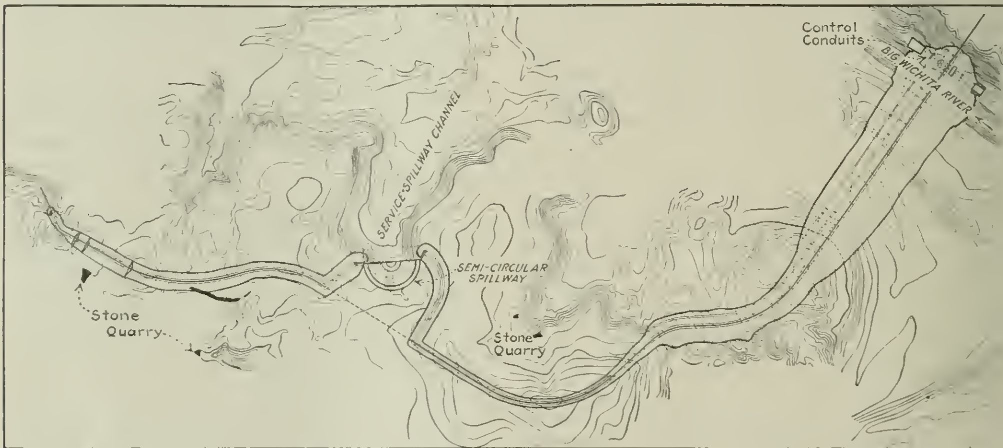
Under capable engineering management, such measures will assure the fuller success of the reclamation development created by the labors of twenty years. It is for Congress to enact these measures into law and thereby take the final step in realizing upon the country's reclamation investment. It is also for Congress to give tardy recognition to the engineering responsibilities of reclamation by requiring the Service to be under direction of a competent technical authority and preventing its being the plaything of party politics.

Fast Hydraulic Filling of the Wichita Falls Dam

Monthly Lifts of 12 Ft. Each Were Made with Material Consolidating Immediately and Supporting Dragline Throwing Up Levees for Pool

By Albert S. Fry and R. A. Thompson and O. N. Floyd
Morgan Engineering Co., Memphis, Tenn. Chief Engineer and Assistant Chief Engineer Wichita Co. Water Improvement District 1, Wichita Falls, Tex.

The HYDRAULIC fill storage dam of the Wichita County Water Improvement District 1, 40 miles west of Wichita Falls, Tex., is practically completed. As noted in *Engineering News-Record*, June 21, page 1080, the main structure is 7,500 ft. long, has a 100-ft. maximum height and contains 1,500,000 cu.yd. of fill. of which 1,285,000 cu.yd. was placed by hydraulic dredge and the remainder by teams. A second article, in *Engineering News-Record*, June 28, page 1118, described the flooded dry-fill diversion dam 15 miles downstream from the storage dam. This third article deals mainly with the construction of the storage dam which was carried up at a rapid rate by means of an electrically-operated hydraulic dredge built within the reservoir where was found an almost ideal material for quick consolidation. Wooden bulkheads retained the pool on the upstream side; on the downstream side it was retained by levees thrown up by a small dragline excavator. Riprap on the semi-circular spillway slope consists of a thick rubble paving of limestone cap rock found on the site while on the water face of the main dam an 18-in. hand-placed layer of the same material was used.



STORAGE DAM OF WICHITA COUNTY WATER IMPROVEMENT DISTRICT 1

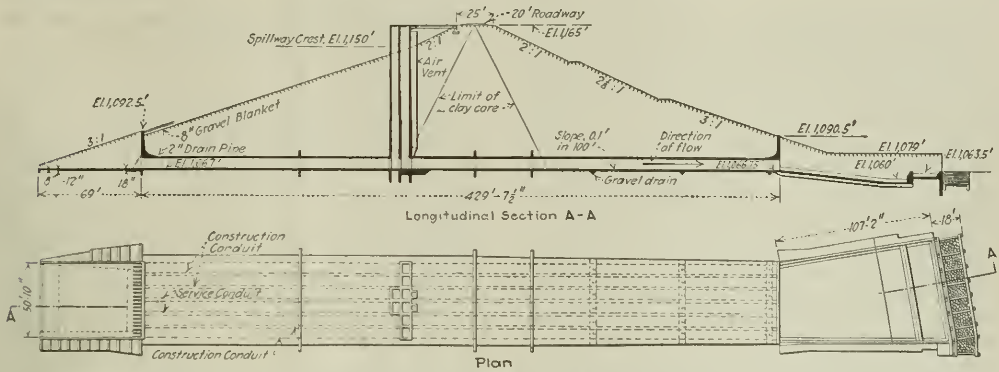
The storage dam is located 8 miles from Mabelle, the nearest station on the Wichita Valley R.R. At the beginning of construction, a road was built from this point to the dam over which to transport equipment and materials. Most of this road was on the top of a divide and no grading was required except at a few steep places which were cut down by a 1-cu.yd. gas crawler tractor shovel as it was being moved in.

Conduits—At the dam site the river channel is close against the south side of the valley and the six 7-ft. circular reinforced-concrete outlet conduits, 430 ft. long, which carry the stream flow during construction and which will later control the outflow from the reservoir, were located in the south bluff. It was necessary to place the conduits in this location in order to secure a good foundation although so doing required the excavation of a large volume of material from the side of the hill. The upstream entrance to the conduits is protected by precast oval-shaped reinforced-concrete guard bars. The outlet is designed to provide for the control of the hydraulic jump and reduction of the velocity of the water from the conduits to a safe velocity for the river channel below the dam. All corners around which water must flow were rounded to reduce friction losses.

Four of the conduits, built for construction purposes only, will be sealed after the main dam and spillways are completed. It was necessary to build six conduits to provide capacity for passing such floods as might occur during construction, and this provision has proved ample. The two center conduits, which are the permanent service conduits, are each fitted with two cast-iron gates with bronze facings to control the outflow.

Air ducts were constructed for the two service conduits to introduce air below the point of regulation of the main gates to prevent disturbances in the flow through the gates and injury to the gates themselves. Each duct consists of a concrete well 3 ft. square, built on the downstream side of the gate tower.

Core Trench—A core trench was excavated under the dam for its entire length except across the river channel and the service spillway. Across the river valley this trench is 20 ft. wide at the bottom, has side slopes of 1 to 1, and was excavated to the level of the bottom of the river. Steel sheetpiling was driven in the center

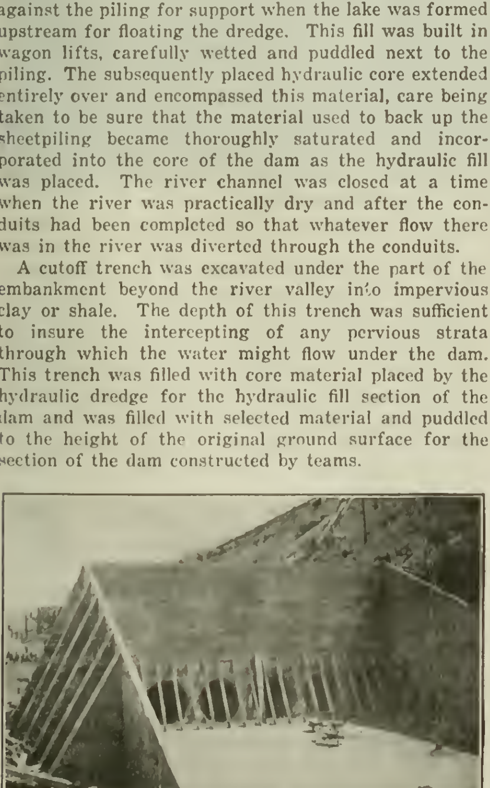


CROSS-SECTION OF DAM AND PLAN OF CONDUIT

of this trench to a penetration of from 4 to 5 ft. into a shale formation. The sheetpiling was driven from the north side across the river valley and channel to the south toward the conduits.

After the river channel had been closed off, following the driving of the sheetpiling, an embankment was built with teams out of carefully selected material, suitable for core purposes, on the lower side of and against the piling for support when the lake was formed upstream for floating the dredge. This fill was built in wagon lifts, carefully wetted and puddled next to the piling. The subsequently placed hydraulic core extended entirely over and encompassed this material, care being taken to be sure that the material used to back up the sheetpiling became thoroughly saturated and incorporated into the core of the dam as the hydraulic fill was placed. The river channel was closed at a time when the river was practically dry and after the conduits had been completed so that whatever flow there was in the river was diverted through the conduits.

A cutoff trench was excavated under the part of the embankment beyond the river valley into impervious clay or shale. The depth of this trench was sufficient to insure the intercepting of any pervious strata through which the water might flow under the dam. This trench was filled with core material placed by the hydraulic dredge for the hydraulic fill section of the dam and was filled with selected material and puddled to the height of the original ground surface for the section of the dam constructed by teams.



INLETS TO FOUR CONSTRUCTION AND TWO SERVICE CONDUITS THROUGH THE DAM
Rounded bars guard entrance to conduits having rounded ends

Hydraulic Fill—Material for the hydraulic fill was dredged from the river valley above the dam. The material in the borrowpit is mostly a rather fine sand containing probably 25 per cent of clay and very fine sand suitable for core purposes. Ordinarily the dredge takes a cut of this material from 30 to 45 ft. deep and in this depth there are usually encountered one or more layers of stiff red clay from a few inches to a few feet thick. Occasionally small layers or pockets of gravel are struck and sometimes a few large boulders. The accompanying table shows the results of mechanical analyses of material in the slopes of the core and the dam:

MECHANICAL ANALYSIS OF MATERIALS

Sieves	Near Outer Slope	Midway Between Core and Slope	Near Core	Core
Through ¼-in. mesh and on 10-mesh	0.0	3.0	9.4	0.0
Through 10-mesh and on 20-mesh	1.1	4.0	2.6	0.0
Through 20-mesh and on 40-mesh	20.4	41.2	20.0	0.0
Through 40-mesh and on 80-mesh	59.6	46.0	48.1	2.7
Through 80-mesh and on 200-mesh	16.3	4.6	8.5	32.1
Through 200-mesh and on 0.04 m.m.	2.6	0.2	1.4	23.1
Smaller than 0.04 m.m.	0.0	0.0	0.0	42.1

The figures given are the average from three samples, taken Dec. 15 and 31, 1922, and April 1, 1923. The material retained on the 10-mesh sieve as shown in columns 2 and 3 was largely clay balls. Samples of the sand or slope material taken from time to time as the dam was built up showed no particular change but the samples of the core showed that the material in the core gradually became coarser as the dam rose and the core pool became narrower. This material makes a compact and stable fill. A team can be driven over it either wet or dry without sinking into it more than an inch or two.

Ball Test—After the large cutoff trench was filled, there was a slight excess of core material which, of course, was desirable as it eliminated danger of sand slides into the core. While the core was from 80 to 100 ft. wide and the cutoff trench was being filled a 6-in. cast-iron ball would sink into it from 12 to 17 ft. When the dam had reached a height of from 25 to 30 ft., this softer material had been crowded out and the ball showed a penetration of only 6 to 8 ft. below the water surface. The penetration decreased as the height of the dam increased and near the top the ball would sink only 2 or 3 ft. As the top of the dam was approached, the proportion of core to the balance of the fill diminished considerably. This caused more core

material to be wasted which in turn caused the core to be stiffer as the fine particles went out first.

On the night of April 11 the core pool broke through or over the downstream levee near the north end of the dam, making a gap 24 ft. deep at the toe of the slope and extending about 15 ft. back into the core. A section of the core about 15 ft. high was exposed. This stood up in excellent shape. The core was very stiff and broke off in large blocks as the supporting sand was washed away. The core stood with face 8 to 12 ft. high practically vertical except for the large blocks at the toe which had broken off and slipped down. A cubic-foot sample weighed 140 lb.

Dredge Operation—While the conduits were under construction, a launching pit was excavated by a dragline machine in the floor of the river valley a short distance above the dam, and a hydraulic dredge was assembled in this pit. The dredge is 111 ft. long and is equipped with a 42-ft. beam and a hull 9½ ft. deep. Northwest fir was used in building the hull. A ladder 75 ft. long, built up of 30-in. I-beams and cast-steel saddles carries the cutter head and suction pipe. The two wooden spuds are 26 in. square and weigh 9 tons each. The dredge was operated with electrical power brought in over a transmission line from Wichita Falls 41 miles away. Transformers located on the south side of the river reduced the 38,000-volt current to 2,300 volts. Twin submarine cables carried the power from the transformers to the dredge. The dredge was launched May 30, 1922, and began operating on Sept. 11, 1922.

The dredge pump is of the centrifugal type direct-connected to a 1,600-hp. motor and is run at 360 r.p.m. The pump is designed for necessary pipe friction plus a maximum lift of 65 ft., the difference in elevation between the top of the dam and the surface of the ponded water during the final stages of construction. The manganese-steel pump shell has cast-iron side liners which can be replaced when worn out. The runners are cast steel and range in size from 54 to 64 in. In the beginning the smallest size was used and the larger ones were put on from time to time to take care of the increased head as the dam became higher and longer. When the dredge pump had handled almost a million yards, the shell was so badly worn that sectional cast-iron liners were made and bolted in all the way around so as to enable the same shell to finish the job.

The dredge has a daily capacity of 10,000 cu.yd. and pumped about 200,000 cu.yd. per month for the first four months. After the dam became high and narrow the various delays reduced the monthly output considerably. The vertical rate of progress on the dam for the first five months was about 12 ft. per month. This decreased to about 8 ft. per month during the latter stages of the work due to delays and increased length of dam. With the possible exception of the river section of the Taylorville Dam on the Miami Conservancy District, it is believed that no other hydraulic fill dam has been brought up so rapidly. In spite of this unusual speed, however, there has never been the slightest indication of any lack of consolidation of the core or slopes, and it is the opinion of the engineers on this dam that a hydraulic fill dam, if properly handled, will consolidate as fast as it is practicable to deliver the material and build it up. The slope material is as compact the moment it is placed as it ever will be and the core consolidates by the water being forced up through the newly deposited mud because the weight of any good core material is at least twice as heavy as an equal volume of water.

HYDRAULIC FILL STORAGE DAM UNDER CONSTRUCTION

Bulkheads were used on upstream side and levees on downstream side. Concrete tower built the six conduits and the gate and air tube shafts. Sheerboards were placed along edge of pool to prevent formation of tongues of sand.

Pipe Experience—The discharge pipe was made up of 20-in. 10-gage riveted-steel pipe, which is unusually large for hydraulic dam construction. Wooden pontoons were used for floating the pipe across the lake above the dam. The shore pipes were slip-joint sections 20 ft. long. The pontoon pipes were 32 ft. long and were connected by rubber sleeves.

As the principal wear is on the bottom third of the periphery the pipes were turned so as to even up the wear. The average life of the shore pipe on this job was about 600,000 cu.yd., but even after that much service patches were welded over the holes, and the pipe gave considerably more service out near the end of the lines where the pressure was not great.

The velocity through the pipe line was from 10 to 15 ft. per second. Apparently 10 to 12 ft. per second would be sufficient, but there was no provision for con-

trolling the speed of the motor and a runner large enough for the longest line of pipe had to be kept in the dredge pump. Therefore, on the short lines it was inevitable that too much water was pumped.

During the first stages of construction, the fill material was confined by wooden bulkheads about 4 ft. high and stepped to form the required slopes. It was later found to be more advantageous to confine the material by a levee thrown up by a small dragline machine operating on the outer edge of the fill. However, because of the amount of lumber purchased for bulkhead construction, the bulkheads were continued in use on the upstream slope and the dragline levees were used on the lower slope. The material is discharged from the pipe near the outer slope of the dam and flows toward the core pool in the center of the dam, grading hydraulically. The width of the core at any elevation has been made the same as the height of the dam above that elevation.

During the early stages of construction, the pool was drained by means of a timber spillway over the side of the embankment into the lake. This proved unsatisfactory, however, as the dam attained size, and vertical wells or sumps built up as the height of the dam increased were constructed within the fill with pipe outlets to the upstream toe to provide for the return of the pool water into the lake. Inasmuch as all of the water is returned to the lake above the dam there has always been sufficient water to maintain operations even during the driest season.

As the embankment and core pool rose and narrowed it was necessary to use care to prevent tongues of sand from shooting out into the pool. Boards were placed about 5 ft. back from the margin of the pool to deflect the water, reduce velocity and prevent sand being carried out into the core.

Wooden racks bordering the pool were used for storing discharge pipe when not in use.

About 4,500 ft. of the main dam containing 215,000 cu.yd. lie north of the hydraulic fill. This is a low section averaging about 20 ft. in height and has been placed by teams and dump wagons using elevating graders.

Service Spillway—The service spillway is located across a canyon just north of the main body of the dam. A semi-circular hollow concrete dam forms the crest of the spillway from which a sloping paved discharge channel leads into a deep pool, the bottom of which is some 50 ft. below the present ground surface, 5 ft. below river bed and 90 ft. below the spillway crest. The downstream side of the pool, formed by the natural shale which occurs here, was excavated to a ¼ to 1 slope. Water flowing over the spillway will discharge into this deep stilling pool and will then flow off over the natural shale rim of the pool, down the canyon into the channel below.

The design of this spillway was adopted after a consideration of various types of structures, and was influenced to a considerable extent by the character of the material through which the canyon leading from the spillway down to the river is cut. This material is a very heavy shale with occasional thin layers of sand and limestone. When exposed, the shale disintegrates slowly to a shallow depth and it is expected that when there is a flow over the spillway the disintegrated shale will be washed away and a new surface of shale will be exposed to the atmosphere after the flood has passed. This action will occur after each flood, but many years will elapse before the bed of the canyon below the spillway is cut down to river level, and there will be ample time for observing conditions and taking such measures as may be necessary to prevent destructive action at the lower end of the spillway.

SEMI-CIRCULAR SERVICE SPILLWAY BEFORE ERECTION OF HOLLOW DAM AT CREST

After dragline was used in excavating the slope the heavy riprap was placed and the interstices were filled with concrete. Mixer plant at left chuting concrete to place. Shale (at left) will not be excavated but left to disintegrate.

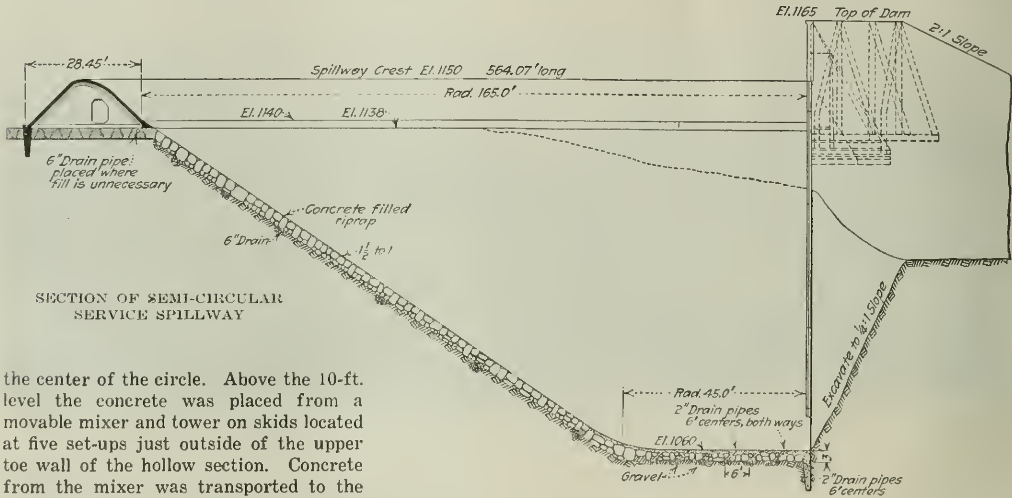
The depth of the stilling pool was determined by the velocities which will obtain in the canyon below the spillway when the natural surface below the spillway cuts down to the bottom of the stilling pool, the depth being such that the velocities in the canyon, when this has taken place, will not be sufficiently great to cause damage.

The excavation for the service spillway was made by dragline and gas shovel. The dragline has a 70-ft. boom and 2½-cu.yd. bucket operated with distillate oil. All the material that could be reached conveniently by a dragline was removed by that method. Operating on the upper rim of the spillway, the excavated material was placed in a spoil bank above the spillway and some of it was later loaded with the gas shovel onto wagons and used in the wings adjacent to the headwalls. Material taken out with the dragline from the lower side of the spillway was wasted below. The dragline and shovel worked in conjunction, each machine being used when it could be operated to best advantage. Long lines were used on the dragline bucket, which

enabled it not only to remove material from the bottom of the excavation but also to strip the slopes of the excavation from the bottom.

The rock for the rubble paving for the floor and slopes of the spillway came from a limestone stratum of cap rock about 30 in. thick found near the spillway. This rock was broken out with light charges of black powder and required very little stripping before being quarried. The rock was placed with the dragline from which the bucket had been removed. Holes were cut into the rock with a jackhammer for inserting hooks to insure safety in placing.

The concrete in the floor cutoff walls and slopes of the spillway to a height of about 10 ft. above the floor was placed from a mixer located on the lower side near the center of the circle. Above the 10-ft. level the concrete was placed from a movable mixer and tower on skids located at five set-ups just outside of the upper toe wall of the hollow section. Concrete from the mixer was transported to the top of the slope in buggies and allowed to flow down the slopes as the voids in the rock were filled. The flow was directed by men with shovels and other men with rods worked the concrete into the open spaces in the rock. The spillway concrete slope paving was divided into sections about 10 ft. wide to facilitate construction. A slightly wet mixture of 1:2:4 concrete was run in first to fill up the voids between the rocks. This was followed with a rather dry mixture placed on top and troweled into place, giving a fairly smooth surface.



SECTION OF SEMI-CIRCULAR SERVICE SPILLWAY

Emergency Spillways—The emergency spillways, located at the extreme north end of the dam, consist of two sections of earth dam, for which the crest has been lowered, confined by headwalls so that they will be the only parts of the dam to give way during extraordinary floods. The first emergency spillway is 70 ft. wide and its crest is 7 ft. below the top of the dam. The second emergency spillway is 335 ft. long and its crest is 4½ ft. below the top of the dam. The riprap paving which is used on the upstream face of the dam is extended over the upper slope of the emergency spillways. The water will be flowing over the service spillway 8 ft. deep before the first emergency spillway would go out and 10½ ft. deep before the second one would come into action. In the event that the emergency spillways are washed out they will be washed down only to the underlying limestone rock which is near the surface where the spillways are built and no appreciable volume of stored water will be lost.

Riprap—The upstream face of the dam is protected by a layer of limestone riprap 18 in. thick placed by hand. The spaces between the stones are rammed full of spalls with a sledge down to the 8-in. gravel blanket which underlies the riprap. This riprap will give better protection and is less expensive than a thicker layer of rock loosely dumped. The rock for the riprap was quarried from the cap rock ledge of limestone in the vicinity. A gravel blanket with minimum thickness of 8 in. was placed on the upstream slope of the dam under the riprap. It was obtained from a gravel bed on the slope of the hill at the north end of the hydraulic fill.

Materials—Coarse aggregate for the conduits was crushed limestone shipped in by rail from Chico quarry, about 125 miles south, and was hauled from Mabelle station to the dam in wagons. The coarse aggregate for the concrete for the spillways was obtained from a pit located at the end of the hydraulic section of the dam. A gravel washing and screening plant was installed and the bank gravel washed and screened. The sand used in the spillway concrete was a by-product of this washing.

R. A. Thompson is chief engineer for the district and in direct charge of the work. O. N. Floyd is assistant chief engineer. The Morgan Engineering Co. is consulting engineer, L. L. Hidinger, president, giving immediate supervision. The general contractor for all of the work is the Callahan Construction Co., of Dallas, Tex., from whom the Puget Sound Bridge & Dredging Co. of Seattle, Wash., subcontracted the hydraulic fill.

Motor Vessel Use Increases Ten-Fold

The annual report of Lloyd's Register shows that in July, 1923, 1,831 motor vessels were in use in the United States, with a gross tonnage of 1,668,414. This compares with 297 motor vessels in use in 1914. Of the 1,831 in use in July, the sizes run: 60 over 6,000 tons; 65 between 4,000 and 6,000; 87 between 2,000 and 4,000 tons, and the remainder less than 2,000 tons.

Simple Balancing of Quantities in Highway Grading

Special Tables Afford Quick Preliminary Estimate —Reduction of Irregular Sections to Level Sections Required

By Fred. M. Garnett
Office Engineer. State Highway Department of Georgia, Savannah, Ga.

WHETHER there should be strict adherence to the practice of balancing quantities in highway grading is a debatable question. When possible, however, this office balances quantities thereby avoiding unsightly borrow pits and waste banks along the right-of-way. The method employed has been used for more than a year on various projects in the division, and whether the cross-sections are fairly level, irregular, or very irregular the results attained are well within the limits of expectation. Indeed the method has proved to be practical, economical, and simple, within its scope of application, under widely different topographical conditions.

This method relies largely upon the use of three tables. First, a table of yardage per 100 ft. is required, with which every engineer is acquainted, and which is extensively used in almost every highway engineering office. Second, a table of areas for regular trapezoidal sections in fill is prepared, giving areas for sections from 0.1 ft. fill to 15.0 ft. fill; this table is made to conform with the standard type of roadbed adopted. Third, a similar table is prepared for regular level sections in cut. By the use of these two tables areas corresponding to any cut or fill between 0.1 ft. and 15.0 ft. can be rapidly taken off, and used in computing the yardage, together with the yardage table already mentioned. The procedure is as follows:

After having plotted the profile, decide upon the economical and advantageous limits of haul. These points are noted as shown in Fig. 1, referred to as balance points. Next endeavor to set tentative grades so that the cuts and fills will balance between these points. In Fig. 1 is shown a profile of a portion of Project S-8-108, Toombs County. It was decided to try and balance the quantities between stations 145 and 170. The tentative grade was set as shown with the object of balancing quantities.

A preliminary computation of quantities was next made between these balance points by use of the three tables described. On the preliminary computation sheets are recorded the cut or fill as the case may be for each station between the two balance points. These cuts or fills are at the center of each section and are the difference between the elevations of subgrades and the elevations of the profile. The areas corresponding to the cuts and fills are taken directly from the table of areas, and are used in conjunction with the yardage table in computing volumes.

After having made a preliminary estimate of the quantities, they were compared and it was found that there was an excess of 1,235 cu.yd. of cut. The final grade was adjusted as shown in Fig. 1 to eliminate this excess material. Had there been a preponderance of cut over fill, the grade between stations 158 and 170 could also have been adjusted. From experience, or by means of a rough calculation, it is easy to determine how much a grade should be adjusted to balance the quantities. Since the objective balance points were selected at stations 145 and 170, by referring to the mass diagram shown in Fig. 2, some idea can be gained as to the practical working value of this method. The mass diagram shows that a balance point occurred at station 146 plus 70 instead of at station 145, and at station 169 plus 80 a balance point occurred instead of at station 170. From station 131 to station 349, a distance of 21,800 ft. on this project, no borrow or waste whatever was incurred, and economical haul was obtained.

This method of balacing quantities is not designed or intended to be absolutely accurate, since the areas were computed for regular level sections in the preparation of the tables.

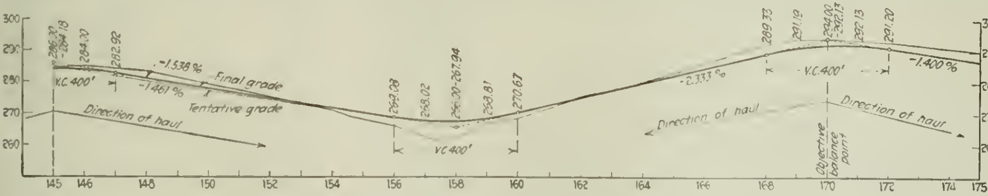


FIG. 1—PROFILE INDICATING PROCEDURE IN BALANCING QUANTITIES

If the cross-sections are very irregular as shown in Fig. 3, they can be approximately reduced to level sections by means of a thread or triangle placed across the sections as shown by the line XY, so that the material above this line will balance the material below this line, making the necessary correction at the center, according to whether this balance line is above or below the original cut or fill shown on the preliminary computation sheet. The corrections are added to or deducted from the original values, and the volumes determined as described.

FIG. 2—MASS DIAGRAM

This method is based upon the premise that all sections are regular level sections, but such is not always the case; however, by reducing irregular sections to level sections as described, a fair working approximation can be obtained, and much of the guess can be taken out of the work.

In using this method it is not necessary to templet the cross-sections in computing the preliminary quantities; neither does the planimeter have to be used in conjunction with preliminary work. After the preliminary work is finished, the final quantities are computed and recorded on the final computations sheets, but it is not necessary to transfer the areas from the cross-

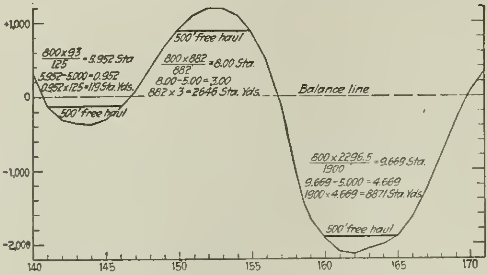


FIG. 3—LEVELING UP IRREGULAR SECTION

section sheets to the computation sheets, since only the volumes are required in computing the mass of ordinates. Much time can thus be saved, and the chances of errors minimized. The final yardage is computed from planimetered areas.

The two tables of areas can be used to good advantage in checking planimetered areas, by reducing irregular sections to level sections as heretofore described and reading the areas from the two tables. This work is only approximate, but errors of a serious nature can be readily and rapidly detected.

One of Oldest Private Water-Works Taken By City

WHEN the Proprietors of the Morris Aqueduct handed a deed of their property to the authorities of Morristown, N. J., on Dec. 15, the last of the fifteen privately owned water-works in the United States at the close of 1800 was transferred to municipal ownership. As shown by the table herewith, there were only sixteen water-works in the United States at the close of the eighteenth century and of those only the one at Winchester, Va., was municipally owned.

The transfer of the Morristown water-works comprises the entire holdings of the company, including the sources of supply and the distribution system, the latter extending into some outlying territory. The population of Morristown in 1920 was about 12,500, but it is estimated that from 18,000 to 20,000 people are supplied by the Morristown water-works. The following information regarding the purchase, together with some information regarding the early history of the plant, has been supplied to *Engineering News-Record* by Clyde Potts, civil and sanitary engineer of New York City, and mayor of Morristown:

The transfer marks the close of more than four years of negotiation with the company. On Sept. 9, 1919, the people of Morristown voted decisively to own their water-works. It was only during the past summer that negotiations were completed for the purchase of the present system. The purchase price of $686,000 was based on an appraisal made by Willis H. Dutton, chairman of the water committee in 1920, in which pre-war prices were used. The original appraisal was $605,000, to which $81,000 was added for extensions and some undeveloped sources not included in Mr. Dutton's appraisal.

The Morristown water-works is one of the oldest in the United States. It was built in 1799 under a charter granted by the State of New Jersey to the Proprietors of the Morris Aqueduct, dated Nov. 16, 1799. The plant has been reconstructed a number of times since then and at the present time the plant on the whole is up-to-date.

The original plant was an aqueduct four miles in length, including its various branches. The water supply was drawn from springs 100 ft. above the town on the Jockey Hollow Road, about a mile distant. The main supply line from the springs to the town was constructed of tile pipe, later replaced with chestnut logs, with a 2-in. bore. The original work was completed on June 20, 1799, by Pelatiah Ashley of West Springfield, Mass.

The annual gross earning of the plant is $80,000. It is anticipated that the town will be able to pay operating and interest charges from the earnings, and apply from $18,000 to $20,000 to the retirement of the bonds.

The final column of the accompanying table shows the years in which the fifteen cities mentioned above as being under private ownership of water-works at the close of the eighteenth century changed to public ownership. No change was made until 1828. Between then and 1848 there were three changes. In the full decade immediately preceding the Civil War there were five more changes and in the Civil War decade itself no changes whatever in ownership. From 1871 to 1896 there were six changes, thus leaving Morristown for the twenty-seven years the sole remaining town of the original fifteen under private ownership during the past twenty-seven years.

WATER-WORKS IN THE UNITED STATES AT THE CLOSE OF 1800

Location	Date Built	Change to Public Ownership	Order of Change	Change Year
Boston, Mass.	1652	1848	Lynchburg	1828
Bethlehem, Pa.	1761	1871	New York	1843
Providence, R. I.	1772	1871	Boston	1848
Geneva, N. Y.	1787	1896	Albany	1851
Plymouth, Mass.	1796	1855	Worcester	1852
Salem, Mass.	1796	1873	Hartford	1854
Hartford, Conn.	1797	1854	Plymouth	1855
Portsmouth, N. H.	1798	1891	Newark	1860
Worcester, Mass.	1798	1852	Bethlehem	1871
Albany, N. Y.	1798 or 1799	1851	Providence	1871
Peabody, Mass.	1799	1873	Salem	1873
New York, N. Y.	1799	1843	Peabody	1873
Morristown, N. J.	1799	1923	Portsmouth	1891
Lynchburg, Va.	1799	1828	Geneva	1896
Winchester, Va.	Before 1800	(Always public)	Morristown	1923
Newark, N. J.	1800	1860	...	...

Summary By States

New Hampshire	1	Connecticut	1	Pennsylvania	1
Massachusetts	5	New York	3	Virginia	2
Rhode Island	1	New Jersey	2		
				Total	16

According to "The Manual of American Water-Works for 1897" there were in the United States at the close of 1896 a total of 3,196 "complete works" supplying water for both domestic and fire protection uses, of which about 53 per cent were under public ownership. Complete figures for later dates are unavailable, but of the 4,437 works listed in the McGraw Waterworks Directory for 1916 about 70 per cent were under public and 30 per cent under private ownership.

Slide Movement in Gaillard Cut

On the morning of Oct. 28 a slide involving from 250,000 to 300,000 cu.yd. of material developed on the west bank of the Panama Canal in Gaillard Cut. It was approximately 1,100 ft. long and at the point of greatest encroachment extended 150 ft. into the channel. There was ample width and depth to the east of the slide for the passage of ships of any draft, but to facilitate the work of the two dipper dredges engaged in clearing the channel, ships in transit are assembled on either side of the obstruction and held until a specified time in the afternoon when the dredges are shifted and the waiting vessels pass through. There has been no enlargement of the slide subsequent to the original movement, and it is estimated that six weeks will be required to clear the channel entirely.

Sir William Mackenzie

An Appreciation of his Greatness as a Railroad Builder and his Solidity as a Man

By Henry K. Wicksteed
Toronto, Canada

THERE LIES buried today in the churchyard of his native village, a remarkable man, justly appraised by the public press as one of the "makers of Canada"—the same public press which a few years ago was anathematizing him in connection with the Toronto railway deal as the cold-blooded head of a soulless corporation.

Sir William Mackenzie was born in 1849 in the village of Kirkfield, 88 miles northeast of Toronto, of Scotch parentage, in humble circumstances. His birthplace was in those days just as much a frontier settlement as are the outlying villages around Sudbury today or those along the North Saskatchewan farther west. Young Mackenzie grew up to manhood in this frontier settlement. He received the ordinary education of a Scotch boy, an education which evidently included the shorter catechism, for while he never in later life showed outwardly much religious feeling in the ordinary sense, he was always aware of his debts and obligations, and he learned Scotch thrift and economy. In my personal intercourse with him I found him always keen and apparently hard as nails in driving a bargain and holding the "weather gage" of a rival business man. He was almost penurious in his personal habits and tastes, but this was quite compatible with extreme generosity and kindliness towards old friends of himself and his family who had been less fortunate than himself in the accumulation of this world's goods. His dislike for ostentation and display amounted to passion.

Young Mackenzie taught school for a time and engaged in mercantile business. In the early 70's one of the pioneer narrow-gage lines, the Toronto and Nipissing, pushed its way into the pineries from the neighborhood of Toronto, and it was here that he got his first experience of railroading. About the same time the "Northwest" as the central prairie belt of Canada was then called was opened up for settlement and the Canadian Pacific Ry. was initiated by the federal government. Young Mackenzie had imagination, and these signs of progress evidently fired it and stimulated him to greater things. In the 80's he went West and followed railroading almost exclusively. He did some contracting and lumbering in the mountains of British Columbia, and also on the "Short line" of the C. P. R. in Maine, and in the latter case he was one of the few contractors who carried his work through and made some money out of it.

It was at this period that he became associated with D. D. Mann—Mackenzie and Mann soon became a recognized Canadian institution. In 1890 Mackenzie became impressed with the possibilities of electrification in connection with urban railways and carried through successfully that of the Toronto system. This was his first notable success and it merely paved the way for greater enterprises. Towards the end of the century Mackenzie and Mann took up the charter of a small branch line in Western Manitoba. Instead of selling it to the C. P. R., which had now become a dominant element in the Northwest, they elected to hold and operate it themselves, and engaged D. B. Hanna, another Scotchman, as manager. To their surprise the concern paid its way in the very first year, and this became the inspiration and the nucleus of the Canadian Northern Ry. The subsequent history is a romance which will be written some day.

The acquisition of the Manitoba, Southeastern and Ontario and Rainy River charters, and the extension of their Manitoba line to Lake Superior formed a second "Granger" line to Great Lakes navigation. There followed the expropriation of the Northern Pacific Canadian lines by the Manitoba government and their lease to the Canadian Northern, and the latter became a power in the prairie country and extended westward through Saskatchewan and into Alberta. But the end was not yet, the Canadian Northern was handicapped by being a "Granger" road pure and simple and lacked eastern connections. Negotiations with the Grand Trunk fell through. Mackenzie had conceived the idea of a transcontinental line and was bound to carry it out. The Grand Trunk wanted to buy, and failing to arrange, played on the vanity of the powers at Ottawa, and the National Transcontinetal and Grand Trunk Pacific deal was the result. This was the beginning of the end and the rest is current history. Mackenzie built his through line at a fraction of the cost of the rival, but the western country was as yet too poor to support both. The final crash was hastened by the war, itself brought on by rivalry and vanity and thirst for power.

Mackenzie's personal vanity was absurdly small. His desire was for achievement. Money was merely a means to an end. Quick and hot-tempered, he was always amenable to argument and reason, and some of the pleasantest hours of my life, possibly of his own, have been spent in poring over maps and plans with him, and formulating development schemes. How much of his success was due to personal magnetism, how much to the spirit of romance and adventure which hung over the whole project, is hard to say, but he had in a rare degree the gift of putting the right man in the right place, and implanting and retaining loyalty in his subordinates. The loyalty was not only to himself and his partner and the enterprise, but it bound the heads of the different departments together as actual friends. Never was there an organization with fewer internal jealousies and rivalries. Unquestionably much of his success is due to this. He heartily appreciated the man who as a matter of principle could fight him with his own weapons.

The Toronto mayor who drove a hard bargain with him over the Toronto Ry. franchise became a warm friend and later manager of the system. How much, again, of his success was due to his partner, D. D. Mann, of different temperament, but with profound knowledge of railway construction and of men is hard to judge. And last, but not least, how much was due to the gracious lady, his wife, a native of his own village, who rose with him, and was for years the chateleine at "Benvenuto," his Toronto home, and a recognized society leader in the truest sense!

Dravo Contracting Co. Built South St. Bridge

The statement in *Engineering News-Record*, Nov. 22, 1923, p. 861, regarding the opening of the city-built bascule bridge over the Schuylkill River in Philadelphia at South Street, should have named the Dravo Contracting Co., Pittsburgh, as contractor, instead of the American Bridge Co. The Dravo Contracting Co. had the entire contract, but sublet some of the construction to the American Bridge Co.

Concrete Aggregate Produced From Local Deposit

High Cost of Imported Stone and Sand, and Uncertainty of Transportation, Lead Contractor to Screen Gravel on Job—Cubic Yard Cost Far Below Cost from Outside Sources

By J. Arthur Garrod
General Superintendent, Aberthaw Construction Co., Boston, Mass.

IN APRIL, 1922, the Aberthaw Construction Co., of Boston, Mass., was awarded a contract at Northbridge in Southern Massachusetts, for constructing three buildings for the same owner requiring aggregates for some 11,000 cu.yd. of reinforced concrete. The original estimate contemplated the use of 1½-in. crushed stone for coarse aggregate, with a reduction in price if similar sized gravel was substituted. It was decided by architects to accept the proposal for the use of gravel. Crushed stone, as specified, would have cost $2.35 per ton f.o.b. cars near the main part of operations. Gravel screenings were offered at $2 per ton on cars, and would have cost still more if the architects' requirements to use all 1½-in. stone had been strictly enforced. Good concrete sand was offered at $1.75 per ton on cars at the job.

When plant requirements were surveyed it was found that all the side-tracks in the immediate vicinity of the job would be required for the handling of cement, so that unloading space for aggregate, and machinery for unloading, if provided, would have to have been at some distance from the sites of the four mixers used on the widely separated buildings. Railroad conditions, although unsatisfactory at the time work was started, showed signs of becoming more so; so that the use of local materials, even at the same price, was most desirable.

Preliminary Examination—An examination of all developed and some undeveloped deposits within a three-mile radius showed several possible sources of supply, two pits proving superior to all others. Both of these contained excellently graded material. The pebbles in both pits had an adhering coating of clay, a coating which was not present in harmful quantity in the sand. This material could be purchased at 10c. per cubic yard, bank measurement, all overburden removed being deposited on the premises and only the quantity actually taken away to be paid for. One of the two deposits had been worked intermittently for years; the other deposit had been worked on a previous occasion but a large knoll was practically unexplored. Eight test holes showed excellent gravel in sufficient quantity but with two to three feet of overburden. The first-mentioned deposit was finally decided upon as it was located nearer to a good road and within 1,500 ft. of the Blackstone River.

A trucking concern interested us in a method of screening with the aid of portable gasoline-driven belt conveyors. They guaranteed to supply coarse aggregate at $2.50 per yard, and fine aggregate at $1.50 per yard delivered at the site, two miles from the pit. A week's trial showed we could not rely upon their method: the sizing of the coarse aggregate was not acceptable; oversize stones cluttered the pit; the adhering coating of clay was not loosened from the stones; the usual controversy commenced regarding the size of loads, so the Aberthaw company decided to erect a plant and prepare the aggregate by its own forces.

A sample of the sand showed a tensile strength of 110 per cent of Ottawa standard sand, so the architects decided that the finer material was suitable without washing. Screen analyses of the pebbles showed them to be well graded, and examination showed them to be of more than average hardness. As some 10 per cent were larger than was permissible in the concrete, a crusher was needed. The architects required that the coarse aggregate be washed free from the adhering coating of clay.

The outlay for a special washing and sizing plant for treating the material would have been large and would not have been justified on account of the temporary nature of the installation. The Aberthaw company then decided to install used crusher, elevators, screen and pump stored at the time in their Boston yard. The electric service company was ready, for a small installation charge, to provide supplementary transformer facilities and to supply power at the current authorized rates.

Design of Plant—The job force, under the writer's direction, proceeded to design the plant and bins and to obtain the most suitable equipment available at Aberthaw's yard.

The rotary screen, erected lengthwise of the bins, was 32 ft. in diameter and 16 ft. long; the upper 7 ft. of this screen was perforated with ½-in. holes, the remainder with 1½-in. holes.

A bin and gate were used at first for feeding the boot of the elevator but this was found unnecessary as an 8-in. x 12-in. timbered opening at the floor elevation of the pit gave a fairly regular supply of material and enabled the horse scrapers to be dumped directly over it. The excavated gravel was raised with a single chain bucket-elevator having 15-in. buckets spaced 12 in. c. to c. on the chain. The elevator fed the gravel through a chute 3 ft. long, at a 45-deg. inclination, to the head of the screen. The total height between the bottom-shaft and head-shaft of the elevator was 40 ft. The sand was screened dry and the 40 per cent sand determination, made at the beginning, remained fairly constant throughout the operation. The bin was partitioned accordingly. Oversize pebbles or tailings remaining on the screen were conveyed to the crusher through metal-lined gravity chutes. A 10-hp. motor supplied all necessary power for this screening and elevating outfit.

The jaw-crusher had a 12-in. x 20-in. opening and a rated capacity of 12 tons per hour. It was set on a concrete foundation at right angles to the direction of the screen. The product of the crusher was raised by a bucket-elevator similar to the one which raised the gravel. Crushed pebbles and stonedust were dumped from the head of the elevator into a short chute at right angles to the long chute which fed the gravel

from the main elevator to the screen. The clean angular stones and stonedust from the crusher, thus introduced into the gravel, assisted materially in both dry and wet screening operations. A 25-hp. motor, belted directly to the crusher, supplied power to both crusher and elevator. At no time was this crushing outfit used to capacity but both fine and coarse aggregates were improved by the addition of the material resulting therefrom.

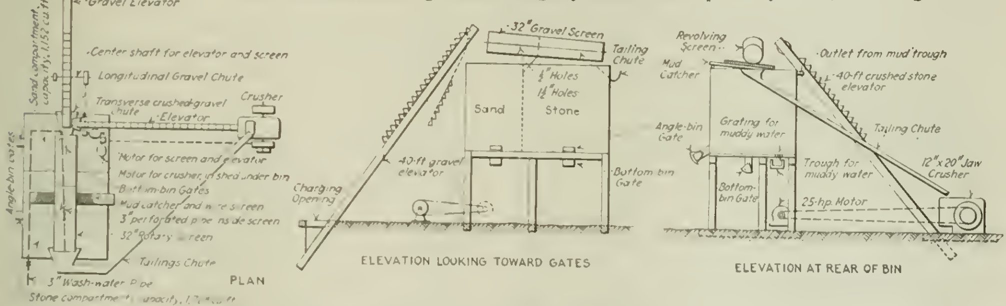
To remove adhering clay from the stone, streams of water were played upon the coarse aggregate from a heavy 3-in. pipe, 16 ft. long, which was introduced at the head end of the rotary screen. The portion of this pipe which corresponded with the 1½-in. holes in the screen was perforated with a double row of $\frac{3}{16}$-in. holes spaced 1¼ in., the aggregate area of the openings being slightly larger than the pipe diameter. The pipe was turned so as to direct the water against the sector of screen where gravel would lie when the screen was rotating. The extreme end of the pipe was blanked off and formed a bearing which carried the pipe on the revolving shaft which supported the back end of the screen. Some of the perforations were subsequently plugged so that the largest streams of water were concentrated near the middle of the screen.

Water for washing purposes was pumped from the Blackstone River about a quarter of a mile away, the water being handled by a large-periphery single-stage centrifugal pump adapted for high lifts. A 10-hp. motor was belted to this pump and gave ample power. The total head, including the usual allowances for friction and bends, was 45 ft. The water was conveyed to the gravel plant through a 3-in. steel pipe, purchased second-hand. As the installation was temporary and not designed to operate in freezing weather the pipe was laid over the ground. The waste water from the washing operation was designed to fall out through a grating towards the back of the coarse aggregate bin and run through a surface ditch to an abandoned canal which formed an excellent sedimentation basin. The water which reached the river contained no mud or suspended matter.

Plant Operation—Difficulty in operatioh was at first experienced as the screened gravel in the bins became contaminated by the dirty water from the washing. This was later obviated to a large extent by the introduction, near the center of the bin, and immediately under the screen, of a trough formed of a 15-in. structural steel channel covered with a stout galvanized mesh with wires $\frac{3}{16}$ in. apart, this mesh being arranged with a sharp slope to either side of the trough so that the muddy water would pass out comparatively free from sand grains. This modification enabled us to produce a clean coarse aggregate under normal running conditions. Some clay from the water which had been used for washing was still accumulated in the coarse stone remaining in the bin when bin-gates were operated normally. During repairs, when it was necessary to empty the bins, this clay was removed by thoroughly washing with a hose and nozzle connected with the wash-water supply.

The bin was 20 ft. long, 12 ft. wide and 12 ft. deep. It was built of second-hand yellow pine timbers and local hardwood plank. It was arranged so that trucks could back up under the side opposite the crusher, leaving the head end free for the screen, and the lower end free for handling the tailings. One bottom circular bin-gate and one angle circular bin-gate were used in each of the two compartments. Practically no spreading was necessary in the truck as the truck moved slightly ahead when partially filled, receiving the load evenly. The truck drivers left their cabs to operate the bin-gates but without descending to the ground. The ground grade was arranged to slope away from the bins. The floor of the gravel pit was above the grade of the highway, so the trucks were not delayed in loading or getting away.

It was found that one man could attend the entire plant and take care of the tailings, except when the material in the bank was wet following a rainstorm. The plant was placed against the available faces in the gravel pit so that some excavation was necessary to make room for the crusher and the bottom of the gravel screen. A 15-ft. depth of face was available when operations started. From 12 in. to 18 in. of loam and other overburden had been removed and care was taken that the material fed to the plant should include due proportions of the various strata. At first the feeding was done by hand-shoveling from the immediate vicinity of the elevator boot. After a few days this was supplemented by a pair of horses and a drag scraper, a method of excavation used exclusively thereafter. Near the end of the operating period the haul to the boot averaged 250 ft. Five was the maximum number of teams and scrapers used at any one time. As the haul became greater wheel scrapers were tried, also a much advertised kerosene-driven tractor, without and with crawling traction. The soft underlying sand made the hauling too heavy for wheel scrapers and did not afford



PLAN AND ELEVATIONS OF ABERTHAW GRAVEL SCREENING PLANT AT NORTHBRIDGE, MASS.

proper traction to the tractor, so these methods were not adopted. Some form of dragline excavator was carefully considered but on account of the wide angle it would have been necessary to cover this method was not considered economical.

Production and Handling—A larger amount of sand was produced by the screening plant than was needed for concrete. To handle this surplus an occasional truckload was removed from the bin and deposited on the floor of the gravel pit near the road. To make the maximum use of this sand and to facilitate handling, two 16-in. x 24-ft. portable electric-driven belt conveyors, with low belt-cleats, were purchased. One of these had a device for screening the surplus concrete sand into peastone or torpedo sand for granolithic finish, and finer material for brick mortar. These conveyors loaded trucks from storage piles economically but the screening device was of little use as a small amount of moisture in the sand prevented its further separation. Most successful operation was attained during long spells of dry weather. These conveyors were readily moved around within the pit but it is extremely doubtful whether the results obtained justified the expenditure made for their purchase and upkeep.

The two-mile haul from the pit to the mixers was accomplished by 3½-ton dump trucks hauling about 4 cu.yd. per trip. These were hired at $2.50 per hour including driver, fuel, oil, etc. No serious mechanical difficulties attended the use of these trucks and the road, although hilly, remained in fair condition throughout the season. Some scraping with a road drag had to be done on a stretch of unimproved highway near the pit during spells of wet weather. No accident to persons or property attended the operation of the trucks although the route traversed was through the principal business street of the town.

The overburden excavated was 1,100 cu.yd., which was left in the gravel pit; 12,451 cu.yd. of material were measured in the bank and paid for; and 272 cu.yd. of prepared material were sold at the gravel plant and trucked by others. The cost of preparing this material and the price received for it have been excluded from the figures tabulated. Of coarse aggregate 244 cu.yd. remained in the gravel pit as a surplus when concreting was completed. All surplus fine aggregate was trucked to the job as backfill and is included in the 14,309 cu.yd. reported.

The maximum storage around the mixers which could be used economically would care for one day's run only, so that during the active period of the job it was found necessary to install incandescent and flood lights at the gravel pit and to run during the night as well as during daylight hours to provide sufficient aggregate for the daily scheduled runs of concreting. The labor cost of night operation averaged one-third higher, when work was running well, than during the daytime; and occasional breakdowns, when the needed help to make unusual repairs was not immediately available, still further increased costs.

The plant was in operation June 7 and work of dismantling was started October 17, a period of 18 weeks. Allowing for Sundays and wet weather, an average of 143 cu.yd. of both coarse and fine aggregate was produced daily, including about 30 nights when gravel was produced and transported.

During wet weather the sand would not separate in the dry screen and some few loads had to be re-screened by hand to enable proportioning to be consistently accomplished at mixers.

The quality of the material was maintained throughout; 1:3 briquettes made with the sand averaged well over 100 per cent of Ottawa standard. An occasional batch of 1:2:4 cylinders was made, which, when crushed at 28 days, gave average strengths of over 3,000 lb. per square inch compared with the average of under 1,900 lb. obtained from aggregates from the same pit before the plant was operating.

The estimated and actual costs are tabulated above.

Average Cubic Yard Cost—From the table of comparative costs it will be noted that the average cost of coarse and fine aggregate delivered by trucks at the mixers was $2.055 per cubic yard. No direct comparison can be made with other sources of supply as no concern or concerns were found who could supply gravel screenings as required. The one concern which did bid, was tried and proved unsatisfactory. Acceptable crushed stone could have been purchased for $3.13

TABLE — ESTIMATED CONTRACT COST OF GRAVEL AND ACTUAL COST WITH SCREENING PLANT ON JOB

Performance	Estimated Cost	Actual Cost	Actual Unit Cost per Yard of Material Del'd at Mixers	Saving	Overrun	Remarks
1. Labor stripping bank, 1,100 cu.yds...	$1,200	$529	$.037	$671		Overburden piled on premises.
2. Labor on plant unloading, erection, maintenance, dismantling and loading..........	1,825	2,196	.154		$371	Includes lubrication, repairs and upkeep.
3. Labor of operation, including foreman, teams and men loading and handling, 14,309 cu.yds. of coarse and fine aggregate.......	6,609	10,663	.745	...	4,054	Estimated 13,217 cu.yds. @ 50c.
4. Trucking aggregates from pit to mixers, 14,309 cu.yds.	7,930	8,222	.575		292	Estimated 13,217 cu.yds. @ 60c.
5. Proportion of overhead at main job office....		570	.040		570	Includes watchman Sundays and holidays
6. Electric power and installation, including wiring for motors and lights......	800	1,195	.084		395	Amount of salvage received allowed for.
7. Plant rental..................	2,600	2,235	.156	365		Crusher, screens, elevators, pumps, repair parts and renewals on rented equipment.
8. Lumber for bins, bolts, nails, etc....	500	456	.032	44		Amount of salvage received allowed for.
9. Pipe for wash water supply (2nd hand)........	200	206	014		6	Amount of salvage received allowed for.
10. Two portable belt conveyors...............		918	.064		918	Includes freight from factory and allowance received for salvage.
11. Freight, express and trucking on equipment......	250	303	.021		53	From Boston and return.
12. Sundries, including hand tools, horse scrapers, bin-gates, grease, oil, waste, etc....	50	664	.046		614	Amount of salvage received allowed for
13. Paid to owner of pit for material removed.........	860	1,245	.087		385	12,451 cu. yd. bank measurement.
	$22,824	$29,402	$2.055	$1,080	$ 7,658	
Overrun..	6,578	...	....	6,578	....	
	$29,402	$29,402	....	$7,658	$7.658	

per cubic yard f.o.b. cars, plus an estimated cost of 50c. for unloading and trucking to mixers. Freight conditions during the construction period were such as would have made it hazardous to rely upon obtaining aggregates by rail, and the absence of unloading facilities would have made it extremely difficult to receive the material by cars even though car service had been satisfactory.

Thus assuming that crushed stone at the above price and sand by cars at $2.33 per cubic yard could have been made available, and the unloading from cars and trucking to mixers could be accomplished at 50c. per yard, the average price at the mixer would have been $3.36 per yard against the actual cost recorded—$2.055 per yard. Similarly, assuming that gravel screenings could have been obtained at $2.66 per yard f.o.b. cars with 50c. for unloading and trucking, then the average price of screenings and sand would have been $3.16 against the $2.055 actually obtained.

Alum, an Aid in the Filtration of Activated Sludge

Sanitary District of Chicago Finds Alum Success at Three Plants with Advantages Over Use of Acid

UNIFORM success in the use of aluminum sulphate in the pretreatment of activated sludge for pressing has been attained at three sewage treatment plants of the Sanitary District of Chicago. Alum is found preferable to acid as an aid to filtration since it is safer to handle, it decreases time of filtration, it is as cheap, gives a clean filtrate and it is not necessary to control the amount within narrow limits. F. W. Mohlman, chief chemist, in a paper presented recently to the American Chemical Society at Milwaukee, described experiences of the past year with alum, mostly with plants of full-size working scale, at Des Plaines, Calumet and Argo. An abstract of his paper follows:

Des Plaines Works—Approximately 3,000 lb. of dry activated sludge is produced daily at the Des Plaines works. As removed from the aeration tanks the moisture content averages 98 per cent, although it frequently is as low as 97 per cent. Sludge is removed for pretreatment from the Dorr thickeners daily and stored in rectangular tanks containing filtros tile aerators. From these storage tanks the sludge is pumped directly to the filters.

When the press house was put in operation, in September, 1922, two types of presses were available. The first was a 120-plate Simplex press, a typical recessed-plate filter press with a special type of grooved recess. A perforated sheet-metal plate was riveted over the grooves on which the filter cloth rested. The plates were center-feed. The thickness of the cakes was 1 in., and the filtering area was 1,815 sq.ft. Pressure could be built up to 125 lb. per square inch. The Worthington platen press, similar to the one used at Milwaukee in 1918, held eighteen bags, each 5 x 8 ft. in area, supported between perforated platens. The filtering area was 1,440 sq.ft.

The first few pressings were made with untreated sludge. The bags soon clogged, and slimy cakes were produced, even with a long pressing of from 7 to 8 hours. It became increasingly difficult to handle the sludge produced.

Acid was used for a number of pressings, and as far as practicable the pH was adjusted to the optimum value, approximately 3.5 as shown by laboratory tests with Buchner funnels. Results were very unsatisfactory, with wet slimy cakes and dirty bags. It was necessary to press 24 hours per day, with a chemist present only during the day shift, consequently perfect adjustment of the acidity could not be obtained.

A marked improvement in filtration was noted immediately on the use of alum. The cakes were dryer, time of filtration was shortened and the bags were cleaner. The use of alum was so satisfactory that it was adopted as routine procedure in the pretreatment of sludge.

The comparison of the relative efficiency of acid and alum for pretreatment, shown in the table, was obtained by filtration of 250 c.c. of treated sludge through a battery of Buchner funnels, using a sludge with 99.06 per cent water.

TABLE—RELATIVE EFFICIENCIES OF ACID AND ALUM FOR PRETREATMENT OF ACTIVATED SLUDGE

Sulphuric Acid—66 Deg. Bé			Filter Alum		
c.c. per Gal.	Time of Filtration Min. and Sec	pH	Lb. per 1,000 Gal.	Time of Filtration Min. and Sec.	pH
0	7:30	7.1	0	8:00	7 1
1	10:15	6.2	3	2:00	6.7
2	9:30	5.3	6	1:50	6.4
3	6:00	4 3	9	1:40	6.2
4	5:00	3 2	12	1:30	6.0
5	4:00	2 5	15	1:15	5.8

These results have been verified a number of times, and show facts which indicate why alum has proved so much more satisfactory than acid. An insufficient amount of acid, or a drift back to a pH between 5 and 6 may actually cause an increase in the time required for filtration. On the other hand the addition of even small amounts of alum produces a sharp decrease in time of filtration, with little tendency toward deflocculation, and at no time an actual increase in time of filtration The curve shows no "humps," and no sharply defined iso-electric point. Similar results have been noted by Van der Meulen and Smith in experiments on the use of alum for coagulating Imhoff sludge.

Laboratory tests, proved by months of practical operation, have shown that the sludge may be too concentrated for effective use of alum. These observations have resulted in the following procedure for the pretreatment of the sludge: The sludge is drawn into the storage tank, where its moisture content is determined approximately by means of a special hydrometer which has been calibrated by many tests on sludges of various moisture contents. If the apparent moisture content is below 98.5 per cent, effluent or city water is added to bring the moisture up to that point. Alum is then added, never more than 10 lb. per 1,000 gal. If possible the sludge is used up within 6 hours; if it has to stand 24 hours more alum is added.

The pH is usually decreased to 5.8 to 6.0, at which point practically all the alum is precipitated as $Al_2(OH)_6$. It will be noted that the function of the alum is thus as a coagulant used in water filtration, and not for its salt effect, after the iso-electric point has been obtained by the use of acid. Much lower amounts are required if alum is used as outlined than if acid and alum are used together.

The amount of alum left in the sludge as a diluent of the valuable nitrogenous material is absolutely negligible. At the rate of 10 lb. per 1,000 gal. of 98.5 per cent sludge, only about 30 lb. or 1.5 per cent of Al_2O_3 will be added to a ton of dried sludge.

Alum has been used as described above since October, 1922, with uniform success. We encountered no so-called "winter sludge"; pressing and pretreatment were for practical purposes just as satisfactory in January and February as in July and August. We did, however, encounter a period of difficulty in April, 1923, when we attempted to cut the air in the aeration tanks to the minimum amount capable of giving an effluent that would not decolorize methylene blue in less than 8 or 10 days. We gradually reduced the air to as low as 0.66 cu.ft. per gallon, but as we cut the air the nitrates in the effluent were reduced from 7 or 8 p.p.m. down to 1 or 2 p.p.m. The effluent was still clear, but stabilities began to drop off. The main difficulty was noted in the filtration of the sludge Although the same pretreatment was continued, in fact the alum dosage was increased, slimy cakes were obtained and filter cloths clogged rapidly. The air was soon increased to 1.2 cu.ft. per gallon and the nitrate built up to 5 to 10 p.p.m. Coincidentally the sludge began to press more easily, and soon was back to its former satisfactory condition.

The present trend of development of the activated-sludge process seems to be in the direction of decreased aeration and minimum nitrification. Numerous mechanical and biological schemes are proposed which require less power than that required by aeration with compressed air, but generally no nitrification is obtained. The writer believes that thorough activation, as evidenced by formation of 5 p.p.m. or more of nitrate nitrogen, is essential for the production of a sludge that will filter easily.

Calumet Works—The Calumet works include two activated-sludge units, each with a capacity of 1.75 m.g.d. Sludge was built up and ready for pressing in June, 1923. An Oliver filter has been installed and has been filtering all sludge produced. This filter is 11½ ft. in diameter and 14 ft. long and is covered with 495 sq.ft. of filter cloth. It has not been possible to run for more than 7 or 8 hours continuuosly with this filter as the sewage is quite dilute and the sludge accumulates slowly. As at the Des Plaines works it was found that untreated sludge would not filter satisfactorily. Alum was used for preparation of the sludge, but it was found desirable to add more alum, up to 14 lb. per 1,000 gal. A number of tests with Buchner funnels indicates much more rapid filtration with alum treatment than with acidification. The filter has worked satisfactorily during the short time it has been operated. The average rate of filtration has been approximately 0.011 lb. of dry sludge per square foot of filtering surface per minute. This high rate of filtration, combined with the fact that filtration is continuous and cleanly, has indicated that this type of filter is preferable to the pressure filters at Des Plaines.

Corn Products Testing Station—An unusual type of activated sludge has been produced at the testing station treating the wastes from the Corn Products Refining Co., at Argo. This sludge is usually very light and voluminous, frequently containing over 99 per cent water. It contains more than 75 per cent organic matter on the dry basis, and from 6.5 to 7.5 per cent nitrogen. The problem of pressing this sludge is unusually difficult because of its watery nature and the rapid changes in its character due to biological conditions.

Two filters have been used for pressing this sludge, a recessed-plate filter press and a small American continuous filter. The latter is a rotating leaf suction filter containing 20 sq.ft. of filtering surface. In principle it is similar to the Oliver filter. Many substances have been used for pretreatment of the sludge before filtration. It was frequently found impossible in the winter of 1921-22 to produce a cake in the filter press, no matter what was the pretreatment.

The American filter has offered more hope. Sludge has been pressed both hot and cold many times, using, as filter aids, sulphuric acid, alum, di-calcium phosphate, spent bone ash, sulphur dioxide and filter-cel.

Conclusions—General conclusions are as follows:

1. By suitable pretreatment of the sludge it should be possible at all times to produce a cake with a type of suction filter similar to the American filter.

2. A very dilute sludge (99.5 per cent water) or one not well-activated cannot be pretreated with any of the above substances, including heating to 150 deg. F., so as to give a high rate of filtration (that is, a rate greater than 0.08 lb. per square foot per minute). A well-activated sludge with a moisture content of 98.5 or 99.0 per cent can be treated with either alum or acid, with or without heating, and will give a satisfactory cake with a high rate of filtration. The moisture content without heat is usually about 85 per cent, with heat from 80 to 82 per cent. Heating apparently does not materially increase the rate of filtration. Alum treatment is generally more effective than acidification.

3. Phosphates, bone ash, filter-cel and sulphur dioxide are of little value.

4. The ratio of time of pick-up to time of drying is fixed. It would be desirable to be able to vary the ratio, that is, to shorten the time of pick-up with a heavy sludge and to lengthen it with a dilute sludge. Control of the degree of vacuum or blanking off of one or more sectors are unsatisfactory methods for accomplishing such variations.

Flood Flows or Maximum Runoffs of Montana Streams

Tabular Data and Curves for Streams East of Divide, West of Divide and on Prairies, Based on Recorded Runoffs

By George Henry Ellis

Hydrographer, Office of State Engineer, Helena, Mont.

In determining the required capacity of the waterway under a bridge, a highway or railway culvert, or the spillway of a dam, the best method is to be there when the greatest flood occurs and measure the discharge. If that has not been done, perhaps the next best method is to find some marks left by the highest flood, and make an estimate of quantities based on measurements of cross-section and slope. If this method, in turn, is impractical or uncertain, the drainage area

FLOOD FLOWS OR MAXIMUM RUNOFFS FOR THREE CLASSES OF MONTANA STREAMS

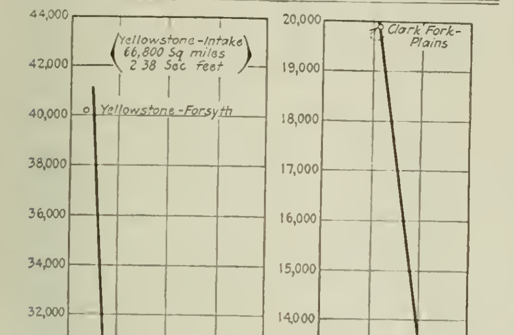
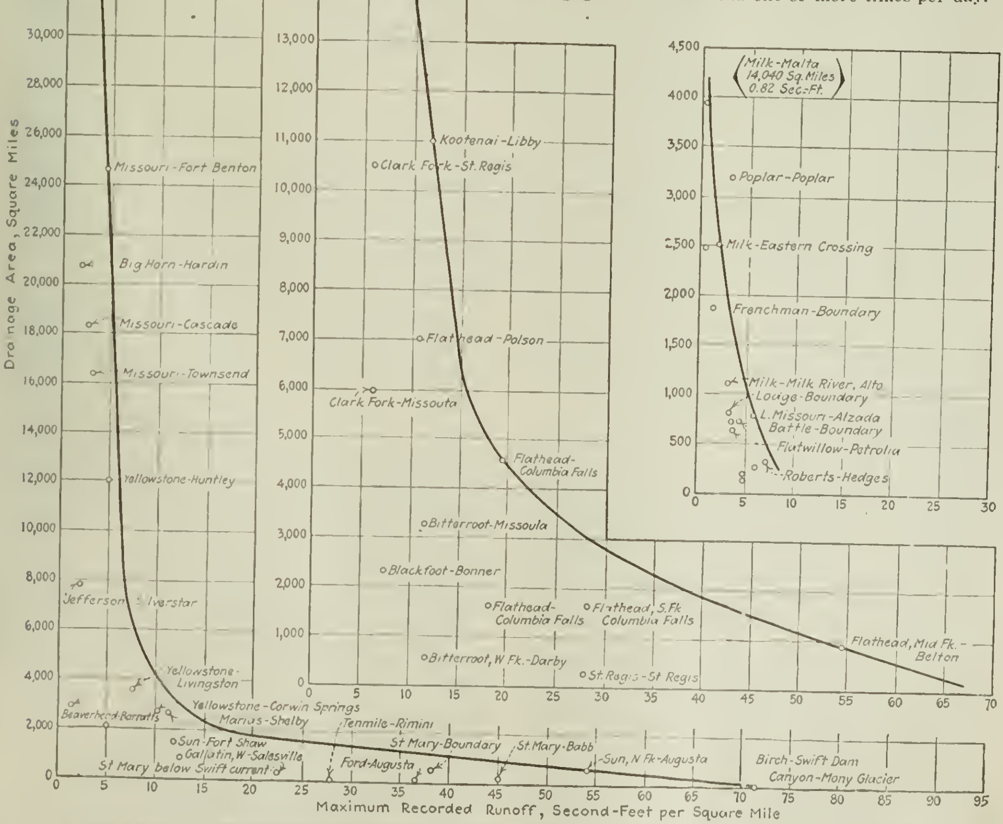
Stream, Station and Period	Drainage Area, Sq.Mi.	Record Flood, Sec.-Ft.	Date		Second Feet Per Sq.Mi.
Mountain Streams East of the Divide:					
Beaverhead R. at Barratts 1907–22	2,870	3,640	June 19–20,	1908	1.27
Jefferson R. nr. Silverstar 1910–16; 1920–22	7,840	16,500	June 15,	1913	2 10
Missouri R. nr. Townsend 1891–01	16,400	52,500	June	1899	3.20
Missouri R at Cascade 1902–15	18,300	49,300	June 5,	1908	2.69
Missouri R. at Fort Benton 1881–91; 1902–22	24,600	107,000	June 7,	1908	4 35
Madison R. nr. Norris 1897–05	2,085	10,300	June	1899	4.94
Gallatin R. (W) nr. Salesville 1895–05; 1910–13; 1921–22	860	10,750	June 18,	1896	12.5
Tenmile C. nr. Rimini 1915–22	33.9	984	May 15,	1917	27.9
Sun R. Nth. Fk. near Augusta 1889–90; 1903–21	596	32,300	June 21,	1916	54.2
Sun R. at Ft. Shaw 1912–22	1,475	17,500	June 22,	1916	11.9
Ford C. nr. Augusta 1906–12	19.7	720	June	1908	36.6
Marias R. nr. Shelby 1902–08; 1911–22	2,610	29,500	June 24,	1907	11.3
Birch C. at Swift Dam 1913–22	75	5,275	June 21,	1916	70.3
Yellowstone R. at Corwin Springs 1910–22	2,630	26,500	June 14–15,	1918	10 1
Yellowstone R. at Livingstone 1897–05	3,560	26,820	June	1897	7 53
Yellowstone R. at Huntley 1907–16	12,000	58,100	June 30,	1916	4 84
Yellowstone R. at Forsythe 1921–22	40,200	63,600	June 15,	1922	1.58
Yellowstone R. at Intake 1911–22	66,800	159,000	June 21,	1921	2 38
Big Horn R. nr Hardin 1904–22	20,700	40,800	June 17,	1908	1.97
St. Mary R. nr. Babb 1902–15	177	7,980	June 5,	1908	45 1
St. Mary R. blw. Swiftcurrent C. 1901–02; 1910–15	298	6,690	July 4,	1902	22 45
St. Mary R. nr. Int'l Bdry. 1902–22	472	18,000	June 5,	1908	38.2
Canyon C. nr. Many Glacier 1918–22	7.0	500 est.	May 16,	1922	71.4
Mountain Streams West of the Divide:					
Kootenai R. at Libby 1910–22	11,000	130,000	June 21,	1916	11.8
Clark Fk R. at Missoula. 1898–07	5,960	35,800	June	1899	6.01
Clark Fk R. at St. Regis 1910–22	10,500	62,800	May 30–31,	1913	5.98
Clark Fk R. nr. Plains 1910–22	19,900	115,000	June 5, and July 2,	1913 1916	5.78
Blackfoot R. at Bonner 1898–05	2,310	17,244	June	1899	7.47
Bitterroot R. W. Fk nr. Darby 1910–17	572	6,730	June 17,	1917	11.76
Bitterroot R. nr. Missoula 1898–01; 1903–04	3,260	37,437	June	1899	11.5
St. Regis R. nr. St. Regis 1910–17	278	7,740	May 28,	1917	27.85
Flathead R. nr. Columbia Falls 1910–17	1,620	29,500	June 20,	1916	18.2
Flathead R. at Columbia Falls 1922	4,560	88,200	June 5,	1922	19.3
Flathead R. nr Polson 1907–22	7,010	75,400	June 13,	1913	10 75
Flathead R. N. Fk. at Belton 1910–22	900	49,000	June 21,	1916	54 44
Flathead R. S. Fk. nr. Columbia Falls 1910–16	1,640	46,200	June 19,	1916	28.2

Prairie Streams:					
Roberts C. at Hedgesville 1920–22	320	'2,290	June 17,	1921	7.16
Flatwillow C. at Petrolia 1921–22	649	2,400	June 6,	1922	3.70
Milk R. at E. C. 1913–22	2,514	4,860	Apr. 9,	1917	1.94
Milk R at Malta 1902–22	14,040	11,500	Mar. 27,	1918	0.82
Milk R at Milk River, Alberta 1909–22	1,104	3,467	Feb. 17,	1916	3.14
Lodge C at Int'l Bdry. 1917–22	806	2,700	Mar. 31,	1918	3.35
Battle C. at Int'l Bdry. 1917–22	730	3,200	Apr. 13,	1917	4.39
Frenchman R. nr Int'l Bdry. 1917–22	1,875	2,780	Apr. 30,	1917	1.48
Pig Muddy C. nr Culbertson 1908–21	3,930	1,550	Mar. 31,	1916	0.40
Little Mo. R. nr Alzada 1911–22	780	4,550	Apr. 6,	1912	5.84

tributary to the stream at the proposed structure may be measured and compared with some similar area for which the maximum flood is known. Data for use in the latter method on streams in Western United States, and in New York State, have recently been presented in these columns, and similar data for Montana are given herewith. (See *Engineering News-Record*, July 3, 1919, p. 28, article by John T. Whistler, and Nov. 4, 1920, p. 879, article by E. H. Sargent.)

In a country so varied as to climate and topography as Montana, considerable judgment must be used in basing estimates on data of this sort. Even after the data have been classified as to mountain streams (1) East, and (2) West of the Divide, and (3) Prairie streams (see table and diagrams), there are still no two drainage areas just alike as to exposure and forestation. Many streams in Montana are so thoroughly used for irrigation that even the flood flow is affected thereby; for example, Beaverhead River at Barratts did not have a greater discharge than 1.27 sec.-ft. per sq.m. during the sixteen years, 1907-1922. Many Montana streams have not experienced their maximum flood during the period for which records have been obtained, and perhaps the Beaverhead is one of these.

The data are from published records. Some represent absolute maximum, as obtained from an automatic water-stage recorder, and others are maximum reading of a gage which was read one or more times per day.

MAXIMUM FLOOD DISCHARGES OF MONTANA STREAMS EAST AND WEST OF DIVIDE AND ON PRAIRIES

Federal Land Reclamation: A National Problem

9. The Future of Federal Reclamation

By HON. ADDISON T. SMITH

Chairman, Committee on Irrigation of Arid Lands, House of Representatives, U. S. Congress

The Ninth and Last of a Series of Articles on History and Performance of the Great Government Adventure in Irrigation of the Arid lands of the West

THE 68TH CONGRESS, which has just assembled, has before it innumerable problems of national and international importance, many of which are of great interest to engineers as such, as well as from the standpoint of good citizenship. Among these questions, there is perhaps none more vitally important, as it relates to the stability of government and of business institutions, than that of the national policy of land reclamation and settlement. From the earliest times the land question has been recognized as fundamental in the stability of all government. In fact, one of the most difficult questions and one which threatened the existence of the nation as a whole was that growing out of the ownership and use of the vast tracts of land west of the original colonies; when the title to these lands was finally confirmed in the United States, then and not until then was the stability of the Union assured.

The necessity of using these public lands for homes for citizens was early appreciated, but the ways of assuring such best use were not finally agreed upon until the passage of the homestead act, which in effect dedicated to home-making the greater part of the public lands of the country. The growth of the United States in population, industry and in everything that makes for good citizenship has been closely connected with the utilization of the vast extent of lands which could be employed in the creation of the small self-supporting farm homes—small in distinction from the great estates or ranches of other countries but large enough to absorb the available labor of the owner and his family.

Reclamation to Develop Homes—The fact that these public lands, suitable for home-making, had practically disappeared by the beginning of this century led Theodore Roosevelt and his associates to urge that the benefits of the Homestead Act be extended, not by annexing lands belonging to other nations but by internal expansion, by removing obstacles to the cultivation of lands which were then lying idle because of lack of water. In his first message to Congress, December, 1901, Roosevelt urged that the public lands of the arid region be reclaimed so that homesteading might continue. Under the stimulus of his personal interest in the matter and with the active efforts of many notable statesmen the Reclamation Act finally became a law, being signed by President Roosevelt on June 17 (Bunker Hill Day), 1902.

> ### Congressman Addison T. Smith on Future Reclamation Problems
>
> *Many of the projects now proposed may cost more than the productive value of the land.*
>
> *We are at the beginning of development, but we must go at it in some other way than has been practiced in the past.*
>
> *A self-supporting home established in the East is as important to the nation as one in the West.*
>
> *The existence of public lands should not be made the prerequisite for the continuation of the national policy of home-making. On the contrary, this policy should be adapted to present conditions of land ownership.*
>
> *The formation of reclamation districts under state law is one of the large steps in advance. We must go back to the original conception, that if the government initiates the work and puts it on its feet there must be some organization or district acting under state law which must take up the petty details of dealing with the individuals.*
>
> *The federal government is furnishing all the money, doing all the work, is being criticized because it does not enter into more details, while the state is doing little or nothing in the way of solving the problems of its citizens on the reclaimed lands.*

Two decades and more have elapsed since that time. The vacant public lands so far as these may be irrigated or reclaimed have practically all disappeared. Although about 190,000,000 acres of vacant public lands remain on the tract books of the Land Office, practically all of these consist of rejected areas—of mountains, plateaus or rock-strewn valleys, and lands where the soil is too thin for cultivation. Every valley in the arid region has been explored, every piece of land which under any conceivable plan may ultimately be utilized is gone, so far as government reclamation is concerned.

The extraordinary and unlooked-for success of the Reclamation Act has resulted in a great stimulus of enterprise in the arid region as a whole, and to an extent such as to force land prices so high, as compared with recent crop values, as to render further reclamation plans a matter for serious consideration from the financial or economic standpoint. Many of the projects now proposed may cost more than the productive value of the land.

Is More Reclamation Needed?—It is not to be inferred that the West is completely developed. On the contrary, we are at the beginning of development, but we must go at it in some other way than has been practiced in the past. This is shown by the many applications for relief from payment of the installments due the government. This is in spite of the fact that the conditions for such payment for water for the reclaimed land have been made, by act of Congress, more lenient than in any other part of the world or by any other country or organization. Last year 2,000 settlers applied for relief or extension of time of payment, and this year over 4,500 are urging

some concession. Many of these claims are doubtless meritorious, but the fact that so many are making application indicates that there must be some change in present methods.

It should not be assumed that the West, which has contained such vast areas of public land, is the only undeveloped portion of the United States. The country as a whole, as concerns its continued growth and prosperity, cannot confine its efforts to any one section. A self-supporting home established in the East is as important to the nation as one in the West. It is the contented and prosperous home which should be considered, not the particular locality of that home.

This important consideration that the nation is concerned, not with the reclamation of public land because it is public land, but with the ultimate object of home-making gives a broad view of the situation. It forces us to consider the opportunities offered in every part of the country. For many years the people of the South have been insistent that so far as national and business stability are concerned it is the unused land of the South which should have early consideration. They have claimed that with the rapid development of the West, the South now presents more opportunities. There are no public lands remaining in the South. The existence of public lands should not be made the prerequisite for the continuation of the national policy of home-making. On the contrary, this policy should be adapted to present conditions of land ownership and be so modified as to encourage the settlement of vast tracts of land suitable for homemaking.

Opportunities In the South—There is no doubt but that the success of reclamation in the West has stimulated other parts of the country to demand that equal consideration be given to their claims. It is a matter of history that when the Reclamation Act was under consideration the South voted to help the West and with the understanding that, if the time should come that the South was in a position to need similar legislation, the western men would come to its aid. The time has now arrived when the people of the South are demanding such consideration and are pointing to the fact that if the ultimate object of the Reclamation Act is the making of homes, then, under present conditions, homes can be made in the South as well as in the West.

To put it in another way, the success of national reclamation in the arid region has stimulated interest and enthusiasm in the underlying ideals of home-making, and if the West is to continue with federal assistance it must share this with other parts of the country. It can no longer stand alone or claim the unique distinction of having public land to be reclaimed in any considerable tracts.

This claim for general consideration is by no means new. Congress has already recognized that something should be done; in 1918 it appropriated $100,000 for a study of the unused lands in every state. The report, printed in 1919, illustrates the fact that there are lands available in every section of the country, many of which may be utilized as need arises. It is true that these lands are in private ownership, individual or corporate, but they can be obtained on terms not much more onerous than those attached to public lands. The owners of many of these tracts, seeing the hopelessness of financial gain in the reclamation and settlement of these lands, have offered to turn over these areas to bona fide settlers at rates which may be approved by competent authority as being fair.

It is possible to conceive of a land reclamation and settlement district, organized under the state law, embracing suitable lands and conducted in such way as to give reasonable assurance to home-seekers that they will have a square deal. It is also possible to conceive that the financing of such districts may be done under federal auspices in such way as will ultimately recover the investment, although the interest may be lost to the government during the years of pioneering. Compensation for this loss of interest is more than made up by the fact of the ultimate settlement of the land, and the making of self-supporting homes. It is recognized that, in every undertaking of this kind, some aid must be given; the most effective way is through this forfeiting of interest on the investment during these early stages.

Improvement of Existing Laws—The Reclamation Law as it now stands is applicable only to lands in the sixteen arid or semi-arid western states, Kansas to California, Montana to Arizona. It has been amended from time to time in certain details, particularly those having to do with the repayment of the amount owed to the government on account of the capital investment in irrigation and drainage works. The result is that the law as a whole is more or less of a patchwork; it is somewhat inconsistent in its details and requires for effective application many fine-drawn distinctions or inferences which should be covered by explicit statement of principles. In short, the methods of administration forced by the necessities of the case are not embodied in the law but are permissible by inferences drawn from apparent intent of the act, rather than from direct authorization.

This latitude of the reclamation law was very desirable and even essential twenty years ago, when conditions were almost unknown, but now that federal reclamation has become an established fact, it is the part of wisdom for Congress to recognize the larger needs and to place responsibilities more definitely than in the past.

Reclamation Districts—The formation of reclamation districts under stated law is one of the large steps in the carrying out of the objects of the Reclamation Act. These districts should be encouraged or even compelled to take a larger responsibility in the administration of affairs, not leaving the land owners and their tenants to shift the burdens of operation and maintenance to the shoulders of Uncle Sam. The Reclamation Act in its very essence requires that large responsibility be assumed by the federal department or bureau having the matter in charge, but the duties have been greatly increased by this strongly marked tendency to force good-natured Uncle Sam to carry the burden longer and to a larger extent than was contemplated originally.

Under the Act of 1902, it was assumed that payments would be made without interest during the pioneer period of ten years, and that before this time had elapsed the local people would have assumed full responsibility and control. Congress extended the time to twenty years, but made no requirements such as to facilitate the government's laying down the burden. Recently, a provision was inserted in one of the Appropriation Acts which may require the government, in connection with the Milk River project, in Montana, to keep control and practically peddle out water for fifty

years. It is thus forced to interfere in the local affairs of water distribution to small communities, a condition which tends toward continued misunderstanding and exasperation. We must get over this and go back more nearly to the original conception, that if the government initiates the work and puts it on its feet there must be some organization or district acting under state law which must take up the petty details of dealing with the individuals.

Extension of Time—In connection with the operation of the Reclamation Act there is no one thing which has taken up so much time of Congress and in its committees and has led to such exasperation on the part of its members as the steadily increasing demand for extension of time of payment. At the end of the first ten years, Congress concluded that a ten-year period for payment of the capital invested in the water which made the farm available was too short, even though this payment was made without interest. After considerable discussion it was concluded to grant *terms so easy that under no possible condition could any landowner fail to make good*; that is to say, to make the installments on the capital invested less than the ordinary payment of interest.

For example, the government may have invested $80 per acre in the reclamation of land. This land was given away originally under condition of settlement. The man getting this piece of land was required to pay this $80 for the water in installments without interest, extending over a period of twenty years. To put it in another way, if the landowner paid 5 per cent a year for twenty years, he could have the water for nothing. More than this, to cover the pioneer period, it was provided that for the first four years the landowner need pay only 2 per cent installments, then for the fifth and sixth years only 4 per cent installments, and for the remaining fourteen years 6 per cent, all of these without interest on the deferred amount. Here were terms far easier than those offered by any country or community and Congress gave a sigh of relief that the whole thing was settled and for all time. Many members thought this too easy, and urged that at least a small interest charge should be demanded, and conditions after the first ten years made comparable to those of the Federal Farm Loan banks.

Now, however, after a few years of payment of the installments on the capital invested of 2 per cent, thousands of landowners plead that they cannot keep up this rate of installments. Last year 2,000 appealed for relief, this year over twice as many. There is no doubt but that many of the settlers do need help, on account of excessive cost of the project, poor soil, small yield and the like, but those unfriendly to the reclamation policy argue that the beneficiaries under the Reclamation Act should be required to meet their payments or accept terms comparable to those of the Federal Farm Loan Act, amortizing the debt in from 30 to 40 years but with payment of a small interest, equivalent to the amount the taxpayers are carrying on money borrowed by the government.

The annual relief bills will probably come before Congress as long as there remains any debt to the United States, unless some general rule should be laid down consistent with sound business principles, and the commissioner of the Reclamation Service or a board given the power and duty to establish regulations for adjustment of payments after a thorough investigation has been made of the necessities of the settlers on the different projects and to see that these regulations are carried out in a spirit of fairness.

Co-operation Between State and Nation—One of the chief criticisms of the Reclamation Act is that it is too one-sided. The federal government is furnishing all the money, doing all the work, is being criticized because it does not enter into more details, while the state is doing little or nothing in the way of solving the problems of its citizens on the reclaimed lands.

Undoubtedly there will be better appreciation of the work done by the government if much of this is made contingent upon the performance of equally important functions which fall within the state jurisdiction. The selection of settlers, getting the reclamation lands into the hands of men who will actually use them, providing advice toward better crop production—all of such work and many other details should be handled to a larger extent by the state or state organizations, farm bureaus, and others. The national government should be in a position to deal with the state or municipality organized under state laws and not be put in the position of supervising the details of water distribution to thousands of farms.

In particular, the financing of the settler is a matter which should be taken up by the state. Under present conditions, the landowners must borrow considerable sums of money, on which they are paying 8, 10 and 12 per cent, a rate which it is impossible to continue for any considerable time without injury. There are many arguments why, if the federal government will provide the water, the state or its subdivisions should give proper attention to these financial needs.

Taxes—In addition to the heavy interest charges for which relief should be offered, there are the steadily increasing taxes which are piled on the back-breaking load of the irrigator. Remember that the greater part of the taxes is of local origin, state and county. These taxes are under local control and yet they have increased with such rapidity that many an otherwise well-to-do farmer has been compelled to give up, the taxes representing a proper margin of profit.

The reason for this heavy taxation is evident in that on the reclaimed areas the people in the towns especially have demanded the conveniences of a highly settled community. They are building roads, bridges, schools and public buildings surpassing those of communities which have been settled for a hundred years. They are trying to pay for these things in a few years. All of them are desirable, some are necessary; but more necessary is it to keep the taxes within the limits where they can be paid.

A Vision of the Future—In what I have written I have tried to point out the things which should be done, and it might be inferred that, because I have pointed these things out, they are the large features of reclamation. On the contrary, while important they are not the whole story. I have not taken time to amplify upon the advantages and the great opportunities which lie before us in the future. I am merely pointing out the bad places in the road. At the same time the road does lead through pleasant valleys and has great attractions. It leads to far better conditions than I have touched upon. We are only at the beginning of land reclamation. We will realize even more largely than in the past the vision of the men who work for reclamation and the making of farm homes. We will ulti-

mately achieve these but we can do so more quickly and more satisfactorily to all concerned if we consider the rough spots and smooth them out.

The country as a whole not only needs more opportunities for homes but can provide these opportunities to be taken up in an orderly manner as needed, when we make use of the experience we have had in the last twenty years. By utilizing that experience and by doing some of the things which I have described, we will be performing not only a necessary duty but one which will redound to the peace and prosperity of the whole nation.

Dining-Car Train Serves Mid-Shift Meal to Tunnel Crew

TWO OF THE headings on the 13-mile Florence Lake tunnel, which is being constructed by the Southern California Edison Co. on the Big Creek project are now two miles underground. Because of the distance from the portal camps a great deal of time would be lost in taking the tunnel crews out to their mid-shift meal. Moreover, from the point of view of the workmen there is serious objection in the winter time to the long ride and cold outside air, without time for a shower which they would take when coming off duty, thus both the crews and the company are highly pleased with a plan recently put in effect whereby the tunnel crews are supplied with a hot mid-shift meal served in the tunnel near the heading.

This plan has been made possible by the construction of dining-car trains, one of which is shown in the accompanying picture. This train is composed of five cars, three of which are equipped with tables and benches as shown, the other two being designed to carry the food into the tunnel and for use there as serving tables.

The food is transported in containers originally built for army use, which utilize the fireless-cooker principle in keeping the food hot in transit. Two waiters accompany each train, make the "set-up" prior to the meal, replenish the dishes and afterward clear up and return the utensils to the cook house at the portal camp.

MESS TIME IN FLORENCE LAKE TUNNEL

Each dining-car train is handled by an extra locomotive so as not to interfere, in any way, with the mucking operations. Needless to say the inbound dining-car train does not meet with delay en route if the tunnel crew can prevent it. Under present conditions it would take a minimum of 1½ hrs. to bring out the crew, give them time to eat and return them to their work. This time, of course, would increase as the heading is advanced. The new arrangement takes the men away from their work only for the length of time required to eat. The plan was put into effect in November and was very popular with the workmen from the outset, as now they do not have to come out into the cold air until they can go direct to their bunk houses.

Construction methods on the Florence Lake tunnel were described in *Engineering News-Record*, May 3, 1923, p. 776. The work is being done by force account under the direction of D. H. Redinger, resident engineer, for the Southern California Edison Co.

Ballast Sections on French Railways

AN INCREASED depth of ballast has been adopted on several of the French railway systems as a result of the greater weight of modern locomotives and rolling stock. This change is noted in the *Revue Generale des Chemins de Fer* by M Descubes, maintenance engineer of the Eastern Ry., and it is pointed out that the engine loads do not reach those of American railways. Formerly the depth under the tie was about 9 in. on straight track (sometimes only 7½ in.) and 6½ in. to 7 in. under the lower ends of the ties on curves.

In the new roadbed and ballast section of the State Rys. the ballast depth is 10 in. under the ties or 15.6 in. from top of tie. This is also the minimum depth under the low rail on curves. On double track the depth is 14.6 in. at the crown or middle of roadbed and 18 in. at the shoulders. The Southern Ry. uses an 8-in. bed of sub-ballast and a minimum of 7.3 in. of ballast proper. A similar construction on the Eastern Ry. has 8- and 6½-in. depths respectively. In all cases the ballast is level with the tops of the ties and has a shoulder 32 in. to 36 in. outside of the rail. Formerly this distance was 39 in. to 48 in., with a view to affording lateral support to the track, but it is now considered that the value of such a shoulder is relatively small. Where a bottom course of sub-ballast is used, it sometimes extends the full width of roadbed and forms side berms outside the ballast proper.

A conference of engineers of maintenance-of-way in August, 1923, adopted conclusions which are summarized below:

1. A thickness of ballast sufficient to distribute the load uniformly over the roadbed will avoid maintenance work on operated lines the cost of which work would be out of all proportion to the slight saving by using less ballast. On new roadbed the thickness of ballast and sub-ballast should be at least 14 in. under the tie at the rail. This depth may be reduced when the roadbed material is both stable and permeable, but on irregular rocky roadbed it should be increased, since a good cushion of ballast will reduce rail breakages. On an old roadbed, compacted and drained, a thickness of 10 in. under the ties may be sufficient.

2. A width of 32 in. from rail to shoulder of ballast is sufficient, but may be made 39 in. on new lines to provide a reserve of ballast in surfacing.

3. The ballast proper should be at least 6 in. deep under the ties. Sub-ballast should be of a finer material but sufficiently permeable for drainage.

4. Transverse crowning of the roadbed with grades of 0.3 to 0.5 per cent is advisable for drainage. On curves, the summit or high point may be placed under the outer track to avoid excessive depth of ballast.

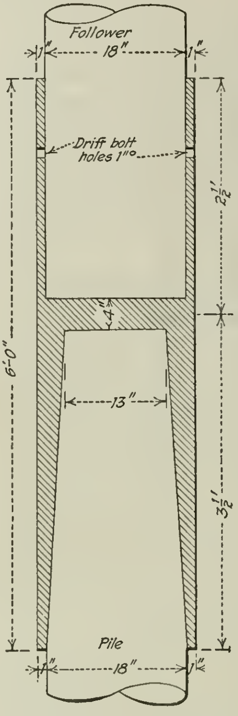
Deep Water Pile Driving for Seattle Bridge Piers

Good Progress Made on Pile Foundations for Spokane Street Bridge—Convenient Form of Follower Head Saves Time

THE CITY of Seattle now has under construction the Spokane St. crossing of the West Waterway which will be a bridge for vehicular and electric railway traffic, having for its central span a 288-ft., double-leaf bascule. Despite the depth of water around the piers for this central span, which required the use of an unusually long follower, good speed was made in driving the piles. In an ordinary eight-hour shift 20 piles or 1,700 lin.ft. of piling were driven using piledriver leads much shorter than the average length of the piles themselves. Piles were driven through silt to hard bottom 130 ft. below mean high water.

The order of procedure found most satisfactory was as follows: A derrick with a 90-ft. boom picked up the piles, which averaged about 85 ft. in length, and delivered them to a skid-rigged driver. Before taking the pile the driving crew put down between the driver leads a jet consisting of a 5-in. pipe, 100 ft. in length, in which a pressure of 250 to 300 lb. was used. This pipe was put down for each pile, first to the full depth and then thrust down three or four times to depths of about 40 ft. The bottom was hard enough to shut off the water pressure abruptly, making further jetting impracticable. Ordinarily this operation required about 3 or 4 minutes for the first long thrust and about one minute each for the thrusts to a lesser depth, and carried the top of the 100-ft. pipe as much as 30 ft. below the top of the cofferdam shown in the illustration.

The jet was slung from a block attached on one side of the leads near the top so that, as soon as the pipe was lifted and the guy line holding it between the leads was slacked off, it would swing out of the way of the pile which would then be put in the leads as quickly as possible so as to get it down in the jetted hole before there was time for the hole to fill up. The pile was simply centered in the leads and dropped; about 90 per cent of the time piles handled in this way went down into the jetted hole until supported by their own buoyancy, that is, the pile would float upright in the hole made by the jet and would remain with 15 to 20 ft. of its upper end projecting above water level. The cofferdam had been excavated to a depth of 53 ft. below mean high water.

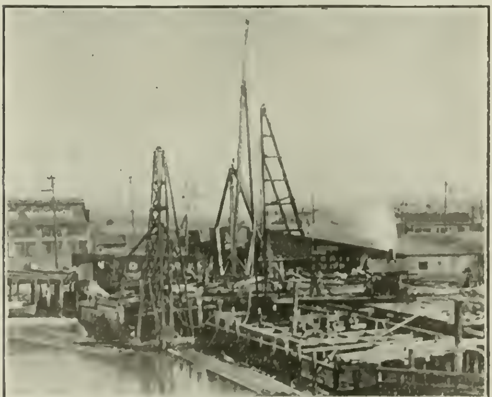


ELEVATION THROUGH CAST-IRON FOLLOWER HEAD

By using a cast-iron head of the type shown in the accompanying sketch no time was required in centering the head on the pile because of the taper section in which the specially prepared heads of the piles would center themselves. The pile heads were all axed off while drawn up on the deck of the floating driver by a boom-man and helper, this axing giving the pile head a taper corresponding with the taper in the iron head.

The head shown in the sketch was attached to a selected 18-in. fir follower, about 60 ft. long, to which it was fastened by four 1-in. bolts driven into the follower through holes in the casting. The follower with the head attached was put on the pile immediately after the latter stopped sinking of its own weight. The weight of the follower caused it to sink still lower, in fact always low enough so that the hammer could be placed upon the follower. In driving 560 piles there were only two cases where the head stuck to the pile.

The hammer was a 4,500-lb. drop hammer. This was ordinarily used about ten minutes on each pile with blows varying from 8 to 10 ft., which was sufficient to give the 85-ft. piles a penetration of 50 to 60 ft. in addition to the depth they had sunk in the jetted hole.



DRIVING LONG PILES WITH A FOLLOWER
The derrick boom is ready to deliver pile to the driver on the right from whose leads the jet pipe is being removed. The driver at the left is used only to pump water for jetting.

The floating driver was used only on account of its pump equipment which supplied water for the jet. The derrick was so placed that it could pick up a pile and place it vertically alongside the driver leads where it would hang until the jet pipe was removed and the pile could be swung into the leads. After delivering a pile to the driver the derrick picked up the follower and held it suspended ready to place in the leads on the pile. This saved time.

The driving crew consisted of one foreman, one stationary engineer on driver, one stationary engineer on pump, one boom-man and helper preparing pile heads, three loftsmen, one man on winch handling line—a total of nine.

The work was done by the J. A. McEachern Co., contractors, J. A. McEachern, president, and B. F. Cook, general superintendent. The project as a whole is under the direction of J. D. Blackwell, city engineer. A. Münster is bridge engineer for the city and E. K. Triol is supervising engineer in charge of construction for the city.

Through the Reclamation Country

By F. E. Schmitt
Associate Editor, *Engineering News-Record*

THIS is the twelfth and last of the series of letters written by Mr. Schmitt during a journey recently made through the West in which he visited irrigation projects, studied developments, and interviewed builders, operators and settlers, in order to present to our readers the actualities of reclamation as revealed to an unprejudiced investigator.

Chicago

MANY illuminating opinions on irrigation and reclamation were expressed in the course of the interviews I have had during the last two months in the irrigation country. They are the views of men who have lived in contact with irrigation farming and its successes and troubles for many years, and who have seen the endless promotion, mismanagement and confusion of private irrigation work as well as the much troubled development of federal work. Moreover, these men are familiar with the farmer's problems and his psychology.

Because the opinions expressed in these interviews give an excellent perspective of the irrigation situation, a selection of citations from them will help the engineering reader in appraising the present reclamation situation. Names are omitted.

Success in reclamation farming comes to the same kind of people that would succeed on other farms; and in ordinary farming there are always many failures. I can't see how the weeding-out process is ever going to be avoided in reclamation. The successful farmer can pay the construction charges, the others can't.—*Grand Valley farmer.*

The statement that it takes from two to three crops of settlers to make an irrigation project a success is specially true of private projects. All have been failures, in some cases again and again. The few exceptions were cases that had the best land and the simplest and cheapest water supply.—*Former state engineer.*

The Congressional relief acts did not work well here. Many people applied for relief who could pay but thought they would never have to.—*Project manager.*

Eighty per cent of the settlers here weren't farmers, and these are mostly gone. The other 20 per cent, the farmers, are still here.—*Water users' official.*

I believe the Reclamation Service never took the trouble to see that in starting up an irrigation project there lay problems that it was their obligation to solve even at the cost of stirring up Congress to improved legislation and a change of system.—*Engineer farmer.*

Farm debts are probably in good part due to inflation and deflation, but in part to the farmer's inability to make his farm pay. The men that came here were the skimmings of farming and other communities. As the records show, it was largely the failures in business elsewhere that came to try farming on this project. There is some real sentiment that the farmers should not pay the construction charge, but most of the protest sentiment is created or magnified by political agitators.—*County attorney.*

A large part of the farmers' difficulties here is due to speculation in sheep and land, and some in oil, during the war boom of prices. Those who took their crop money to pay their debts are not grumbling now.—*Project manager.*

Probably no other region of the same size in this valley is as good as ours in soil. Yet last year we had to sell 120 tax titles, and this year we will sell 20 more, and probably few of these will be redeemed. They include some of the best land on the project here.—*Water users' board member.*

Outside of not enough water in July, our trouble is lack of capital, inexperienced farmers and high freight rates. In shipping our produce we are like the last man on the ditch.—*Chamber of Commerce manager.*

The reclamation projects are *not* failures in agricultural productiveness. They are well located, have a good water supply, and are operated economically. But in constructing them the government created an increment of value, and by putting no bar to transfers it encouraged land speculation. That is the root trouble.—*Private project manager.*

People in irrigation regions are enthusiastic about irrigation when they haven't got it and want money to provide it. Afterwards they complain. At Yakima farmers on private ditches pay $10 per acre, those on the government projects $2 to $3, but the latter protest while the former pay. The settlers' attitude toward their obligations is an essential element in the whole problem.—*Irrigation engineer.*

Water users might operate more cheaply than the government, through eliminating the overhead of the outside offices. But if any emergency happened, the water users might not have the means to handle it. This makes government operation safer for us.—*Umatilla farmer.*

All talk about the condition of the farmer is largely an outburst of something that has been seething for a long time. The price unbalance is at the root of it.—*Banker.*

The engineers on this project were learners, and naturally they had to cover up their mistakes. At that time and later the farmers had the difficulty of not being able to reach the higher ups.—*Newlands farmer.*

A man who gets right down in the dirt and roots can't fail to make a success in irrigation farming here.—*Another Newlands farmer.*

From my experience in private irrigation and on this project I would say that people here are the same as elsewhere except that they lack the habit of self-help. The government has given so much relief that whenever anything happens they look to the Reclamation Service to help them out and take care of them.—*Irrigation superintendent.*

We have many kickers, usually kicking about nonsensical things. One fellow objects to drainage construction, and wants the river excavated to do away with flood dangers. We also have farming failures and these must be weeded out. There is no way of avoiding or shortening this process. But even apart from this, we still have far to go; we need more dairying, more poultry, and more truck farming, and we need farmers who like and understand these branches.—*Southwestern merchant farmer.*

The experiment station and the project office teach the doctrine of cow dung, elbow grease and butter fat. Alfalfa is worth twice as much when fed here as when shipped out. Every farmer who has good cows, tends to them decently and understands them, is getting along and is paying his bills.—*Project manager.*

Our project is a thorough success, taken altogether. But we have howlers, some because they are failures and others because they are such by temperament; none of them has constructive ideas. I doubt whether the unsuccessful farmer can be helped by advice or guidance. The chief trouble is that our people are not high-grade enough. We need more of the spirit of self-help and the spirit of co-operation.—*Southern banker.*

When the Reclamation Service warned the farmers on this project of the need for drainage, the warnings were not believed, and the farmers took no action for several years. Their losses from this neglect exceed the total construction cost of the project. But some farmers now want to blame the Service for not cramming drainage down their throats.—*Water users' official.*

The Federal Land Bank discriminates against project lands. It will loan on private irrigation land but refuses to loan on a federal project close by.—*Project manager.*

We are afraid that the project farmers have become

imbued with the idea that there is no need of paying the water charges, as they have always been able to secure extensions and deferments.—*Land Bank official.*

The reclamation farmer is too heavily burdened with debt. His average debt per acre is equal to or greater than the annual production; it should not exceed half this amount. The debts are not due to pioneering, but to speculative buying. Further, the farm regions have gone too fast with public improvements, which makes bonds and taxes too high. But farm land values are apt to ignore both the government equity and the tax rate. As to the farmer's attitude toward his obligations, and its effect on his credit, the facts speak clearly enough; the desire to evade obligations is there, and it weighs in the granting of loans. Aside from this factor, debt and inflation conditions are nearly the same in other recently developed agricultural districts.—*Federal Land Bank official.*

In considering applications from reclamation projects we apply just the same rules of sound appraisal as to private irrigation land. Due weight is given to the moral hazard. The bank is apt to regard the reclamation farmer as a less desirable borrower than an irrigation district farmer, because of the former's persistent attitude of disregarding his contractual obligations.—*Land Bank appraiser.*

The ones that don't pay and want relief are those who aren't good farmers.—*U. S. Senator.*

Perhaps 25 to 30 per cent of all our farmers are kickers, but most of these also are heavily in debt and are not succeeding. When they get out of debt they reform.—*Irrigation manager.*

Farming, like any business, requires some capital to start. Neither now nor never can the farmer get any other start than through his own effort.—*Banker.*

The man who has only $1,000 shouldn't expect to come here and make a go of it. This irrigation farming is not a poor man's game.—*Banker.*

Liquid financing is absolutely insufficiently provided for. —*Water users' official.*

Any farmer in sound condition and really in need of working credit can come in here and get all he wants.—*Banker.*

I don't believe you can select the good farmer at the start; but you can tell him by the results after three years, and then the government should weed out the unsuccessful ones by foreclosing the lien.—*Water users' official.*

Some years ago much land here in the Northwest was sold to clerks who thought they needed only to tickle the soil to become rich. When they found that they had to work two or three years they gave up.—*Washington engineer.*

Irrigation is often pure exploitation of people who have become obsessed with the back-to-the-land idea. Managers of irrigation developments either should keep out the unfit or they should teach them. These Carey Act projects, in particular, have even a more miscellaneous lot of people than government projects. One of the greatest hardships is the lack of a home at the start, with the result of throwing an excess burden on the wife; possibly half of the people who pulled out of here did so because the wife became discouraged.—*Idaho engineer.*

The Carey Act system appears to have failed. Successful for a short time, it was soon made speculative, and inadequate preliminary study of water, soil and cost became general. There are only one or two successful Carey Act projects. Fundamentally, it is the best system for reclaiming *raw desert.* The district system is good for operating, or for rehabilitating an area already settled. — *Oregon engineer.*

The federal reclamation enterprise is partly responsible for the failure of private irrigation. It gave a general boom to irrigation, which led to unhealthy conditions, failure to study water supply carefully, easy marketing of bonds, and the like, with disappointing results, which led to financial collapse. In other cases the difficulty of raising funds led to the hiring of low-priced engineers, which in turn resulted in dam failures and other ruinous results. It might have been better to let irrigation work out by evolution rather than to develop new areas under the impulse of federal reclamation.—*Colorado engineer.*

In one respect we enjoy an advantage over the government projects. We are not hampered by politicians. If the government doesn't eliminate this trouble and settle down to a fixed practice, all irrigation will suffer. We close out the failures promptly. The government can do the same thing; and it would, if it were left alone by the Secretary.—*Private project manager.*

Most of the farmers here are satisfied with ordinary crop yields. They overlook the fact that high production is necessary if they are to clear their obligations.—*Nebraska engineer.*

Where land before irrigation is worth only say $15, the attempt to bond it under an irrigation district for $60 to provide irrigation is questionable. The process involves the assumption that the land will be benefited correspondingly. Security for the bonds does not exist to begin with, and may not exist even after the loan has been made and expended. Yet this is widely done.—*Oregon engineer.*

The advocates of the $350,000,000 reclamation plan with forty-year repayment and 5½ per cent interest will have to hunt up much better projects than the present ones if they want them to pay out.—*Project manager.*

A fatal error is embodied in the reclamation system: charging the farmer no interest on the construction cost, which removes all incentive to pay when he has money available.—*Former state engineer.*

Two serious mistakes of past reclamation practice were that the government allowed entry on land before water was available, and that it dealt direct with the individual. —*Congressman.*

The reclamation policy as relieved by the twenty-year amendment and the extension act has worked out very well. The only matter in which its administration has been a little remiss is colonization and attention to the farmer. Thirty-year payment at the discretion of the management should be authorized, with interest at say 4 per cent. It may be necessary to write off some losses; but we should not put any permanent government investment into irrigation, for that would pauperize the farmer. —*Washington engineer.*

There is no room for a middleman between the water and the farmer.—*Mid-West Senator.*

It is the government's business to increase the water supply of the arid regions, but it is not the government's business to operate irrigation systems.—*Agricultural engineer.*

I see no way to cut government red tape in such work as operation of reclamation projects.—*California engineer.*

The reclamation fund was raised from Western lands and belongs to the West. We've got the reclamation fund, and you birds down East just try to get it away from us! —*State official.*

Two essentials of a reclamation policy are projects that will enable the average farmer to make a decent living when the costs are paid, and protection of the original owner from the temptation to borrow money at high rates and to sell for speculative profit.—*California engineer.*

Our people have cussed the government a lot, but at the same time when they sit down and think things over, they know it is all right.—*Yuma farmer.*

One fault in the original reclamation law was that it is not fair to private irrigation. The law should have provided for construction of storage only, leaving distribution to private initiative. It should have provided for interest payment, to be fair to private irrigation. It should have required selection of settlers for available capital, farming experience, attitude of wife, and the like. And the law should have put more freedom of action into the hands of the secretary. As to financing the settler, I see no ready way of doing it through the federal government. Development of the projects would be best handled by state settlement and state financing.—*Agricultural engineer.*

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Concrete Ships

REVIEWED BY S. C. HOLLISTER
Consulting Engineer, Philadelphia, Pa.

SEAGOING AND OTHER CONCRETE SHIPS—By N. K. Fougner, C. E., M. Am. Soc. C. E., Medlem Norsk Ingenieur Forening, Assoc. Inst. N. A. London: Henry Frowde and Hodder & Stoughton. New York: Oxford University Press, American branch. Cloth, 6x10 in.; pp. 216; halftones and line cuts. 22s.; American price, $7.

This constitutes the first important book on the single subject of concrete ship construction. It comes from the pen of an engineer who has been actively engaged in this type of construction for more than a decade, and who enjoys the distinction of being the builder of the first seagoing concrete ship, the "M. S. Namsenfjord."

The book, while it relates the progressive experiences of the author's work, is especially valuable in that it discusses frankly the advantages and disadvantages of concrete ships and minor service craft in commercial competition with wood and steel vessels. It is significant that in the world at large the concrete ship was not a product of the World War, but rather that its beginning was rooted in the peace time prior thereto. Whereas the war greatly stimulated the building of large cargo carriers, the post-war reduction in shipping together with the over production of vessels will probably prevent, in this country at least, the thorough operating trial that this type of vessel would receive in time of normal shipping. It is quite likely that the commercial aspect of the concrete ship will be determined earlier in Europe than in this country, because private interest in it there is more general, and because it was being seriously developed in time of peace. The book gives ample evidence of the two outstanding facts that concrete ships can be built on a commercial basis, and that they are seaworthy.

The author goes into considerable detail concerning the design and construction of vessels built by him, and summarizes, also, the design and construction of the U. S. Shipping Board's concrete ships. He presents many data on the properties of concrete, pertinent to ship construction, including the use of special lightweight aggregates.

Considerable discussion is also presented to show that the author has achieved in his construction vessels whose ratio of unloaded weight was less per ton of cargo than those built by the U. S. Shipping Board. It should be borne in mind that the latter vessels were designed to carry from three to six times the cargo of the largest of the author's vessels; and that no concrete ships of anything like their size had been built prior to their undertaking. There is little doubt that, had the program been continued, considerable economies in weight could have been effected as experience was acquired from the earlier vessels. Within certain limits, pioneer engineering in any line sacrifices economy in the interest of assured safety, and economy will only come as a refinement gained through experience.

There is presented a very interesting discussion of barges and lighters, together with well-established conclusions as to the advantages and economy of concrete craft of this class.

It is hoped that this book will outlive the present shipping situation in this country, to the end that its justified usefulness will be constructively available to those who are bound at some future time to continue the development of concrete craft. Certainly in those countries where the shipping is again finding itself, the book will present much of importance in developing in a sound commercial way the building and use of concrete ships of moderate size.

Earth, Sun, Climate and Civilization

REVIEWED BY X. H. GOODNOUGH
Chief Engineer, Massachusetts State Board of Health, Boston

THE EARTH AND THE SUN: An Hypothesis of Weather and Sunspots—By Ellsworth Huntington, Research Associate in Geography in Yale University. New Haven: Yale University Press. London: Humphrey Milford-Oxford University Press. Cloth; 6x9 in.; line cuts. $3.50.

CIVILIZATION AND CLIMATE—By Ellsworth Huntington, Author of "The Pulse of Asia." [Second Edition, with New Introduction.] New Haven: Yale University Press. London: Humphrey Milford-Oxford University Press. Cloth; 6x9 in.; pp. 333; line cuts. $3.50.

CLIMATIC CHANGES: THEIR NATURE AND CAUSES—By Ellsworth Huntington, Research Associate in Geography in Yale University, and Stephen Sargent Visher, Associate Professor of Geology in Indiana University. New Haven: Yale University Press. London: Humphrey Milford-Oxford University Press. Cloth; 6x9 in.; pp. 329; 13 line cuts. $3.50.

Earth and Sun, is a companion volume to the author's earlier Climatic Changes and should be read in conjunction with it in order that the general discussions and data presented may be intelligently followed. In Earth and Sun, the author illustrates very clearly and submits diagrams which indicate a close relation between solar disturbances and terrestrial temperature. He presents also studies of the relation of solar conditions to climatic variations, storms and electrical activities. This volume no doubt would be of less interest to the engineer than to members of certain other of the scientific professions but is of value to those engineers who are interested in studying the causes of the various climatic changes, including the distribution of moisture and variations in temperature.

The results of the study showing the relation of sun spot occurrence to rainfall are not conclusive so far as the rainfall in the northeastern part of this country is concerned, but such a comparison is difficult because of the limited period available for comparison as presented in this volume. Further study along the line indicated would be of great interest and might prove most valuable.

The correlation of data in this book must have required much research work on the part of the author, and the results of his interesting studies should encourage further investigation along the same lines.

Civilization and Climate, now in a second edition, is an investigation of the influence of certain climatic

conditions upon health and industry in various parts of the world and is interesting to engineers as well as to geologists, geographers, meteorologists, historians and others who have made less general studies of similar subjects. The writer traces a connection between climate and health, especially in human progress, in a very interesting way. It is somewhat unfortunate, however, that more detailed information is not presented in the appendix to assist those readers who might be interested in ascertaining the facts from which the conclusions in this volume are derived. The addition of this information would have enabled students of the subject to carry the matter further and make other comparisons without going over again the data from which the information was collected. It is hoped that certain other volumes which the author is about to publish may include the exceedingly valuable information which he has collected.

Large High-Speed Reservoir Outlets

HIGH-PRESSURE RESERVOIR OUTLETS: A Report on Bureau of Reclamation Installations—By J. M. Gaylord, Electrical Engineer, and J. L. Savage, Designing Engineer. Washington, D. C.: Bureau of Reclamation. Part I: Cloth; 6x9 in.; pp. 179; 32 halftone plates and 44 figures in the text. Part II: Cloth; 8x11 in.; folding plates of detail drawings. Part I, $5; Part II, $10.

One of those rare government reports that form basic contributions to technical literature has been produced by Messrs. Gaylord and Savage. Their detailed account of Reclamation Service experience with large-volume, high-head valves and discharge conduits contains a record of practice unequalled by any other treatment of the subject. It promises to remain the principal document of the subject for many years to come. Their work is distinguished also by a clearness and simplicity of statement that makes the report additionally remarkable. An album of drawings accompanying the text increases its value and scope well beyond that of the ordinary text-book.

In attacking their subject the authors begin with a simply stated outline of its elements; the growth of the reservoir-outlet problem from early ages, the application of butterfly and simple gate-valves, and finally the development of large slide, cylinder and needle gates. Still following the schematic plan of presentation, they next describe the various types of outlet arrangement, involving the position of the valve, with reference to the discharge conduit and the provision of means for admitting air to weak vacuum and for getting at the valve to inspect or repair it. Losses in outlets are briefly discussed and some data are given concerning high-head outlets for large discharges.

The detailed treatment then takes up in succession the various valve types, most space naturally being given to the needle type, in view of its dominant position in this field. Then follows as the main part of the book a series of chapters dealing separately with outlet development at various high dams built by the Reclamation Service. The troubles encountered, how they were dealt with and to what extent they were solved are treated in full. This is the part of the book that assures its permanent position in the literature of engineering and entitles the authors to the thanks of the profession.

A section of quite independent value, printed as an appendix, is a bibliography of reclamation articles and books on irrigation, including in 33 pages several hundred entries.

Filtration Broadly Considered

Reviewed By Robert Spurr Weston
Consulting Engineer, Boston, Mass.

A TEXT BOOK OF FILTRATION: Industrial Filtration and the Various Types of Filters Used—By Charles L. Bryden, E. M., B. S., and George D. Dickey, B. S. Easton, Pa.: The Chemical Publishing Co. Cloth; 6 x 9 in.; 264 halftones and line cuts. $5.50.

As stated in the Preface, this book was written "to give the fundamental principles underlying filtration, the modifications necessary under varying conditions, the proper procedure for carrying on experiments, the available data on filtration and a description of the various types of filters which have been developed as a result of scientific research."

In the Introduction, the authors assume the particles of precipitates to be spheres for the purpose of making clear the theory of the art, yet are not misled into assuming that all particles of like volume offer equal resistance to filter media. Twenty-four clear photomicrographs of precipitates illustrate the variations both in size and in nature of precipitates. The importance of microscopic examination in filtration problems is well developed. The relations between rate of flow, pressure and cake thicknesses are well illustrated by tables and formulas and the influences of viscosity and temperature concentration are likewise mentioned.

The practical laws of filtration given are: (1) As open a filtering medium as possible should be chosen. (2) If possible in any way to control precipitation prior to filtration microscopic examination and experiments should be carried on to determine the best form of precipitation for filtration. (3) In filtering non-rigid solids care must be taken to build up the pressure gradually and uniformly. (4) High pressures do not necessarily give hard dry cakes. (5) A thin cake offers lower resistance than a heavy and consequently gives a higher rate of flow, and easier washing and drying. (6) The cake should be as uniform in porosity and thickness as possible in order to get good washing and drying. (7) Lack of proper agitation in leaf filters gives pear-shaped cakes, and uneven or partial filling of a filter press produces a cake of varying porosity and thickness, both of which are undesirable. (8) The higher the temperature the lower will be the viscosity and consequently the greater the capacity of the filter.

The book contains an interesting history of filtration with a page devoted to the development of water and sewage filters. About eighty per cent of the space is occupied with descriptions of dewaterers, clarifiers, filters and presses, for removing the suspended matter from gases and all sorts of liquids—aqueous, oleaginous and organic. Indeed the spirit of fairness has led the authors into redundancy in describing so many makes of the same types of apparatus. For example, there are quite detailed descriptions of the products of a dozen makers of water filters and it is rather unfortunate that the apparatus are described with the makers' names rather than types of filters as headings.

The chapter on Centrifugal Machines contains valuable information, although it bears a strong resemblance to catalogue announcements, and the chapter on Air, Gas and Light Filters should be read by those who use air for the agitation of sewage and other liquids. Even the Cottrell process and color screens are described briefly. Laboratory filtration has a chapter devoted to it but there is no mention of the new "stream-line" filter.

In their chapters on Leaf and Frame and Leaf and Rotary Filters the authors have compiled much valuable information which, while of greater interest to the industrialist than the public-health engineer, should not be overlooked by the latter when studying the problems of dewatering and partially drying sewage sludges and the precipitates from factory wastes.

The chapter on Coagulants and Filter Aids is rather disappointing. The reviewer had hoped to read a popular statement of modern theories of coagulation but the theory of the past decade is employed. There are some good diagrammatic operating data given in a special chapter and descriptions of thickness, pumps, coagulant feeders, compressors, etc., are not wanting. Some good tables, useful for filter operators and others, are contained in the Appendix, among them one giving the proper materials and fittings to be used for pumps for handling various liquids, corrosive or otherwise.

While the book will be read more by mechanical and chemical engineers than by civil engineers, the reviewer commends it to all interested in filtration, especially to those sanitary engineers who have to dispose of troublesome solids. The expert on water-purification will find better information elsewhere.

Early Effects of the Steam Engine

CAPITAL AND STEAM POWER. 1750-1880—By John Lord, Bachelor Scholar of Christ's College, Cambridge. London: P. S. King & Son, Ltd. Cloth; 5x8 in.; pp. 253. 7½s. net.

With its full references to the original sources from which the greater part of its historical data were taken, this book is not only interesting as an historical document but is also an engaging account of the development of the steam engine and its introduction into the industrial life of England. As a background, the author has outlined the conditions in trade and industry in the period immediately preceding the introduction of steam power and the development of the capital system up to that time. Then comes a description of the early developments in atmospheric steam engines and their application to and effect on industry. This leads to an account of the development of Watts' engine, the method of financing it, and the uses of this improved means of power in developing the basic industries of the country. The book closes with a review of the condition of capital and labor in 1800 and a discussion of the importance of the work of such energetic men as Watts in raising the standards of industrial life to their present level.

Spanish Railways

THE RAILWAYS OF SPAIN—By George L. Boag. Author of "Manual of Railway Statistics." London: The Railway Gazette. Cloth; 6x9 in.; pp. 129; halftones and line cuts. 12s. net.

The Railways of Spain, as the title would indicate, is a description of the Spanish railways from the time of their inception until the present day, with a discussion of their future and of nationalization and government intervention. The author's knowledge was gained during several years of experience in the management of a railway in Spain. The book gives the essential facts concerning the railways, starting with the original construction and financing by the aid of government subventions and continuing with a discussion of present-day conditions, earnings, fares and rates, and descriptions of typical structures and equipment. The last chapter is devoted to a brief outline of the railways of Portugal.

This is a book that should be read by all advocates of government ownership, because of its exposition of the results of "too much government" in the railways.

Tremors and Noise Caused by Machinery

THE PREVENTION OF VIBRATION AND NOISE—By Alec B. Eason, M.A. (Cantab.), Assoc. Inst. C.E., A.M.I.E.E. [Oxford Technical Publications.] London: Henry Frowde and Hodder & Stoughton; New York: Oxford University Press. Cloth; 6x9 in.; pp. 163; 65 halftones and line cuts. $5.

Tremors and noise transmitted from moving machinery through buildings or through the ground are the author's subject in this work. His text is essentially a bibliographical summary of what various people have studied and written on this topic. Its perusal gives a definite impression of the primitive state of the subject, but for this very reason the book may prove a convenient starting point for many who will have to deal with practical problems in transmission of tremors.

Publications Received

Ventilation of Central Station Buildings and Equipment, a report of the subcommittee on ventilation of the Electrical Apparatus Committee, Technical National Section of the National Electric Light Association, is a study of the laws governing the movement of air and their use, both in present practice and in proposed installations, for the ventilation of central station buildings and prime movers. The paper gives a number of diagrams of air movement in typical installations and tables of air duct sizes, also a description of various types of ventilating machinery. (National Electric Light Association, New York City; 25c. to members; non-members, 40c.)

The Institution of Civil Engineers (London) has issued a second supplement to its investigation on the Deterioration of Structures in Sea Water, called The Third Interim Report. The latest appendix gives further reports of the behavior of steel in wood, in sea water, in various marine exposures of the British Empire and throughout the world. Concrete is not discussed. (London: H. M. Stationary Office; 3s. 2d.)

The Very Heavy Reinforced-Concrete Slab Beams tested during the war in the interest of concrete ship construction have been made the subject of Technologic Paper No. 233 of the Bureau of Standards (Washington, D. C.) entitled Tests of Heavily Reinforced-Concrete Slab Beams, Effects of Direction of Reinforcement on Strength and Deformation, by W. A. Slater and Fred D. Seely. The results give some useful information on the behavior of diagonal reinforcement in thin slab beams.

Last Year at the American Concrete Institute, Prof. W. K. Hatt, of Purdue University, gave some preliminary information on studies to prove the value of the ball test as a determinant of the quality of concrete. More elaborate notes on these tests are now supplied in a bulletin entitled Ball Test Applied to Cement Mortar and Concrete, by R. B. Crepps and R. E. Mills. (Purdue University, Lafayette, Ind.)

The United States Bureau of Mines (Washington, D. C.) has issued a Bibliography of Magnesian Cement, by G. H. West, R. L. Sebastian, and W. A. Darrow. It was compiled in the course of research work on the utilization of magnesite in the West.

The Department of Commerce, Bureau of Foreign and Domestic Commerce, has issued as miscellaneous series No. 119 a bulletin on Inland Water Transportation in the United States. It has a prefatory section on the economics of inland waterway transportation generally favorable to that neglected field, and is followed by a categorical descrip-

tion of all of the waterways in the United States and an appendix giving a digest of the various governmental reports on inland waterways.

DR. J. A. L. WADDELL delivered two addresses at Brown University in September, the first entitled Some Observations on the Regeneration of China and the Engineering Work Involved Therein, and the second, Functions of Both Pure and Applied Science in the Future Development of China. Both of these are now available in one small volume. (The author, 35 Nassau St., New York City.)

ELEVEN 20x14-IN. CHARTS in a flexible loose-leaf binder have been prepared by E. V. Willard, Commissioner of the State Department of Drainage and Waters, St. Paul, Minn., giving the flow capacities of ditches and tile drains of various sizes and slopes. There are also three sheets of text. These charts have been prepared under a state law which authorizes the department to issue and publish "rules and regulations" for the information and guidance of officials in public drainage proceedings operating under the state drainage laws. The intention, therefore, is to furnish them only to engineers within Minnesota. They are not for sale and the extent to which outside engineers can be furnished with the charts is left to the discretion of the Department. There is only a limited edition.

THOSE WHO HAVE OCCASION to use population figures will welcome the Census Bureau's Estimates of Population of the United States by States and Cities, 1910 to 1923, and Area July 1, 1923 (15c. from Superintendent Public Documents, Washington, D. C.).

INDUSTRIAL ORGANIZATIONS with many workmen may find useful an illustrated pamphlet on Change Houses in the Lake Superior Region, by Cleve E. Kendall, Mine Car Surgeon, U. S. Public Health Service. (One copy to a person free while they last from U. S. Bureau of Mines; 15c. from Superintendent of Documents, Washington, D. C.)

STANLEY PINEL has written and the Engineering Extension Department, Iowa State College at Ames, has published a 38-p. illustrated pamphlet on The Operation and Care of Sewage-Treatment Plants.

METER INSTALLATIONS AND METER RATES is the title of a short paper by E. I. Roberts, assistant engineer, Ohio Department of Health, Columbus, Ohio, published by the department. The paper is a response to a demand for information from officials of Ohio municipalities "brought about by the increased cost in the operation of waterworks." Diagrams are included..

SMOKE ABATEMENT—domestic, industrial and locomotive —is reviewed by Osborn Monnett in a bulletin issued by the U. S. Bureau of Mines. There is a section on city smoke ordinances. (Washington; one copy free from the Bureau of Mines; 15c. from Superintendent of Documents, Washington, D. C.)

IN SUPPLEMENT 23 TO THE MONTHLY WEATHER REVIEW, Washington, D. C., Jesus Hernandez, an engineer, takes up the Temperature of Mexico. (Free to U. S. Weather Bureau Co-operators; 10c. from Superintendents of Documents, Washington, D. C.)

New Books and Revised Editions

ELEKTRISCHE TEMPERATUR-MESSGERÄT — Von Dr.-Ing. Georg Keinath. Munich and Berlin: R. Oldenbourg. Paper; 7 x 10 in.; pp. 275; 219 figures in the text. Paper, $2.40; cloth, $2.65 (both in Germany.)

ELECTRO-CHEMISTRY RELATED TO ENGINEERING—By W. R. Cooper, M. Inst. E. E.; Assoc. M. Inst. C. E.; Fellow Inst. Physics. (Edited by Bertram Blount, F.I.C.). New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. 136; 53 line cuts and halftones. $3.75.

Among the chapters there is a long one on Electrical Precipitation of Dust, Smoke and Fume, and there are two short ones on Electrolytic Corrosion by Stray Earth Currents and the Relative Importance of Cheap Power and Cheap Freight.

ELEMENTS OF ENGINEERING THERMODYNAMICS—By James A. Mower, James P. Calderwood and Audrey A. Potter [Second Edition, Revised.] New York: John Wiley & Sons. Cloth; 6 x 9 in.; pp. 228; 75 figures. $2.50 net.

ENGINEERING DRAWING—By H. H. Jordan, Head Department of General Engineering Drawing, University of Illinois; and R. R. Hoelscher, Assistant Professor of General Engineering Drawing, University of Illinois. New York: John Wiley & Sons; London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 351; lettering charts, line cuts and halftones. $3 (15/-net).

The authors state that they have included these "five kinds of materials" in their book: "(1) Elementary fundamental theories and concepts underlying all forms of Drawing; (2) illustrations explaining the theory and demonstrating proper modes of execution; (3) complex but related principles; (4) encyclopedic or handbook materials—sometimes called commercial practices; and (5) problems." Principles are laid down and are applied to architectural, structural, map, patent office, and other kinds of drawings. A chapter on the principles of graphic methods is believed by the authors to be new to this kind of a book. Bibliographies are given at the close of the more advanced chapters.

GRAPHICAL ANALYSIS OF STRESSES INVOLVED IN DESIGNING FRAME STRUCTURES; Intended Primarily for Students of Engineering—By G. P. Schubert, Assistant Professor, Department of Civil and Mining Engineering, Michigan College of Mines, Houghton, Mich. Houghton, Mich.: Published by the Author. Cloth; 6x9 in.; pp. 139; 99 line cuts and halftones.

LEHRBUCH DER EISENHÜTTENKUNDE; Verfasst für den Unterricht, den Betrieb und das Entwerfen von Eisenhüttenanlagen—von Dr.-Ing. E. H. Bernhard Osann, Professor an der Staatlichen Bergakademie in Clausthal. Geheimer Bergrat. Erster Band; Roheisenerzeugung. Zweite, Neubearbeitete und Erweiterte, Auflage. Leipzig: Wilhelm Engelmann. Cloth; 6 x 9 in.; pp. 923; 523 figures in the text.

Revised and much enlarged edition of the volume on Pig Iron Production (the Blast Furnace) of the author's Treatise on The Metallurgy of Iron. The first edition was reviewed and highly commended to "every iron and steel producer and metallurgist" by Dr. Richard Moldenke in these columns, Dec. 16, 1915, p. 1175. The companion volume, on Iron and Steel Making Processes based on Blast Furnace Products, was also favorably noticed by Dr. Moldenke, Jan. 19, 1922, p. 121.

MACHINE DESIGN DRAWING ROOM PROBLEMS—By C. D. Albert, M. E., Professor of Machine Design, Cornell University; M. Am. Soc. M. E. New York: John Wiley & Sons. Cloth; 6 x 9 in.; pp. 320; 19 line cuts. $3. 15s. net.

MUNICIPAL GOVERNMENT AND ADMINISTRATION: VOL. I, GOVERNMENT; VOL. II, ADMINISTRATION—By William Bennett Munro, Ph. D., LL.B., Professor of Municipal Government in Harvard University. New York: The Macmillan Co. Cloth; 6x9 in.; pp. 459 and 517. $3 per volume.

PONTS ET COMBLES MÉTALLIQUES — Par T. Godard, Ingénieur en Chef de la Construction a la Compagnie du Midi, Professor a L'École Nationale des Ponts et Chaussées. Avec le patronage de la Société des Ingénieurs Civils de France et de la Société d'Encouragement pour l'Industrie Nationale. [Encyclopedie du Génie Civil et des Travaux Publics]. Paris: J.-B. Baillière et Fils. Paper; 6 x 9 in.; pp. 667; halftones and many line drawings.

PROJECTIVE GEOMETRY, WITH APPLICATIONS TO ENGINEERING—By Peter Field, Professor of Mathematics, University of Michigan. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 98; 74 line cuts. $2.

PUBLIC SPEAKING FOR BUSINESS MEN—By William G. Hoffman, Associate Professor of Public Speaking, Boston University, College of Business Administration. New York and London: McGraw-Hill Book Co., Cloth; 6 x 8 in.; pp. 300. $2.50.

STRESSES IN FRAMED STRUCTURES, Compiled by a Staff of Specialists—Editors-in-Chief: George A. Hool, Consulting Engineer, Professor of Structural Engineering, University of Wisconsin; and W. S. Kinne, Professor of Structural Engineering, University of Wisconsin. New York: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 620; 485 line cuts. $5.

TECHNICAL WRITING—By T. A. Rickard, Contributing Editor of *Engineering and Mining Journal-Press*. [Second Edition, Rewritten and Enlarged.] New York; John Wiley & Sons.; London; Chapman & Hall, Ltd. Cloth; 6 x 8 in.; pp. 337. $2 postpaid (10/-net).

The first edition was noticed in these columns May 20, 1920. A portion of the volume has been rewritten. Chapters on the wrong word and on punctuation have been added.

A TRANSITION CURVE—By J. E. Williams, Professor of Mathematics, and R. B. H. Begg, Professor of Civil Engineering, Virginia Polytechnic Institute. [Bulletin No. 1 of Engineering Experiment Station, Blacksburg, Va.] Paper; 6 x 9 in.; pp. 35; illustrated.

The "Lemniscate" curve is the particular form of transition dealt with in this pamphlet, and the treatment is an enlargement of an article by Professor Williams in *Engineering News-Record* of Aug. 26, 1920, p. 406.

WEATHER PROVERBS AND PARADOXES—By W. J. Humphreys, Ph. D., Meteorological Physicist, U. S. Weather Bureau, Author of "Physics of the Air." Baltimore: Williams & Wilkins Co. Cloth; 5 x 8 in.; pp. 125; 18 halftones and line cuts. $3 in United States, Canada, Cuba, Mexico; $3.50 elsewhere.

Cites many folk-sayings, mostly in rhyme, about the sun, moon, stars, fogs and clouds in relation to the weather and explains their scientific basis in easily understood language. Paradoxes are likewise explained. Contains good halftones pertinent to the text including rainbow and cloud effects.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Constructing Engineer on Apishapa Dam Failure

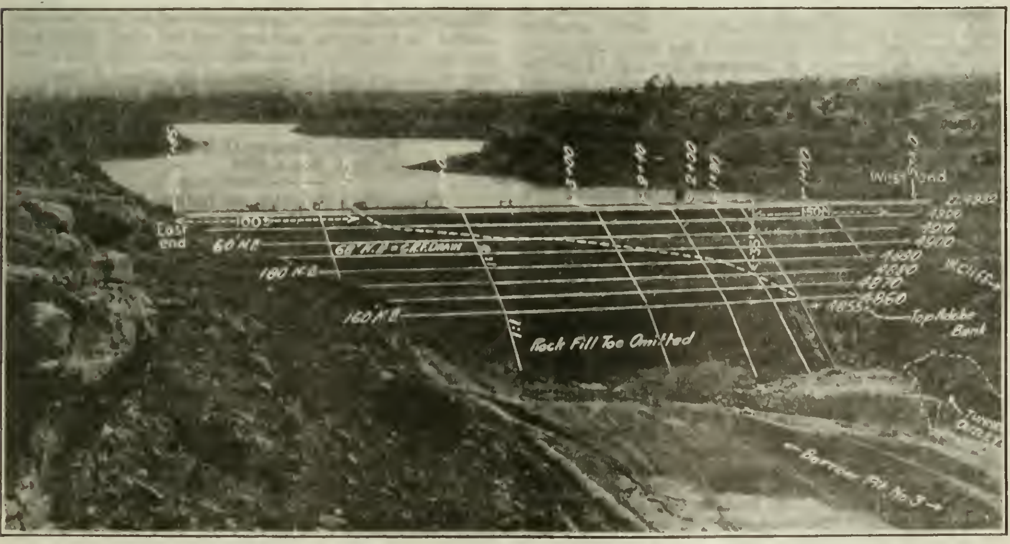
Sir—Since I served, from Aug. 30, 1918, to Sept. 18, 1920, as engineer in charge for the Apishapa Consolidated Irrigation Co. of Fowler, Colo., owner of Apishapa dam which recently failed, and since I also was inspecting engineer for the state engineer, A. J. McCune, who was also actively the consulting engineer to the said company throughout that part of construction subsequent to my employment, I take it that information which I have to give will be of interest to the profession.

The plans prepared by the writer were, with the exception of the plans for outlet works and steel cutoff wall with its various appurtenances, and the rock-fill toe of embankment, merely filed with the state engineer as a record of the changes made in previous plans, so that the plans on file would correspond with the dam as built. Unfortunately, the writer was not permitted to work out such plans for the embankment as he believed were necessary, for the reason that two former sets of plans, already approved, laid down lines which the company and state engineer believed adequate, and the writer was unable to persuade any of the parties concerned that important increases in crest dimensions and slopes were advisable.

I assume that it is not necessary for me to repeat a description of the "phenomena" attending failure of the dam, since these have, as I believe, been clearly and fairly set forth in the report of Floyd and Jones in your issue of Sept. 13, p. 422. I ask you to publish the enclosed photograph, which shows the stationing of the dam, and the elevation at which water issued at time of failure. The point seems to be considerably lower than stated in all reports heretofore. Stationing of the crack across the dam can also be followed, and anyone interested in speculating upon the relation of settlement cracks to the deeper portions of the fill can do so from this photograph and the plan of the dam in your Sept. 13, issue.

I would like to deal at length with the "causes" of the failure but to touch upon all the causes which contributed to this failure would require so much space that I will limit myself to the following summary: (1) The design of the embankment was inadequate for a dam at the location chosen; (2) the company's financial program was inadequate, and had a vital bearing upon the contractor's methods, and the engineer's power to rigidly enforce the contract; (3) the engineer's specifications were tampered with by a board of directors which, although it contained two "graduate" engineers, did not realize the fact that the utmost care was required to build a dam that would be safe; (4) the contractor after the company had defaulted financially, felt compelled to take the work into his own hands and complete it so as to save himself financial loss; (5) the writer, throughout his connection with the job, was practically the only one who insisted upon the use of thorough construction methods, and was not sustained in his contentions by the state engineer, and but for the writer's insistence, the dam would have been built without either sprinkling or rolling; and (6) had the writer's recommendations been put into effect, the dam would have had a much wider top and heavier section, and would have been constructed of materials all from the canyon bottom—*none from the hilltop*—and all layers 6 in. instead of 12 in. thick. There would have been no omitted rock-fill toe—no unlined tunnel—and far less of settlement cracks. The dam should have been constructed so that settlement *could not* have amounted to much, and here was fundamentally where the writer differed with the state engineer and the company officials, and its two "engineer" directors, all of whom contended that "settlement, even if it *did* occur, would not be a serious matter."

Throughout the construction of the dam, the writer was forced to fight for the incorporation of features of design which he felt were in accord with sound engineering practice, and without which the dam could not be made safe. It was a losing fight. Had it not been for his efforts, Apishapa dam would have been even more unstable than it



VIEW OF APISHAPA DAM SHOWING WHERE WATER BROKE THROUGH LOWER SLOPE JUST BEFORE FAILURE

From a photograph supplied to Mr. Mann by A. J. McCune, lately state engineer of Colorado. To the upright lettering and the dotted line originally supplied by Mr. McCune there have been added by Mr. Mann the inclined lettering and the solid lines. A duplicate of the original view, without lettering, was reproduced on a smaller scale in *Engineering News-Record*, Aug. 30, 1923, p. 358, and the same view, with Mr. McCune's lettering and broken line only, Nov. 29, p. 901.

proved to be. Had his ideas prevailed, the dam would have had a better chance, at least, of being in place today.

Having in all ways tried to bring about the construction of this dam along safe lines, and, failing in this, having warned the proper authorities of the danger attached to improper use of the, as yet, uncompleted structure, the writer thinks he discharged every duty that could reasonably be expected of him—even to "running the level" Mr. Fellows mentioned on p. 776 of your issue of Nov. 8.

In closing, I wish to say that failure of this dam was due to inadequate design, inadequate financial program, improper construction methods, use of material other than that specified and last, but certainly not least, *improper use of a reservoir the dam of which was known to be unsafe for storage to high water line.* A written order and a padlock could have prevented the whole disaster. Reasonable use of the reservoir might have been ordered until proper increases in section, and studies of incipient failure, were made.

As to the character of material complained of by Messrs. Field and Fellows, I am content to ask these gentlemen to read, on p. 53 of *their* 1911 report, the excerpt that follows, and then tell the profession what magic change took place in these materials between 1911 and 1923 that rendered the materials, formerly "good" to be now "unsuitable":

"There is a large amount of soil in the canyon both above and below the dam, *suitable for an earth embankment.* There is also *good dam* material on the high ground to the east of the canyon, and in the reservoir basin itself, so that there is an abundance of material comparatively handy *and suitable in character.*" [Italics mine.] The materials actually used in the dam came from points which they have above described. CLAIR V. MANN.

Rolla, Mo., Nov. 15, 1923.

Why the Garden City Project Failed

Sir—Referring to the letter of George S. Knapp, State Irrigation Commissioner, regarding the Garden City, Kan., reclamation project (*Engineering News-Record*, Dec. 6, 1923, p. 943), the outstanding thing is the apparent lack of a full comprehension of the original intent and scope of the Reclamation Act under which this project was built.

When the law was discussed and passed it was for the purpose of authorizing the Secretary of the Interior to build, operate and maintain certain large works described in Congressional debates as reservoir and main line canals, leaving to the entrymen or landowner the task of distributing the water. The law was also very carefully guarded against committing the government in advance to any cost, and provided in express terms that the cost should be announced by the Secretary after the contracts were let. This was because much of this work was known to be experimental and the Congress was not willing that the Secretary of the Interior should be put in the position of a contractor guaranteeing any specific statements as regards cost or quantity of water to be delivered.

Each Secretary concerned issued drastic orders to the effect that no preliminary estimates could or should be considered as binding and in all cases care was taken to show that any such statement of possible or probable cost of any particular piece of work had no binding effect and could not, until the contracts were let and the Secretary had taken formal action. This has been sustained by the courts who have called attention to the intent of the law and to the care taken by all responsible parties from the Secretary down, to assure each one interested that the preliminary statements were what they purported to be and could not be construed as binding.

The Reclamation Act also provided that work should be begun in each of the states named, among them Kansas. Field examinations had been made in that state for many years and carefully conducted efforts to ascertain the location of a feasible project. Public opinion demanded that some of the Reclamation Fund be expended in Kansas. There was also a widespread belief that the so-called underflow would furnish vast volumes of water. Investigations were made of the rate of flow of water percolating underground and although there were reasonable doubts as to the practicability of bringing this water to the surface in large quantities yet no engineer at that time had sufficiently complete information to be able to withstand the overwhelming popular pressure for a large demonstration of the feasibility of pumping water from this supposedly great underground reservoir. Moreover this question of cost was met by the invariable reply, "We do not care what the water may cost; $100 an acre would be cheap if we can get it."

Under these conditions the Secretary of the Interior, yielding to the insistent demand from all sides, ordered that a large demonstration pumping plant be built. He did not obligate himself to furnish any specific quantity of water or at any specified amount of money. He expressly forbade any advance estimates to be considered other than what they purported to be, namely, statements as to the probable cost of the specific works to be built. This was as far as he could go under the law and as far as he would authorize his engineers to proceed.

Remember at all times that the Reclamation Service so-called has practically no legal existence. It is simply a body of men created by the Secretary of the Interior acting under his orders to carry out the intent of the law. These men cannot proceed a step beyond the express authority of the Secretary. He may ask them for opinions and estimates and he may order them to carry out certain work but they cannot in any way obligate him nor can they bind him by stating informally what in their opinion certain works may cost.

In other words, the Garden City pumping project was carefully planned to ascertain whether water could be pumped in a large scale from underground. It was known that it could be had in quantities practically inexhaustible to the pumps then used but until a series of these was located across the valley the limitations of supply could not be determined.

Had the country been more nearly arid, as for example in portions of California, such a pumping plant might have been highly advantageous but under the conditions which then prevailed in western Kansas the work, although well planned according to the engineering information then available, and carried out well within the estimates of the engineers, was not successful, although it is quite probable that had an equal number of wells been more widely distributed and located within an irrigable tract, reached directly from the wells, the enterprise might have been successful. It is easy to look back and tell what might have been done but looking in the other direction with full knowledge of the law and the attitude of the public, it was obviously impossible for any Secretary of the Interior to have refused to carry out the demand for a pumping plant in the Arkansas Valley. F. H. NEWELL,

Formerly Director, U. S. Reclamation Service.

Washington, D. C., Dec. 1, 1923.

Creosoting Practice on Indian Railways

Sir—I have read with interest on page 857 in the May 17, 1923, issue of your valued publication an editorial entitled "Courageous Pioneering" which deals with the treatment of ties with a mixture of 30 per cent creosote and 70 per cent fuel oil. It may interest your readers to know that about 10 years ago we started experiments by treating sleepers with 50 per cent fuel oil and 50 per cent creosote, which so far have given very fair results.

Some of the Indian railways have been so impressed by these experiments that they have erected pressure-treating plants to treat railway ties with varying percentages of creosote and fuel oil. As an example I may cite the North Western Ry., which has the longest railway system in India. This road is treating pine and fir sleepers with 75 per cent creosote and 25 per cent fuel oil. The Assam Ry. has also just erected a plant and is considering using as little as 33 per cent creosote and 67 per cent oil. The experiments carried out to date lead one to believe that equal proportions of the two oils will preserve the timber beyond the period when such sleepers will have to be rejected for mechanical defects.

Dehra Dun, India, Nov. 6, 1923. RALPH S. PEARSON,

Forest Economist, Forest Research Institute.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Zoning in the West Philadelphia section of Philadelphia has been postponed by the City Council until after Jan. 1, when there will be a change in administration. It is hoped that conflicting interests, in and out of the Council, can then be harmonized.

The Board of Water Commissioners of the city of Detroit has issued formal invitations to the placing in operation Dec. 22 of the new filtration plant. Admission is by ticket. This 320-mgd. plant, the largest of its kind in the world, was described in *Engineering News-Record*, May 17, p. 860.

The Saranac Co. of Plattsburg Has made application to the New York State Public Service Commission for authority to acquire and own the capital stock of the Saranac River Power Corp., a corporation which is now building a new power plant and dam about four miles west of Plattsburg, N. Y.

Contract for the Construction of a 60,000-hp. hydro-electric development on the Ottawa River at Bryson, Quebec, has been awarded by the Ottawa River Power Co., to Fraser, Brace, Ltd., engineers, Montreal. The total expenditure on this work will be approximately $3,000,000, and it is expected to have the first unit installed by Dec. 1, 1924.

Electrification of the London Suburban lines of the Southern Ry., England, is to be extended materially, according to plans recently approved by the company. At present there is electric operation on 85 route miles with 248 miles of track, but by the end of 1925 these figures will be increased to 145 and 358 miles, respectively. This work is estimated to cost $26,000,000.

Nine-Mile Bridge, a Dangerous highway crossing over the New York Central R.R. between Schenectady and Amsterdam, is to be replaced by a new bridge at a more advantageous location, east of the present bridge. This change is the result of an agreement between the railroad company and the New York Bureau of Highways. The estimated cost of the work is $141,000, which cost will be divided between the railroad company and the state.

In Order to Increase the Low Flow capacity of the Ontario hydro-electric plant at Cameron Falls on the Nipigon River, in northern Ontario, the engineers of the commission are studying the possibilities of diverting the waters of Long Lake, a 50-mile long lake just over the height of land from the Lake Nipigon drainage area, from its present drainage north to Hudson Bay, into Lake Nipigon. The peculiar formation of the land between the two drainage areas makes such a proposition possible

Proposed Anti-Oil Pollution Bills Before Congress

Bills have been introduced in each House of Congress providing that it is to be unlawful to pollute any of the navigable waters of the United States with oil or other refuse other than sewage from streets, sewers or vessels. Violations are made punishable by fine not exceeding $1,500 nor less than $500, or by imprisonment for not less than thirty days, nor more than one year.

Engineers Again To Discuss Department of Public Works

In connection with the annual meeting of the Federated American Engineering Societies to be held in Washington Jan. 10-11, a special meeting will be held on Jan. 9 to forward the formation of a Department of Public Works under the Department of the Interior. This meeting will be called the National Conference on Public Works and will be attended by engineers and architects, instructors, manufacturers, chemists, geologists, economists, and business men from all over the country. Local committees of the old National Public Works Department Association will be revived for the period prior to the meeting.

It is the intention, it is announced, of those who are calling the meeting to recommend the adoption by Congress of a bill embodying that part of the Brown plan of government reorganization which provides for the reorganization of the Department of the Interior, so that that department has two divisions, one of which will be devoted to public works and will include all the engineering activities of the government.

A.G.C. Ballots for Officers

Official ballots have been sent members of the Associated General Contractors of America, election for officers to be announced after ballots have been canvassed Dec. 31.

The list of names on the official ballot follows:

For president (to serve one year)—F. L. Cranford, president, Frederick L. Cranford, Inc., Brooklyn, N. Y.; vice-president-at-large (to serve one year)—A. S. Downey, (partner) A. W. Quist Co., Seattle, Wash.; vice-presidents (to serve until 1927) Zone 1—Leonard C. Wason, Aberthaw Construction Co., Boston, Mass.; Zone 2—H. H. Wilson, Winston & Co., Harrisburg, Pa.; H. R. Blagg, H. R. Blagg Co., Dayton, Ohio; directors (to serve until 1927); Districts 2 and 3—W. A. Rowan, James Stewart Co., New York City; District 7—T. J. Baker, Coddington Engineering Co., Milwaukee, Wis.; L. D. Townsend, Townsend, Shuttleworth, Ballmer Co., Lansing, Mich.; District 8—Henry Ericsson, Henry Ericsson Co., Chicago, Ill.; District 13—Natt MacDougal, A. Guthrie & Co., Portland, Ore.; Districts 14 and 15—H. W. Baum, H. W. Baum & Co., Salt Lake City, Utah.

Width and Thickness To Be Added to California Roads

Contracts to the total value of $5,000,000 will be made within the next few months, according to a statement made recently by R. M. Morton, state highway engineer, for widening and thickening existing paved routes on California's highway system. Plans and specifications for this work, which includes stretches of road in many parts of the state, are now in course of preparation and in some cases bids have already been called for. This expenditure will be made from funds derived from the state's share of the new gasoline tax and motor vehicle license fees and is in addition to money available from state highway bond funds. It is estimated that this new source of revenue for highway maintenance will be at least $7,500,000 for 1924, which is 50 per cent in excess of the present revenues for maintenance and reconstruction. The highway commission is to receive its first allotment from the gasoline tax in May, 1924.

Surveys and plans are also under way for considerable construction work on main trunk lines, which is classed as primary construction, and is paid for from bond issues. This work is kept separate from that classed as maintenance and rebuilding, for which the gasoline tax is specifically reserved by law. Primary construction to be undertaken soon includes the paving of 9.9 miles of the highway immediately north of Redding, grading a number of units on the Truckee River route between Auburn and the Nevada state line; work on the Redwood highway north of Eureka to make a connection with the Oregon state highway to Grants Pass, and connections with Yuma, Ariz., in southern California.

Commerce Commission Reverses Decision Against Coal Road

The Interstate Commerce Commission has reversed its decision of June 25 against permitting the Virginian Ry. Co. to build a 1.19-mile extension of its Guyandot River branch in Wyoming County, West Va. into new coal mines. The former decision was based on the claim that the applicant railway was unable to supply cars for the mines now served by it. The Commission also stated that there were more mines open than were necessary for the country's demand and the efficient use of the carriers equipment.

The reason for the reversal is based on the fact that the applicant company has made large increases in its equipment and also plans to increase its capacity by electrification. Moreover the Commission holds that to deprive the coal company of the opportunity to develop these fields would cause it to lose the value of large expenditures which it has made. It also finds that the coal to be mined is Pocahontas smokeless coal, which is in demand on account of its special properties.

Engineers Urged to Take Greater Interest in Civic Affairs

Washington Correspondence

Twice within a week assemblies of engineers in Washington were urged to advocate greater political activity on the part of their members. The first instance was at the convention of the chemical engineers. One speaker asserted that of all the chemical engineers in attendance at the convention, only one had been particularly active in politics.

The other admonition along this line came from President Loweth, of the American Society of Civil Engineers. In an address Dec. 11, before the Washington Section of the Society, he stressed the need for greater attention to public affairs on the part of engineers individually and collectively.

No other profession is as well paid by the communities they serve than is the engineer, Mr. Loweth said. He admitted that the lawyers might contest the statement, but if the earnings of that profession were stripped of profits from real estate and other outside activities, it would be found that their earnings for strictly legal work would show a lower aggregate than that of the engineering profession. Were engineers to take a larger interest in civic matters, even greater returns would come to the profession, but above and beyond the matter of increased earnings, the engineer, he believes, has a duty as a citizen.

Referring to the removal of A. P. Davis from the Reclamation Service, Mr. Loweth said this injustice to an engineer should not discourage engineers from giving service. Very frequently, he said, service is not rewarded as it should be, but the obligation to perform it remains nevertheless.

Reclamation Finances Tabulated

A tabulation of cost, repayments, water charges, and similar data for the various projects of the U. S. Reclamation Service has been prepared in the Department of Interior for the use of the Committee of Special Advisors on Reclamation. The tabulation is reproduced substantially complete herewith. It includes the Buford-Trenton, Hondo, and Garden City projects that have been abandoned by the government, and the Riverton project, yet under construction. It is to be understood that the figures given as originally estimated cost did not contemplate supplemental construction, such as subsequently entered into the actual cost. Included in the cost of construction, further, is a total of $12,922,455, representing the cost of furnishing water under Warren Act and other special contracts. The construction cost figures also include arrears in payment for water charges that have been transferred to construction by act of Congress or departmental order. The water charges given in the table include an item of $1,059,864 representing the cost for the first six months of 1923, for which no assessments have yet been made. The acreages do not include areas to which water is furnished under the Warren Act or other special contracts.

Three projects, Grand Valley, King Hill, and Milk River have not yet been opened by public notice and water is being sold on a rental basis. The Salt River acreage includes some area taken in by the Salt River Valley Water Users Association, on which the association spent additional money for construction. The cost of the Yakima project includes $2,515,875.62 expenditure on the Rimrock dam, which is expected to bring additional acreage under irrigation.

In a statement accompanying the tabulation the following remark is attributed to Secretary of the Interior Work: "The Reclamation Service of the government has had but two directors in its history of twenty-one years, both engineers and each with ten years' service. They have erected their own monuments and the different projects are writing the inscriptions for them."

Yuma Flood Protection Bill Before Congress

Protection against the Colorado River flood danger at Yuma, Ariz., would be assumed by the United States Government under a bill just introduced in Congress by Senator Ashurst, of that state. The bill provides an annual appropriation of $100,000 for such work, and a single appropriation of $100,000 to refund past expenditures on flood fighting, which heretofore has been charged against the Yuma irrigation project as part of operation and maintenance. The bill also declares it to be the policy of the United States to assume the obligation of caring for the river-front work and levee system on the Yuma project.

Two Power Developments Proposed For the Upper Delaware

The Shohola Water Power Co., the Bingman Water Power Co., and the Blooming Grove Water Power Co., have declared their intention jointly to construct two power plants on Shohola Creek, a tributary of the Delaware River, in northeastern Pennsylvania. They propose to construct a 60-ft. dam at the head of Shohola Falls and run a pipe line to a point downstream where they can develop a head of 270 ft., at which point they will construct a power house with two 4,000-hp. units. A second dam is being constructed at Cold Spring Lake and a second pipe line to a power house, where a head of 290 ft. will be developed and three 4,500-hp. units installed. As the project calls for a storage of 2,500,000,000 cu.ft. of water, it is probable that the Federal Power Commission will take jurisdiction over it on account of its effect upon the flow in the Delaware River.

Reject River Diversion Project

The engineering staff of the Federal Power Commission has advised the Newman-Hirstel interests of San Francisco that it will recommend the rejection of their application for a preliminary permit to develop power by the diversion of the San Benito River from its natural course into the San Joaquin River. Investigations of the engineering staff have revealed that all the water of the San Benito is needed for irrigation. Moreover, the staff believes that the development of the river in its natural course is more promising and less expensive than the proposed diversion. The diversion would have the effect of lowering the level of ground water at points below the point of divergence and would almost certainly result in extensive litigation over damages.

Testing Materials Again Will Meet in Atlantic City

Announcement has been made by the executive committee of the American Society for Testing Materials that that society's annual meeting will be held at the Chalfonte-Haddon Hall Hotel, Atlantic City, N. J., Monday, June 23, to Friday, June 27, or Saturday, June 28, 1924.

	FIRST COST		AREA			SETTLER'S CHARGES AND PAYMENTS — CONSTRUCTION						OPERATION AND MAINTENANCE		DELINQUENCIES	
Projects.	Original estimated cost.	Net construction cost to June 30, 1923.	Original estimated irrigable acreage.	Acreage Bureau prepared to supply 1922.	Acreage actually irrigated 1922.	Original estimated cost per acre.	Actual cost per acre to June 30, 1923.	Aggregate charge per acre to settlers under public notice: Original.	Aggregate charge per acre to settlers under public notice: Supplemental.	Years water delivered.	Amount paid on construction to June 30, 1923.	Total operation and maintenance costs to June 30, 1923.	Total operation and maintenance receipts to June 30, 1923.	Delinquent charges, rentals of irrigation water to June 30, 1923.	Amount unpaid by water users on construction, O. & M., water rentals.
Salt River, Ariz.	$3,6_0,000	$10,_88,115.26	[illegible]	213,170	[illegible]	$28.00	$49.50	$60.00		17	$891,815.92				$9,656,303.46
Yuma, Calif.-Ariz.	2,701,136	9,025,546.52	76,966	6_,___	53,970	35.10	142.80	$55 & $75		17	1,093,052.01	$1,667,960.99	$956,921.08	$4,252.08	8,649,368.63
Orland, Calif.	668,085	1,091,77_.87	17,000	20,670	15,1__	40.29	52.80	44.00	$11.00	14	240,634.56	218,810.67	200,251.55		669,440.41
Grand Valley, Colo.	4,565,0_0	4,017,9__.78	[illegible]	30,000	1_,_7_	86.00	133.90	Rental basis		9				32,904.63	4,060,026.61
Uncompahgre, Colo.	2,500,000	4,715,07_.41	150,000	97,410	64,730	25.00	69.00	70.00		16	102,70_.3_	81,724.16	1,543.60	36,351.98	6,720,900.69
Boise, Idaho.	9,867,800	13,731,409.73	2__,_00	1_3,000	112,000	36.50	89.00	26.60 & 77.44		18	1,_08,314.00	1,631,887.35	1,424,281.14	13,127.47	11,543,059.33
King Hill, Idaho.	1,000,000	1,831,391.45	1_,__01	13,_10	6,440	_.66	137.70	Dist. Cont.		3				2,861.38	1,884,252.81
Minidoka, Idaho.	2,_4_,856	8,054,663.26	1_1,_00	141,_40	10_,390	_.78	66.30	130.00 & 56.00	12.00	17	2,866,20_.2_	1,381,916.18	1,198,418.06	267.60	6,372,2_0.74
Garden City, Kans.	2_4,000	385,6_1.07	8,400			__.00					61,176.11				334,474.90
Huntley, Mont.	_00,_00	1,476,40_.61	_,000	32,000	19,520	25.71	46.10	30.00	10.00	16	361,05_.2_	850,502.48	321,605.29	207.92	1,642,268.57
Milk River, Mont.	7,424,4__	6,762,083.26	2_1,906	6_,___	16,170	29.48	101.70	Rental		13	1,11_.00			23,470.81	6,704,440.06
Sun River, Mont.	7,372,400	4,2__,842.94	256,000	_2,___	20,___	2_.8_	100.00	$30 & $36		15	170,178.7_	201,770.14	124,686.46	36,092.00	4,179,640.70
Lower Yellowstone, M.-N.D.	2,032,118	3,110,_19.2_	66,___	[illegible]	15,_00	[illegible]	77.35	45.00	16.50	14	41,232.70	764,430.61	62,36_.87	1,398.50	3,752,571.70
North Platte, Nebr.-Wyo.	3,100,000	13,672,1__.3_	100,000	1_2,___	111,2__	35.00	84.30	56.00	14.00	16	1,742,767.58	2,102,953.08	1,247,896.73	884.11	12,615,0_4._0
Newlands, Nevada.	5,283,997	6,7__,475._2	370,000	73,720	_6,___	14.58	91.75	52.00	8.00	18	822,100.__	1,016,238.05	708,990.14	19.80	6,003,640.62
Carlsbad, New Mex.	600,000	1,39_,994.7_	_0,___	25,000	_,_0	30.00	55.75	45.00		17	391,577.34	483,724.64	406,695.17		1,000,646.84
Hondo, New Mex.	275,000	374,867._7	10,000			27.50								35.49	371,902.60
Rio Grande, N. Mex.-Tex.	7,___,_00	12,1_4,114.4_	175,000	116,000	89,500	30.00	104.70	90.00		18	78,491.00	540,366.12	384,742.60	34,028.18	12,246,275.33
Williston, N. Dak.	23_,140	4__,107.1_	8,77_	7,1_0	1,_90	26.76	60.15	38.00		18	9,210.63	357,244.00	20,594.51		790,604.01
Buford-Trenton, N. Dak.	134,___	221,8__.69	4,500			29.88						71,771.07	2,317.41		294,318.30
Umatilla, Oreg.	1,0__,000	2,5__,___.7_	_,140	24,980	13,_70	53.90	109.10	$70 & $_2	Dist. Cont.	16	373,919.76	534,116.72	251,651.55		3,081,915.30
Klamath, Oreg.-Calif.	6,8__,311	3,976,163.70	236,_01	51,000	38,020	16.59	77.29	$3_ & $90	" "	17	537,692.73	862,268.18	639,773.13	475.80	3,079,711.84
Belle Fourche, S. Dak.	2,___,000	3,547,0__.0_	79,000	82,190	31,1__	40.56	43.15	$__ & $40		16	478,27_.90	972,097.47	579,317.98	100.00	3,511,654.84
Strawberry Valley, Utah.	2,722,000	3,446,7__.00	60,000	52,090	30,___	46.37	64.30	60.00		9	396,182.69	353,254.85	243,775.56		3,178,964.21
Okanogan, Wash.	432,500	1,302,141.45	8,600	8,000	_,370	50.00	163.89	$75 & Dist. Contr.		15	81,477.70	379,212.10	223,062.51	1,643.97	1,408,507.51
Yakima, Wash.	6,515,868	12,161,931.67	181,769	133,340	123,700	_4.00	91.30	$52 & $90		17	3,171,275.12	3,300,887.18	2,093,487.09	614.83	9,198,171.47
Riverton, Wyo.	_,777,225	1,060,220.08	100,000			67.77									1,060,226.08
Shoshone, Wyo.	4,310,238	8,290,965.82	110,000	71,330	42,780	30.16	116.40	[illegible]	[illegible]	16	613,602.50	616,347.91	410,978.89	352.16	7,676,678.08
Totals.	93,435,6_1	141,787,_05._	_,___,__7	_,_00	1,_02,130	40.37	103.76				15,522,__2.58	17,098,931.95	11,370,744.08	160,137.23	132,062,768.28

TABULATION OF COST, REPAYMENTS, WATER CHARGES, ETC., ON RECLAMATION PROJECTS

New Jersey to Bring Suit Against Federal Power Commission

Washington Correspondence

In an action similar to that taken by the state of New York against the Federal Power Commission, the state of New Jersey has now entered a motion for leave to bring suit against the commission to enjoin it from acting in that state "by an abuse of power without lawful and constitutional authority or in pursuance of wrongful and erroneous interpretations of the provisions" of the federal water power act, which act the state will ask the U. S. Supreme Court to declare unconstitutional.

The principal complaint of New Jersey is that the Federal Power Commission is attempting to exercise jurisdiction over the state's proposed development of water power along the Morris Canal. This canal, which runs from the Delaware River at Phillipsburg, N. J. to the Hudson River at Jersey City, was started in 1824, passed through various hands until it eventually came into the hands of the Lehigh Valley Ry. Co., and last year was purchased by the state of New Jersey. As the canal has ceased to be of value as a means of transportation the state proposes to use it to develop hydro-electric power by the construction of some new dams, including one on Lake Hopatcong. The state also proposes to develop power above Saxton Falls on the Musconetcong River and at various sites on the Delaware River. The motion cites that the state has not applied to the Federal Power Commission for permit for this work and does not propose to do so. The state also objects to the Commission's asserting authority over riparian land, which land brings in revenue to the state for its school funds, and to the Commission's interference with the conservation policy of the state in connection with its potable water on account of the possibility of its causing heavy losses in investments in waterworks. The state also challenges the Commission's right to regulate rates for the sale of electric power within the state.

Consulting Engineers Urge Tax Reduction

The tax reduction program proposed by Secretary of the Treasury Mellon was recently endorsed at a meeting of the American Institute of Consulting Engineers in New York City. The Institute, believing that a return to country-wide construction program in the industrial and railroad fields is passible only through restoration of public confidence by a reduction of federal taxes, addressed a letter recently to President Coolidge embodying the hope that the President would urge upon Congress the necessity of reducing taxes.

The subject of the tax reduction was taken up at the latest meeting of the Council of the consulting engineers, a resolution endorsing Mr. Mellon's program without qualification being unanimously adopted. The executive officers of the Institute were, therefore, directed to convey that expression to the Secretary of the Treasury and the chairmen of the appropriate committees of both the Senate and the House of Representatives, in addition to communicating directly with President Coolidge.

Corporate Management Suggested for Federal Barge Service

Washington Correspondence

Corporate management for the Mississippi-Warrior barge service has been suggested to the Secretary of War, and legislation to that end is to be introduced promptly. By the formation of a corporation, which will function under the Secretary of War, it is believed that most of the handicaps of government operation can be avoided, and a greater degree of flexibility injected into the administration of the service. The immediate direction of the service would remain in the hands of Col. Ashburn, the plan contemplates, who is to be released for the provisions of the Manchu law, and advanced to the rank of brigadier-general.

At the public hearing at which this plan was explained to Secretary Weeks, that official asked why the operation of the barge line should not be transferred to the Department of Commerce. Secretary Weeks made the point that something must be done to reduce the non-military functions which are being thrust upon the War Department. This led Senator Reed, of Pennsylvania, to inquire if it is proposed to transfer the Corps of Engineers to the Department of Commerce. He said he could not imagine a railroad having its operating division in one department and its maintenance-of-way in another. The suggested transfer was opposed also by Senator Brookhart, of Iowa; Senator Reed, of Missouri, and Senator Broussard, of Louisiana.

The corporation which is proposed is to be the recipient of the proceeds of a bond issue, which may not exceed $10,000,000. The money is to be used for the purchase of equipment, the construction and maintenance of terminals, and as a revolving fund.

Civil Engineers Appointed on Education Committee

President Loweth, of the American Society of Civil Engineers, has appointed as counselors representing the society on the board of investigation and co-ordination of the Society for the Promotion of Engineering Education, F. C. Shenehon, of Chicago, and J. Waldo Smith, of New York. This board is to study the whole subject of engineering education under a grant of $108,000 from the Carnegie Foundation, as announced in these columns some weeks ago.

Tacoma Revives Lake Cushman Power Project

The construction of the first unit of the Lake Cushman power project proposed by the city of Tacoma, Wash., is provided for in ordinances for the issuance of bonds and letting contracts introduced in the City Council. The ordinance, passed nearly three years ago, which provided for the development of the project must be amended to suit changes in the plan, and a new ordinance providing for $4,000,000 of light utility bonds is expected to be passed in time for a call for bids some time in the near future.

The Lake Cushman project called for an ultimate development of 140,000 hp. and an expenditure of $10,000,000. The first unit will develop 50,000 hp.

To Measure Water Diverted for New York Barge Canal

Measurement of the water passing through the New York barge canal is to be undertaken to determine whether water in excess of the amount needed for navigation is being diverted from the Niagara River. The work will be done by the measuring commission, recently appointed to represent the United States and Canada, the American member being Major P. S. Reinicke, district engineer in charge at Buffalo. W. M. Stewart represents Canada.

It is contended by representatives of the federal government that no water is being diverted through the canal over and above the requirements for navigation, although in issuing a license to the Niagara Falls Power Co. it was assumed that 500 sec.-ft. of treaty water was going through the canal. Certain interests in Lockport and Medina have laid claim to the right to use this 500 sec.-ft. and have applied to the Federal Power Commission for a license to cover its use. Those interests hold a revokable state permit which recites their right to have this amount of treaty water transported through the canal as far as Lockport.

If it is found that no treaty water is being transported through the canal, it is assumed that the Federal Power Commission will license the 500 sec.-ft. for diversion at the Falls. Even in that event it is understood that the Niagara Falls Power Co. is willing to remunerate the holder of the state license for any equity which he may possess.

Trucks to Replace Way-Freight on P. R.R. Branch

Motor trucks have taken so much of the l.c.l. freight business in some thickly settled regions that the operation of such freight trains is no longer economical. To overcome this the Pennsylvania R.R. has announced that it will abandon this part of its way-freight service between Wilmington and Philadelphia, and has entered into an arrangement with a trucking organization for the required motor truck service in the territory affected. The railroad company's statement says that the new plan has enabled it to dispense with two freight trains daily, one in each direction. Two motor trucks are now doing the work of these trains with greater efficiency due to their flexibility and greater speed in movement. The new arrangement does not involve any changes in rates.

Cherokee Bluffs Power Project Well Under Way

Work on the new 132,000-hp. hydro-electric development of the Alabama Power Co. at Cherokee Bluffs on the Tallapoosa River is well under way. Four of the six miles of railroad which the company is building to the power site have been graded and track has been laid for three miles. The high-tension transmission line bringing power to the site has been completed and a 460-ft. section of the cofferdam in the river is ready to be unwatered.

The total head to be developed at this site will probably be increased from 120 ft. to 150 ft. for storage purposes. The first installation will be 44,000 hp.

Municipal Toll Bridge Over Ohio Proposed for Louisville

A report on the project for a new highway bridge over the Ohio River at Louisville has just been made by the bridge committee of the Louisville Board of Trade, embodying the specially interesting feature of a municipal toll-bridge plan. The report asserts the principle that those who use the bridge should pay the main part of its construction cost. It recommends locating the bridge at 10th St., connecting with Warner Ave. in Jeffersonville. The cost of the bridge is estimated at $4,790,000, or, with interest and contingencies, something over $5,000,000. The toll income that might be expected immediately after completion is estimated at $350,000 per year, which would assure a sufficient balance over fixed charges to provide for amortization.

Preliminary plans included in the report to the Louisville Board of Trade made by Fay, Spofford & Thorndike, consulting engineers, call for a structure of 17 steel spans carrying a concrete deck supporting a bituminous wearing surface. The sidewalk will be of concrete and concrete railings will be used. Excluding the approaches, the bridge will contain the seventeen 206-ft. spans and one 410-ft. span across the canal, and a 650-ft. span across the river channel. The total length of this portion of the bridge, which is practically level, is 4,663 ft.

The location of the bridge is about 1,500 ft. upstream from the Pennsylvania R.R. bridge, which it resembles in a general way. The roadway of the bridge will be 40 ft. wide with a 6-ft. sidewalk on the upstream side.

Regional Planning for Chicago 50-Mile District

The Chicago Regional Planning Association, organized Nov. 2 at the second conference on regional planning, is to serve the territory within fifty miles radius from the center of the city. This territory comprises what may be termed the Chicago industrial district and the purpose of the new association is to study conditions and promote co-operation in both industrial and social development, so that, for example, when a new industry is to be established the question of adequate local transportation, sanitary and housing conditions will not be overlooked.

Definite lines of activity by the association are to include the following: (1) A physical survey of topographical conditions, transportation, population and public utilities; (2) an industrial and commercial survey; (3) a health and housing survey as to water supply, drainage, sewerage, zoning regulations and housing conditions; (4) an educational survey of schools, parks, bathing beaches, forest preserves areas and commercial recreation facilities; (5) a governmental survey of the various governmental organizations within the region and a study of legislation.

The meeting elected Dwight H. Perkins as the first president. Three classes of membership are provided in the new constitution: individual, contributing and organization members, the last including county and municipal bodies and civic or community associations.

Retention of Construction Road Raises Common-Carrier Issue

Washington Correspondence

The application of the Portland Railway, Light & Power Co. for an amendment to its license which would allow it to retain the railroad which it built to its power development on the Clackamas River, 50 miles south of Portland, as a permanent adjunct to the development to insure the ready transfer of heavy machinery to the plant in case of accident, has raised the question as to whether such a permit should not require the operation of the road as a common carrier. The power project occupies a site in a very inaccessible part of the undeveloped forest area. The original plan called for the construction of a railroad to a point about 6 miles above the existing terminal at the company's Cazadero plant and the use of a wagon road for the remaining 20 miles. During construction, however, the company found it necessary to build the railroad all the way to the plant. This was done with the permission of local forest officials. These officials now object to the company retaining this railroad for emergency purposes unless it be operated as a common carrier. The power company has agreed to handle such shipments of forest products as are offered to it, but the Forest Service holds that the presence of the railroad along the only location suitable for a wagon road precludes the use of that location as a wagon road, and necessitates the operation of the railroad as a common carrier or else the removal of its rails.

Tramway and Light Railway Society to Meet at Paris

The International Congress of Tramways, Light Railways and Omnibuses will hold its next meeting at Paris in 1924. A preliminary list of subjects includes the following: (1) Improvements in track design and electric and mechanical operation of switches; (2) improvements in car design; motors and electrical equipment; loose wheels; radial axles; reduction in weight; brakes; (3) use of automobiles on rails; (4) transportation facilities in relation to the extension of towns and suburban districts; (5) employment and periodical examination of employees; (6) improvements in locomotives for light railways; fuel economy due to superheaters, feed-water heaters and other appliances; (7) motors for buses.

Largest Hydraulic Turbine Put in Operation

The first of three 70,000-hp. single-runner, vertical-shaft hydraulic turbines of the Niagara Falls Power Company's new plant in the Lower Gorge was put into service on Dec. 18. The new unit uses a flow of 3,200 sec.-ft., the amount now used by seven 5,000-hp. units in the old plant, with twice the output of that plant without any increase in the amount of water diverted from the Falls.

The runner is a single piece of cast steel weighing 105,000 lb. which, with the 32-in. shaft and the 399-ton rotor of the generator, make up the revolving element of approximately 500 tons weight suspended from the top of the unit by a Kingsbury thrust bearing.

Random Lines

Another Argument Gone

In New York the other day a prominent lawyer resigned from the Bar Association because lawyers do not "take enough interest in public affairs." Thus is shattered our fondest illusion and most potent argument for the bettering of the engineering profession. How are we going to argue for a more active participation in community life by the engineer if we cannot point dramatically to our lawyer-ridden government and the precedent lawyer-interest in public affairs.

* * *

An accounting for a water-works construction job came in a while ago with an item labeled "engineers and other odd expenses, $150."

* * *

False Pretenses

Some of the things in this column are meant to be funny. This item is *not*.

The following advertisement has been running for some time in a New York newspaper:

> YOU CAN BE A DRAUGHTSMAN
>
> **Mechanical or Architectural**
> **A Profession Not Overcrowded**
>
> Few months' spare time training under direct supervision of experts, which will not interfere with your present duties will qualify you in this well-paying profession.
>
> Draughtsman earn $5,000 to $25,000 yearly. Let us show you how you can prepare for one of the many positions now open.
>
> **METROPOLITAN INST. OF DRAFTING**
>
> **154 Nassau Street, Suite 610**

It is hereby respectfully called to the attention of the postal authorities.

* * *

A Brutus Stroke

It looks as though we are going backward in our campaign against adjectival engineers. We are being attacked in the house of our friends. First comes the New York Section of the American Institute of Electrical Engineers with a program which announces a discussion on "human engineering" and a plea for intensive work in "membership engineering." And then the American Engineering Standards Committee sends a circular in which we are assured that "standardization engineering" is now a recognized profession in Germany and that advertisements for "standardization engineers" appear regularly in the engineering press. The morale of the technical press in Germany has probably suffered with everything else there. There isn't much they won't do for real money. But why countenance the debasing of the honest word "engineering" in this country? The Standards Committee finds, too, that "another most interesting development is the work of consulting engineers on trade catalogs." Add then to the immortals —"trade catalog engineers."

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 10-11, 1924.

AMERICAN ROADBUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 14-18, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York, Jan. 16-18, 1924.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Chicago, Ill., Jan. 21-24, 1924.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 22, and Ottawa, Jan. 23, 24, 1924.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Meeting, Chicago, March 13-15, 1924.

The North Carolina Section of the American Water Works Association at its recent meeting in New Bern, N. C., elected the following officers: President, J. C. Michie, superintendent of the Durham, N. C., water-works; vice-president, William H. Piatt, construction engineer, Durham; secretary-treasurer, Thorndike Saville, Chapel Hill.

Personal Notes

F. A. LAMMIMAN, formerly connected with the firm of Polk and Robinson, civil engineers of Chico, Calif., has been named city engineer of Chico, succeeding Frank S. Robinson, resigned.

C. F. PRICE, present city manager of San Mateo, Calif., has been appointed city engineer and superintendent of streets, succeeding G. Stanley Whitehead, who has been city engineer of San Mateo for four years and who recently resigned.

The JASPER-STACY CO., a new construction firm, has opened offices at 216 Pine St., San Francisco, and will engage in construction on irrigation, reclamation, power, factory, building, municipal and other enterprises. The firm is headed by B. P. LILIENTHAL, vice-president of the Union Sugar Co. and South San Francisco Land Co. The vice-president is O. W. JASPER, JR., manager of the Shattuck Construction Co. of San Francisco for the past seven years. The secretary is N. T. STACEY, engineer, whose most recent work involved the expenditure of $5,000,000 in townsite, railway and factory work.

WILLIAM ARTINGSTALL, consulting engineer, Chicago, has been made consulting engineer to the Department of Public Works, Chicago, reporting directly to Col. A. A. Sprague, commissioner. His duties include handling the city's supervision of the Illinois Central terminal, Union Station, and other railroad terminals, in addition to all matters coming to the commissioner by special ordinance.

J. E. MOODY, engineer in charge for the city of Chicago on the development of the Illinois Central R.R. terminal, has resigned.

A. J. GOODE has been appointed county engineer of Red River County, Texas, succeeding J. B. Reiman, who has resigned. County engineering headquarters are at Clarksville.

J. P. KEARBY has been appointed county engineer of Fayette County at La Grange, Texas, succeeding CAPT. A. SCHLAFI, who becomes a division engineer for the Texas State Highway Department.

H. G. FLURY and R. A. KIZER have opened an office at 125 Wirthman Bldg., Kansas City, Mo., under the firm name of Flury & Kizer, engineers, for the practice of structural engineering. Mr. Flury was formerly with the Kansas City Terminal Ry., the Kansas City Structural Steel Co. and the Interstate Commerce Commission.

GEN. WILLIAM LUTHER SIBERT has been appointed president and general manager of the Alabama Dock Commission to succeed the retiring temporary commissioner, George Gordon Crawford. Gen. Sibert served as a member of the Isthmian Canal Commission from March, 1907, until April, 1914, and as chairman of the Board of Engineers on the flood prevention work in the Huai River valley, China. He was promoted to the rank of brigadier general and was extended the thanks of Congress by an act approved March 4, 1915. Shortly after the outbreak of war in 1917 he was promoted to the rank of major general and sent to France with the First Division. Following this he served in the Chemical Warfare Service from May, 1919, until February, 1920.

ARTHUR E. LODER, district engineer of the U. S. Bureau of Public Roads, who has been in charge of federal aid work in the southeastern district of the United States, has been selected as manager of the Good Roads Bureau of the California State Automobile Association, succeeding C. C. Cottrell. Mr. Loder, after graduation from Purdue University, was for some years chief engineer of the Los Angeles Highway Commission and division engineer for the California State Highway Department.

F. D. HUDGINS, state highway engineer of South Dakota, has resigned, effective Jan. 1, 1924. His successor has not yet been appointed.

JAMES F. SANBORN and CLINTON L. BOGERT, consulting engineers, have formed a partnership, with office at 30 Church St., New York City, and are prepared to design, report on and supervise construction of water supplies, sewers and sewage disposal, tunnels, concrete structures and municipal works. Mr. Sanborn, a graduate of Harvard University, was connected with the construction of the Battery tunnel of the New York subway and the northern aqueduct department of the N. Y. Board of Water Supply (Catskill aqueduct). Mr. Bogert, a graduate of Cornell, has been engineer in the design division of the Board of Water Supply, New York City, on tunnel and reservoir work. He is co-author with Alfred D. Flinn of a handbook of water supply.

R. DE CHARMS, of Oil City, Pa., has been appointed resident engineer on the construction of a highway bridge across the Allegheny River at Oil City, for Venango County. Mr. de Charms was formerly assistant bridge engineer for the New Jersey State Highway Commission, at Newark, N. J.

JOHN A. FOCHT, recently county engineer of Rockwall County at Rockwall, Texas, has been appointed county engineer of Nolan County at Sweetwater. Nolan County has just voted a large bond issue for highway construction. Mr. Focht is an engineering graduate of the University of Texas and was an engineer officer in the late war. Formerly he was city engineer of Sweetwater in charge of extensive waterworks and paving improvements.

SAMUEL REA, president of the Pennsylvania Railroad Co., has been elected president of the Long Island Railroad Co., to succeed Ralph Peters, deceased. George Le Boutillier, whose election to the presidency of the Long Island Railroad was announced in error some weeks ago, continues as vice-president of the company in charge of all matters concerning operation.

HUBBELL, HARTGERING & ROTH is the name of a firm of consulting engineers recently organized in Detroit, Mich., and composed of CLARENCE W. HUBBELL, J. MCRAE HARTGERING and ALBERT ROTH. The firm will specialize in water supply, sewerage and municipal engineering. Mr. Hubbell was city engineer of Detroit from 1917 to 1922. The address of the new firm is 2346 Penobscot Bldg., Detroit.

S. L. WONSON, bridge engineer of the Missouri Pacific R.R., has been appointed assistant chief engineer, succeeding the late H. R. Carpenter.

F. E. BATES has been appointed bridge engineer of the Missouri Pacific R.R., succeeding S. L. Wonson promoted to assistant chief engineer.

Obituary

ISAAC WINSTON, hydrographic and geodetic engineer, inspector in charge of the Geodetic Field Station in New York City, died recently in his 71st year. Since 1878 he had been in the service of the United States Coast and Geodetic Survey.

GEORGE E. STEELE, civil engineer, who was prominent in engineering in Wisconsin for many years, died Dec. 6 in Grass Valley, Calif., where he has lived in retirement for two years. He was 81 years old. He located in Los Angeles some years ago and designed the streets and sewer system of the city of Hermosa Beach, Calif. Mr. Steele was a native of Ohio.

LOUIS BACQUE, civil engineer, Newmarket, Ont., died in that city Dec. 9 at the age of 67 years. He was a native of Bordeaux, France, and went to Canada forty years ago, where he practiced civil engineering in Montreal and Toronto. He was an authority on the use of peat for fuel.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Interviews with Industrial Executives—4

Close Contact with Job Aids Design and Operation of Trench Excavators

DEMONSTRATING CORRECT OPERATION OF TRENCH BACKFILLER

H. C. McCardell, general manager of the Parsons Co., Newton, Ia., explains how ideas from the field are capitalized in improved design and how demonstrators aid contractors in starting work right.

FROM a heavy, unwieldy steam-driven machine mounted on wood rollers, the trench excavator, in a comparatively short time, has been developed into a compact, mobile, all-steel unit powered by a gasoline engine and operated on crawler treads. Notwithstanding these improvements, the demand for faster-digging machines of greater mobility even now necessitates periodic changes in design to keep the machines abreast of general progress in the construction field. This is a subject to which the Parsons Co., Newton, Iowa, manufacturer of trench excavating and backfilling machinery, attaches great importance. In an interview with *Engineering News-Record's* representative, H. C. McCardell, general manager of the company, stated that it has been the practice of his organization to replace an old design by an entirely new one every five years. This means the introduction of a new machine each year, as the equipment is made in five standard sizes to meet ordinary demands for ranges of work. These five sizes are designed for trenches having widths of 18, 30, 40, 48, and 78 in.

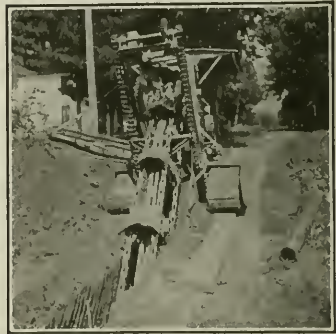
Close contact with the equipment on the job is the foundation of the Parsons Co.'s service to its customers, which begins with the design of the machine. Through its twenty-nine branch offices and agents in the United States and Canada, regular travel by its sales engineers and special trips by members of its designing staff, operating difficulties under actual working conditions are noted and corrected and improvements in design made.

"This policy of contact with the job," Mr. McCardell explained, "has proved of great value both to our company and to the users of our equipment. A case in point is the development of the side-cutting attachment for use on our trenching excavators. The idea was brought back to the factory by one of our operators who was demonstrating a machine for a contractor. The contractor had conceived the idea of this device for increasing the width of cut of the buckets and was experimenting with it on his work. It was something entirely new at that time and when our engineering staff received a detailed report on this attachment an improved design was worked out and the device made regular equipment on all of our trench excavators."

On another occasion, Mr. McCardell added, a Parsons salesman was visiting a contractor in Nebraska who was using a backfiller for a trench in a narrow alley—only 16 ft. wide. The backfiller is equipped with a long boom which makes difficult operation in restricted quarters. This contractor, however, had devised an attachment which solved the problem and, with his permission, the company incorporated this feature in subsequent designs of its machine.

"Ours is a policy of give and take," Mr. McCardell continued. "We get many valuable suggestions from the contractor, and, in the same spirit of co-operation, we offer advice which our experience indicates will aid him in his work. A case of this sort happened when one of our engineers was visiting a contractor in the Middle West doing work in winter. The ground was frozen and he was using picks to dig ahead of his trenching machine. Our engineer suggested that he pipe his exhaust steam ahead, using a cover of straw or manure to thaw out the ground. The contractor adopted this suggestion and made a substantial saving in time and labor."

Supplementing this policy of continuing improvements in design resulting from job contact, the company's plan of co-operation with contractors includes these additional features: (1) Investigation of local ground conditions before a sale to prevent the use of a trench excavator on work for which it is not adapted; (2) shop and field tests of equipment before shipment; (3) operating instructions on the job by one of the company's demonstrators; (4) detailed printed instructions and blueprints; and (5) adequate and prompt supply of repair parts even for machines of out-of-date design.



EACH EXCAVATOR IS TESTED AT THE COMPANY'S PLANT (LEFT) BEFORE IT IS ALLOWED TO BEGIN WORK ON THE JOB (RIGHT)

"We never sell a machine to a customer where there is any doubt as to its ability to do the work in a satisfactory and economical manner," said Mr. McCardell. "Where ground conditions are not suitable we advise a customer against using a trench excavator and recommend such other equipment as, in our estimation, is best suited for the work. The pursuit of such a policy, of course, requires competent men in the sales department whose experience and good judgment may be depended upon for a correct recommendation to the prospective buyer. We believe it is good business to think of the ultimate results to be gained by the purchaser rather than the immediate profits to be secured by the company."

A machine is never permitted to leave the company's shops in Iowa until it has been thoroughly inspected and tested. When it reaches the contractor, therefore, it is ready immediately to go to work. The shop inspection concerns itself principally with checking to see that the alignment of working parts is true and that the driving chains run straight. After this examination has been made the excavator is taken out to a 10-acre testing lot behind the company's shops and made to dig a trench of the maximum width and depth for which the machine is designed. On this test all parts are trued up and adjustments made to insure the satisfactory operation not only of the digging buckets but of the cleaner and conveyor.

The company considers it good insurance to have its machines started right on the job. It has been found that the hardest time to satisfy the customer is when the machine is starting its work. For that reason the company sends one of its trained operators—from three to five of these men are regularly employed—to the work where each excavator is shipped. This man supervises the unloading of the machine and instructs the contractor's operator in proper methods of handling it. The company also maintains a list of skilled trenching machine operators from which a man can be supplied to the contractor if desired for permanent employment.

In addition to this personal instruction, the company sends out with each machine detailed printed instructions and blueprints, together with lists of parts, each being illustrated by a photograph and numbered so as to avoid confusion in ordering duplicates.

TO AVOID TROUBLE

As the result of observing the operation of hundreds of trenching machines the company has noted that, where trouble occurs, it can usually be traced to one of the following causes due to neglect on the part of the owner:

- Failure to keep boxes tightened up.
- Loose bolts.
- Gears out of alignment.
- Improper lubrication.
- Neglect of bevel-gear adjustment.
- Use of chains in which links, pins and bushings are worn out.
- Neglect, during the winter, to paint the machine and grease the shafting and gears.
- Allowing the excavator to remain out in the open all winter instead of placing it under cover.

When the company is advised, by the reports of its field representatives, that owners are not maintaining their machines in good operating condition letters are written to them calling attention diplomatically to these shortcomings.

The shop equipment and organization of the Parsons Co. is lined up for rapid production of parts, even those that may be out of style. The policy is to keep on hand a stock of repair parts for all machines that have ever been built by the company. As part of this service the company operates its own electric steel foundry, so that it is possible to make any particular kind of steel needed for different parts of trenching machines. However, customers are advised to maintain on the job an adequate stock of repair parts.

In designing the different sizes of machines parts are made interchangeable in so far as possible. This is particularly true of sprockets and chains. This policy enables the owner to carry a minimum stock of repair parts and often saves him loss of time due to shutdowns.

A recent improvement has been the use of removable sprocket teeth. In case of a break a single tooth may be taken out and another substituted without removing the sprocket from its shaft. Also, to withstand increased wear, bushings and pins on chains have been made of manganese steel.

"Our whole policy of service," Mr. McCardell concluded, "is built up on the theory that a satisfied customer is our best advertisement."

Business Notes

BARBER ASPHALT CO., Philadelphia, announces the opening of a new district office at 807 Phelan Building, San Francisco, in charge of Major C. M. Foster, former representative of the company in Washington, D. C.

CHICAGO PNEUMATIC TOOL CO., New York, announces the General Machinery Company of Spokane, Wash., as its agents in the eastern part of Washington and northern part of Idaho.

SANDUSKY CEMENT CO., Cleveland, Ohio, announces the election of J. B. John as president and general manager. His connections with other companies will remain as formerly.

Receivers of the SIZER STEEL CORP., Buffalo, N. Y., C. B. Porter, John T. Dillon, and Stewart F. Hancock, announce that the manufacture of all kinds, grades and finishes of commercial forgings has been resumed in addition to the company's output of rolled bars, die blocks, oil well steels, and spiral stems.

EASTERN PAVING BRICK MANUFACTURERS ASSOCIATION, at its fifth annual meeting in New York Dec. 11, re-elected the following officers: President, R. L. Winslow; treasurer, R. T. Hutchins; secretary and chief engineer, William C. Perkins.

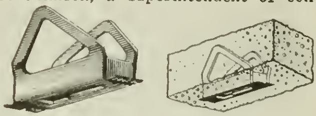
KETTLE RIVER TREATING CO., Madison, Ill., reports that improvements are being made to the plant recently acquired. About 10 acres of land for storage space have been leased and supplied with tracks, while an additional area is being graded and the entire yard covered with cinders. This plant has equipment for both zinc and creosote treatment and also for adzing and boring ties.

COPPER & BRASS RESEARCH CORP., New York, at its third annual meeting held in New York recently, elected the following officers: President, R. L. Agassiz, Calumet & Hecla Consolidated Copper Co.; vice-presidents, B. F. Kelley, Anaconda Copper Mining Co.; F. S. Chase, Chase Metal Works; Walter Douglas, Phelps Dodge Corp., H. J. Rowland, Rome Brass & Copper Co., and U. G. Hungerford, Hungerford Brass & Copper Co.; treasurer, Stephen Birch, Kennecott Copper Corp., secretary, George A. Sloan; manager, William A. Willis.

Equipment and Materials

Inserts in Concrete Carry Angles Supporting Brick Veneer

For anchoring face angles to carry brick veneer in concrete skeleton construction Truscon adjustable pressed steel inserts have been used recently as a substitute for bolts. Where it has been common practice to drill the wooden forms for the insertion of the bolts to carry these face-angles, David J. Johnson, a superintendent of con-



struction in Chicago, devised the new method of construction in a series of six large apartment hotels in Chicago to save money in erection costs. A saving of $3 per hundred in favor of the insert is claimed. The following unit costs are taken from a study of the contractor's time sheets.

	Cents	
With Bolts		
Carpenter's time locating and drilling holes and placing bolts at 87½c. per hour........	13	
Bolts, ¾ x 9 in	5	
Extra nut to hold bolt upright angles to the forms........	1	
	—	19
With Special Inserts		
¾ in. pressed steel insert........	11	
1¼ in. bolt to fasten face angles........	2½	
Placing insert........	2½	
	—	16
		—
Saving in form of inserts........		3

Bolts may be bent when struck by large scaffolding timbers, thus necessitating rethreading and they are often ¾ in. or more out of line due to the sag in the concrete forms. With the insert an inch of adjustment is obtained and angle irons can be attached without the necessity of punching a new hole, even though the beam sags slightly. A bit of mortar is put in the bottom of the insert to provide a bearing surface. Mr. Johnson found that an insert should be placed on each side of the column to carry the angle across the face of the column, and used at every floor level.

Improvements in Creeper Loader

Three improvements are embodied in the new model of creeper loader, manufactured by the George Haiss Manufacturing Co., Inc., New York. The width of the feeding element has been

increased from 7 to 8 ft., which more than doubles the clearance at the side of the creeper element. The machine also has been equipped with an improved type of heavier clutch. The third innovation is the use of a new design of tread link which renders the overlap self-cleaning and does away with any possibility of injury to bituminous pavements.

Among the former design features retained in the new model are the steel-plate feeding propellers, 2-ft. crowding speed, toothed buckets and completely inclosed transmission and clutches. The machine weighs 14,000 lb. and is equipped with a 37-hp. Waukesha gasoline engine.

Reducing Idle Time in Haulage

The problem of keeping motor equipment in continuous operation is intensive when the load must be handled piece by piece as in the case of lumber or iron pipe, or other products in small units. The accompanying illustration shows how, through

the use of a semi-trailer, the truck and its driver are kept constantly on the move in transporting dressed lumber.

The semi-trailer, made by the Trailmobile Co., Cincinnati, is parked on its own wheels with the front supported by a pair of jacks while the lumber is being loaded. When the trailer has its full cargo, the motor truck—which meanwhile has been busy hauling another trailer—backs under it. The fifth wheel or turn-table mechanism which is mounted on the truck and is provided with lift skids projecting to the rear automatically lifts the jacks free of the ground. The fifth wheel mechanism automatically connects the truck with the trailer. The jacks are swung up away from the ground to give ample road clearance and the entire outfit is immediately under way to make delivery.

Publications from the Construction Industry

Water-Tube Boilers — THE KIDWELL BOILER CO., Milwaukee, Wis., has issued a 208-p. volume on boiler design and operation, particularly in regard to the Kidwell two-flow ring-circuit water-tube boiler. This type of boiler, claimed to represent "a great advance over any previous design," is based on a principle of circulation discovered by Goldsworthy Gurney, the Cornish engineer, in 1826, but said to be not generally embodied in water-tube boilers. The design of such boilers, with numerous modifications, is described in full and illustrated by numerous drawings, as well as by photographs.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Bridge Construction This Year and Last

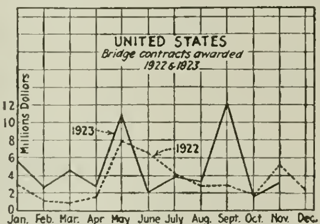
Statistics from *Engineering News-Record* covering bridge contracts of $25,000 and over show two peaks in 1923, in May and in September. The May peak may be explained by looking at the chart of the Far West. During the month a 6-mi. drawbridge over San Francisco Bay costing $10,000,000 was awarded. This of course is reflected on the chart of the United States.

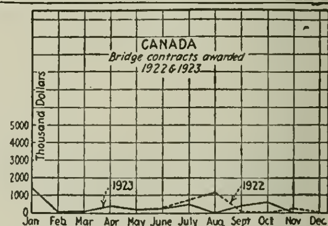
The September peak was due to work in the Far West and the South. During this month the Far West awarded a contract of $4,500,000 for the bridge over Carquinez Straits; a 2,480-ft. double-track steel railroad bridge over St. John's River, costing $1,800,000, and a 1,733-ft. concrete bridge with two steel bascules over the Ashley River, costing $1,067,466. Except for these two peaks both the 1923 and 1922 curves are fairly regular.

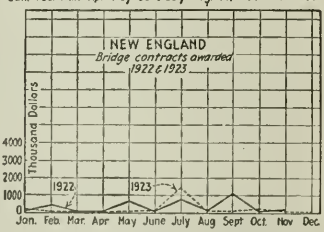
During the first eleven months of these two years, 1922 had 379 awards with a total value of $42,137,000 compared with 346 for 1923 valued at $61,069,000. The average value of each award for 1922 was $111,179 against $176,500 for 1923. The trend of bridge construction may be gathered from the figures of the past five years:

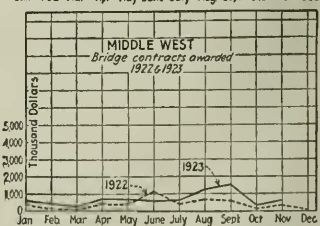
Year	Total	Total for 11 Months	Monthly Average
1919	$27,143,669	$26,555,346	$2,414,123
1920	35,213,881	33,199,984	3,018,180
1921	27,330,677	25,341,282	2,303,753
1922	43,477,000	42,137,000	3,830,636
1923	....	58,196,000	5,290,545

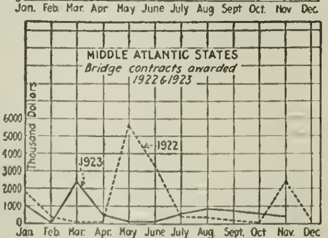
The total for the eleven months of 1923 exceeds the yearly total of any of the four preceding years and gives a monthly average of over $5,000,000. The total for the last month of this year will place 1923 as one of the record years in bridge construction. A contract has just been awarded for a bridge over the Raritan River, at Perth Amboy, N. J., costing $3,702,922.

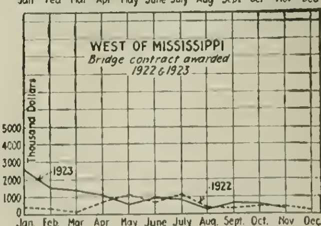


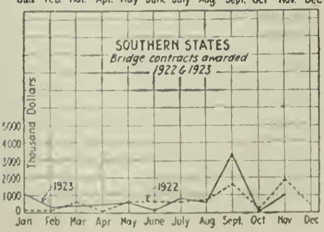


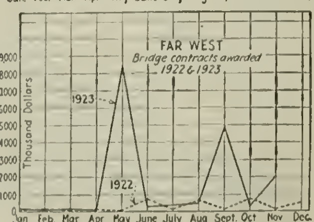












The situation as to bridge construction in the various sections is given by the following comparison of the number and value of the awarded contracts for the first eleven months of 1922 and 1923:

	1922 No.	1922 Value	1923 No.	1923 Value
New England...	21	$2,341,000	18	$3,667,000
Middle Atlantic	50	16,325,000	40	8,891,000
Southern.......	75	8,130,000	67	9,255,000
Middle West....	56	5,173,000	61	8,341,000
West of Mississippi...	136	6,858,000	119	11,293,000
Far West.......	41	3,310,000	41	19,622,000
Total..	379	$42,137,000	346	$61,069,000

E. N.-R. Construction Volume Index Number for 1919 has just been computed. It is 91, compared with 100 in 1913. The full list for every month of the last five years will appear in the January 3 issue.

Lumber Exports 47 Per Cent Heavier Than in 1922

The Department of Commerce reports the total of October exports of wood and wood manufactures is valued at $10,340,863 against $8,271,513 of October, 1922, or a gain of nearly 25 per cent. The total value for the first ten months of 1923 reached $119,652,815 compared with $81,350,155 for the same period of last year showing an increase of 47 per cent. Some of the items exported during October are:

Logs—7,986,000 ft. of cedar; 1,124,000 ft. of Douglas fir, and 216,000 ft. of Southern yellow pine.

Hewn and Sawn Timber—30,785,000 ft. of Douglas fir, 11,247,000 ft. of Southern yellow pine, and 1,891,000 ft. of Cedar.

Lumber—Boards, planks, and scantlings amounted to 127,844,000 ft.

The balance consisted of cooperage stock, plywood, veneers, lath, and shingles.

Brief Analysis of Construction Volume in Peak-Cost Year

In 1920, the year of peak prices, industrial and commercial building construction amounted to 68 per cent of the total construction, according to *Engineering News-Record*. Street and road contracts aggregated 17 per cent of the total, with other classes as follows: water-works, 2 per cent; sewers, 2.3; bridges, 2.2; Federal Government, 2.3; other work, 6.2.

The heaviest month was October, when value contracts awarded was 14 per cent of the total for the year. In the first six months 61.2 per cent of the year's work was placed under contract. The slowest month was November, 4.8 per cent.

Public Bond Sales Still Active

The October activity of the bond market extended into November. The *Commercial and Financial Chronicle* reports the total of state and municipal bonds for November to be $93,462,693; while the October total was $83,561,277 and September $52,251,368.

State bonds took a prominent place in November's offerings. North Carolina led with an aggregate of $15,649,500. California's sale of $6,000,000 was second.

The harbor improvement bond of the City of Los Angeles for $5,000,000 was the largest municipal award.

The total of all forms of obligations placed in November during the past five years follows:

1919	$729,703,393
1920	139,313,577
1921	180,831,418
1922	92,504,602
1923	142,503,175

In the accompanying table of representative bonds, five were sold at par, one below par, and the remainder above. The yields range from 4 to 6 and the rate of interest from 4 to 6 per cent.

The single 4 per cent issue was in Pennsylvania and the five 6s in Michigan, Oregon, New Mexico, Ohio and Washington, respectively.

Insolvencies Among Manufacturers on Increase

The number of commercial insolvencies in the manufacturing industries throughout the United States, during November, shows a gain compared with the same period in 1922, according to R. G. Dun & Co. The number of defaults among dealers or traders, however, are considerably below the total for November of last year.

Lumber manufacturers showed the greatest gains (17 per cent) in insolvencies, compared with last year, while machinery makers came next, with an increase of 8 per cent.

Fewer manufacturers of paints and oils failed during November of this year. Defaults among traders in these commodities, however, increased about 17 per cent.

Glass manufacturing interests and iron foundries showed exactly the same number of insolvencies. in November as during the corresponding period last year.

Freight Traffic Reaches New High Record

A new high record in the amount of freight carried was made by the railroads of the United States during the first nine months of this year, according to reports recently filed by the carriers with the Bureau of Railway Economics.

The freight traffic for that period amounted to 343,796,799,000 net ton miles. This was an increase of 2.79 per cent over the corresponding period in 1920 when the previous record was made, and which amounted to 334,457,000,000 net ton miles.

Compared with the first nine months of 1918 when freight traffic was greatly stimulated by the war, the total from Jan. 1 to Oct. 1 this year was an increase of 4.86 per cent. It also was an increase of 31 per cent over the corresponding period last year, when freight traffic was affected by the strikes of both miners and shopmen.

REPRESENTATIVE BOND SALES DURING NOVEMBER

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Oregon	....	$175,320	4¾	101.57	4.63	Dec. 1, 1923	1943—1959	Ralph Schneeloch Co. and others
County								
Hudson, N. J.	Road	986,000	4½	100	4½	Aug. 1, 1923	1924—1942	A. M. Lamport & Co., New York
	Boulevard	386,000	4½	100	4½	Aug. 1, 1923	1924—1938	
Lapea, Mich.	Road	45,000	6	100.40	5.98	....	..	E. E. Macroo & Co.
Lucas, Ohio	Sewer	138,872	5½	101 70	5.17	Nov. 15, 1923	1925—1933	Provident Savings Bank & Trust Co. and others
	Sewer	54,541	5½	102.50	5.01	Nov. 15, 1923	1925—1933	
	Road	52,910	5½	102 50	5.01	Nov. 1, 1923	1925—1933	
	Road	51,851	5½	102.50	5.01	Nov. 1, 1923	1925—1933	
	Water supply	47,149	5½	102.60	4.99	Nov. 15, 1923	1925—1933	
	Road	51,851	5½	102.50	5.01	Nov. 1, 1923	1925—1933	
	Road	21,163	5½	101.95	5.05	Nov. 1, 1923	1925—1933	
	Road	7,195	5½	101.16	5.17	Nov. 1, 1923	1925—1929	
	Water supply	29,755	5½	102 20	5.04	Nov. 1, 1923	1925—1932	
	Water supply	29,808	5½	102.20	5.04	Nov. 15, 1923	1925—1932	
	Road	9,739	5½	101.11	5.19	Nov. 1, 1923	1925—1929	
	Water supply	3,739	5½	100 55	5.32	Nov. 15, 1923	1925—1927	
	Water supply	57,016	5½	102.72	4.97	Nov. 15, 1923	1925—1933	
	Sewer	45,565	5½	102.28	5	Nov. 15, 1923	1925—1933	
Pulaski, Ind.	Ditch improvement	35,950	5	102.71	4.51	Dec. 15, 1923	1925—1934	Fletcher Amer. Co., Indianapolis
Washington, Ore.	Improvement	30,000	6	98.12	6.35	Dec. 1, 1923	1928—1932	Ralph Schneeloch Co., Portland
Craven, No. Car.	School	165,000	5½	101.57	5.11	Oct. 15, 1923	1924—1953	John Nuveen & Co., Chicago
Municipality								
Albuquerque, N. Mex.	Paving	$140,000	6	....	....	Oct. 1, 1923	1927—1934	Hanchett Bond Co., Chicago
Ashtabula, Ohio	Sewage disposal	$200,000	5½	104.531	5.02	Oct. 1, 1923	1924—1948	Herrick Co., Cleveland
	Storm drain	62,500	6	101.81	5.34	Oct. 1, 1923	1924—1928	W. L. Slayton & Co., Toledo
Iron Mountain, Mich.	Water works	$390,000	5	100	5	Jan. 1, 1926	1946	Hanchett Bond Co., Chicago
Lubbock, Tex	Sewers and water works	125,000	5½	101.28	5.43	....	....	Bregg, Garrett Co., Dallas
Plymouth, Ind.	School	50,000	5	101.82	4.77	Dec. 29, 1923	1924—1943	Fletcher American Co., Indianapolis
Rockwood, Pa.	Street improvement	$10,000	4	100	4	Oct. 1, 1928	1948	Citizens of the City
Sanford, Fla.	Park and sewerage	160,000	5½	100 54	5.47	Jan. 1, 1924	Jan. 1, 1954	Seasongood & Mayer, Cincinnati
Sayreville, N J.	Sewer	149,000	5	100.80	4.94	Dec. 15, 1923	1925—1963	M. M. Freeman & Co., Philadelphia
Seattle, Wash.	Paving, sewers, walks	64,916	6	100	6	Nov. 30, 1923	1933	....
Stoneham, Mass.	School	147,000	4¼	101 393	4 08	Nov. 1, 1923	1924—1945	Kidder, Peabody & Co., Boston

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 335 to 345, are the following:

Club, Philadelphia, Pa., Penn Athletic Club, $2,500,000.

Office, Huntington, W. Va., Coal Exchange Bldg. Co., $1,000,000.

Apartment Hotel, New York, N. Y., Warinick Corp., $2,000,000.

Hospital, Ft. Worth, Tex., Ft. Worth Methodist Hospital, $1,000,000.

Oil Removal Plant, Milwaukee, Wis., Dept. of Pub. Wks., $1,500,000.

Industrial Plant, Toledo. O., Libbey-Owens Sheet Glass Co., $1,000,000.

Railroad, Oregon, Southern Pacific Co., 7 mi. section to cost between $2,000,000 and $3,000,000

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 335 to 345, are the following:

High School, Hartford, Conn., to Southern New England Contg. Co., $1,170,125.

Office, Philadelphia, Pa., to Stone & Webster, $3,000,000.

Theatre, Bank and Office, Flint, Mich., to Wells Bros. Constr. Co., $2,500,000.

High School, St. Louis, Mo., to H. C. Gerhard Bldg. Co., $1,240,000, heating and ventilating to Sodeman Heating & Power Co., $156,447; plumbing to H. D. M. Doerner, $93,315; total $1,489,762.

Improvement, Clearwater, Fla., to Davis Miller, Cone Bros., and Peninsula Constr. Co., $2,413,858.

Bids desired on 40,000 cu.yd. of trench excavation on drainage system by Winterbottom-Connelly Co., 17,316 Madison Ave., Cleveland, Ohio.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Dec. 6; the next, on Jan. 3.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.40	$3.30	$3.55	$4.20	$3.60	$4.10	$4.25
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.25	5.30	5.00	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.38	3.20	3.45	3.85	3.65	4.10	4.00
Steel pipe, black, 2½ to 6 in. lap, discount	44%	40%	43%	47%	53–5%	36%	33.2@42.2%	35%	47.43
Cast-iron pipe, 6 in. and over, ton	61.60@63.60	54.75	61.00	57.20@60.20	60.50	—66.00	59.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	—2.50@2.60	2.35	2.05	2.10	2.42	2.84	2.61	2.90	2.25
Gravel, ¾ in., cu.yd.	2.00	1.75	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.20	2.00	2.00	+1.25@1.50	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+59.00	37.00	54.75	55.50	+44.75@46.00	41.75	—38.00	29.50	42.00
Lime, finishing, hydrated, ton	18.20	23.00	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	1.85	1.50	1.50	2.70	2.10	2.80	9.50
Common brick, delivered, 1,000	+23.65	11.00	11.60	11.00	16@18	12.00	15.50	15.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.10	.11	.0724	.075	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1179	.10	.11	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.95	.95	1.05	.94	1.01	+1.10	1.03	1.15	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	—.40@.45	.35@.50	.50	.62½	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil aod cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on white pine lumber, free on cars at mill. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.50). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in., $119.

Changes Since Last Week

Buying is everywhere upon a conservative basis, owing to the tendency shown by most buyers to close the year with light reserve stocks of materials.

While there has been no decline in building trades wages, some concessions are forthcoming in materials prices. The lower prices in question are designed principally to induce a greater volume of winter building and also to give the dealers a chance to cover against the spring rush for building materials and consequent mill and transportation congestion.

There is evidence, however, of a slight upward tendency in prices of materials used in the latter stages of the construction of a building.

The lumber market is taking on a firmer tone in most centers, although telegraphic advices from San Francisco announce a drop of $3 per M. ft. in Douglas fir timbers.

Common brick are quoted at $20 per M. wholesale, alongside dock, New York, against $19, one week ago. The winter reserve stocks are low, with danger of navigation in the Hudson River being closed at any time by freezing weather. This would of course cut off the supply of Hudson common brick in the midst of a period of active demand. The unusual supply of used brick from building demolition, as well as importations have not as yet affected the price of first grade domestic brick.

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Engineering News-Record

A CONSOLIDATION OF ENGINEERING NEWS, ENGINEERING RECORD, AND THE CONTRACTOR

E. J. MEHREN, *Editor* FRANK C. WIGHT, *Managing Editor*

Contents

A Banner Construction Year in Prospect

WITH the end of the present year at hand, the thoughts of engineers and contractors turn to 1924. What is the prospect for construction during the next twelve months?

The answer, according to the forecast of *Engineering News-Record's* Construction News Department is:

$5,000,000,000

This sum, if costs remain at their present level, will be spent on building and general construction in the United States during 1924, according to the best estimates now available. In other words, if no unforeseen events occur to upset calculations, a banner construction year is in sight.

Assuming that this huge sum will be expended on various classes of work in the same ratio as obtained during 1923, the figures are as follows:

The Construction Prospect for 1924

Streets and roads	$1,250,000,000
Industrial building	350,000,000
Commercial building	1,350,000,000
Residential building	550,000,000
General construction	1,500,000,000
Total	$5,000,000,000

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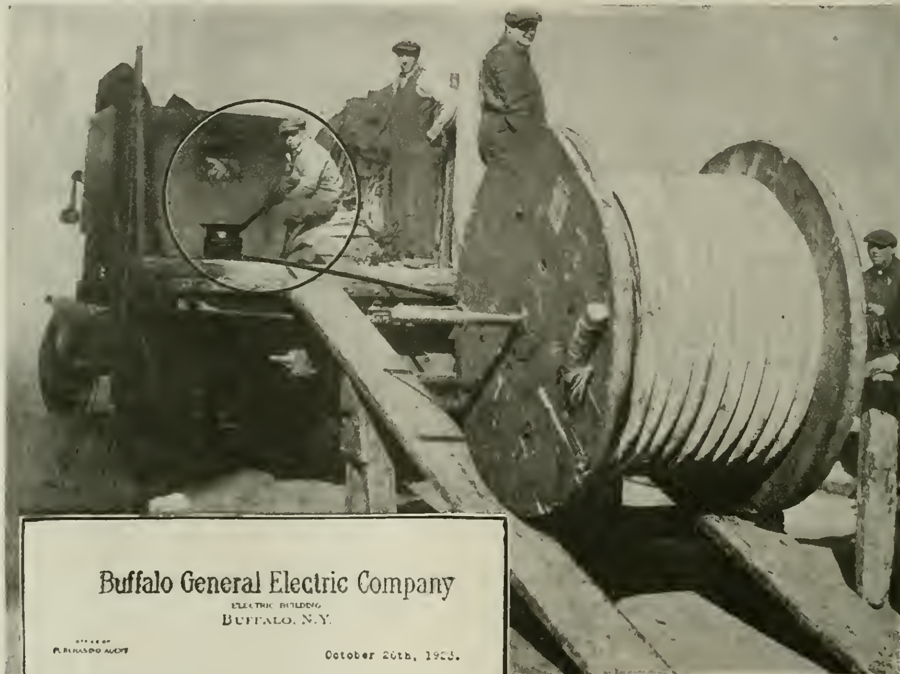
MEAD-MORRISON

VERTICAL CAPSTAN WINCH



Buffalo General Electric Company
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BUFFALO, N.Y.

October 20th, 1923.

TRUCK EQUIPMENT CO.,
1616 Lafayette Ave.,
Buffalo, N. Y.

Gentlemen:

We have the most of our large trucks equipped with Mead-Morrison #901 heavy duty winches and they have been very satisfactory in handling our class of work, and we intend to make it one of our standard equipment.

Yours very truly,

BUFFALO GENERAL ELECTRIC CO.

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". . . . to Make It Our Standard Equipment"

A Vertical Capstan Winch saves time and labor. Equipped with it, your trucks can haul cable, raise poles, or do any of a great number of jobs—each at a minimum of expense. Write for full information.

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1229 Prescott Street East Boston, Mass.

Multiplies Man-Power

HOISTING — HAULING — HANDLING

The shell goes into the ground
—and it stays there

The Concrete goes into the shell
and the shell protects it

*"A Form for
Every Pile—
A Pile for
Every Purpose"*

That is the sole function of the spirally reinforced tapered steel shell into which every standard Raymond Concrete Pile is poured — to protect the length, taper and section of the "green" concrete column — to make certain each pile will be perfect.

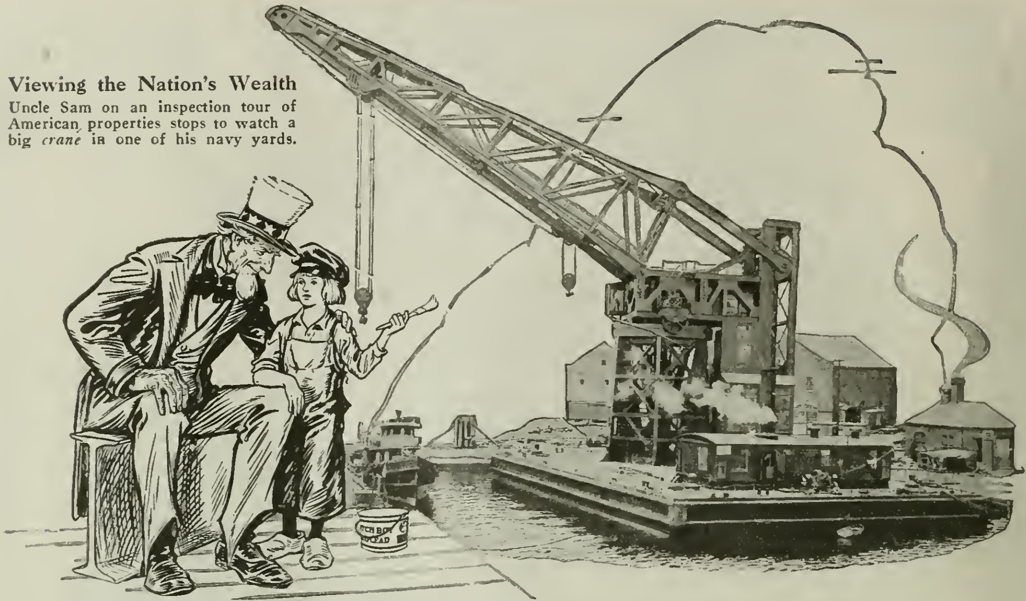
RAYMOND CONCRETE PILE CO.
New York: 140 Cedar St. Chicago: 111 W. Monroe St.

RAYMOND CONCRETE PILE CO., LTD.
Montreal, Canada

Branch Offices in all Principal Cities

Viewing the Nation's Wealth

Uncle Sam on an inspection tour of American properties stops to watch a big *crane* in one of his navy yards.



The Dutch Boy Painter:
"That floating crane can handle tons as easily as an elephant tosses straw. But neither its size, nor its power, can save it from ultimate destruction from rust—if its metal isn't protected!"

This 150-ton floating crane couldn't lift a rust-mortgage

UNPROTECTED metal surfaces soon become plastered with rust-mortages. Every engineer knows what that means. The metal has been robbed of a certain part of its strength. What has been lost can't be recovered, but further loss can be stopped and future loss can be prevented—*by red-lead.*

Red-lead has for many years been recognized as metal's best protection against rust. It is the standard protection. Rust can't form where there is a well-maintained coat of red-lead.

Because it is pure red-lead, Dutch Boy red-lead supplies complete protection to metal surfaces against rust. Rust never holds a mortgage on metal that is guarded by Dutch Boy.

Dutch Boy red-lead sticks tight to clean metal. It forms a tough, elastic coating which expands and contracts with the metal without cracking or checking. It becomes almost a part of the metal's surface. Dutch Boy red-lead costs no more than other good paints. In fact, its cost is materially decreased by its unusual spreading power.

You can get Dutch Boy red-lead as a paste and also in liquid form ready for the brush. The *liquid* comes as straight, untinted red-lead for shop painting and priming coats. It is also tinted to greens, browns and black for finishing coats. The untinted *paste* can be tinted to any dark color.

For the complete protection of metal surfaces, specify Dutch Boy red-lead by name—then stop. There is no "or equivalent."

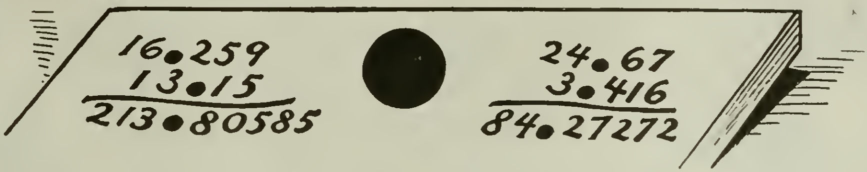
Write for Painting Helps No. 5.

"Save the surface and you save all"—Paint & Varnish

NATIONAL LEAD COMPANY

New York, 111 Broadway; Boston, 131 State St.; Buffalo, 116 Oak St.; Chicago, 900 West 18th St.; Cincinnati, 659 Freeman Ave.; Cleveland, 820 West Superior Ave.; St. Louis, 722 Chestnut St.; San Francisco, 485 California St.; Pittsburgh National Lead & Oil Co. of Pa., 316 Fourth Ave.; Philadelphia, John T. Lewis & Bros. Co., 437 Chestnut St.

Dutch Boy Red-Lead



Accurate Decimal Points

SUPPOSE you had a Scratch Pad with Decimal Points printed on it. Then when you wrote the two factors of a decimal multiplication with the whole numbers to the left of the points and the decimals to the right, the correct answer would automatically appear, *accurately pointed off.*

Such a Scratch Pad would be valuable to you. Accuracy of decimals is equally as important as accuracy of figures.

The Monroe Calculating Machine gives you Proven Results, *accurately pointed off,* in just the same way. As you "write" the two factors of any problem in the machine, you immediately read the Proven Answer, with the decimal point in the correct place.

Ask to see why users say "the Monroe is the finest Scratch Pad ever given a clerk." The coupon below simplifies your request.

Monroe Automatic—Marks a new era in Mechanical Calculating and Adding. A portable, electrically-operated machine for use either on desk or stand.

To Add or Multiply, simply touch the Plus (+) Bar. To Subtract or Divide, simply touch the Minus (—) Bar. The Proven Answers automatically appear with split-second speed.

Monroe Standard Model—Every feature of the Standard Monroe is conducive to speed with absolute accuracy. A forward turn of the crank to add or multiply; a backward turn to subtract or divide.

Special Models to fit individual requirements—British Currency Model, Fraction Models, etc., on which all ordinary calculations may also be performed.

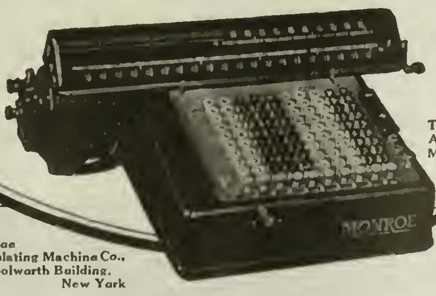
There are Offices rendering Monroe Service at all Principal Points in the U. S. and Canada and throughout the World.

MONROE

REG. TRADEMARK

Adds Subtracts

Multiplies Divides



The 20-Place Automatic Model

Monroe Calculating Machine Co., Woolworth Building, New York

"If you need a thing you pay for it — whether you buy it or not"

Without cost or obligation (check as desired):

[] Send further information on: [] Arrange for demonstration of:

[] Automatic Model [] Standard Model [] Fraction Models [] British Currency Model

Firm Name ______________ *Individual* ______________

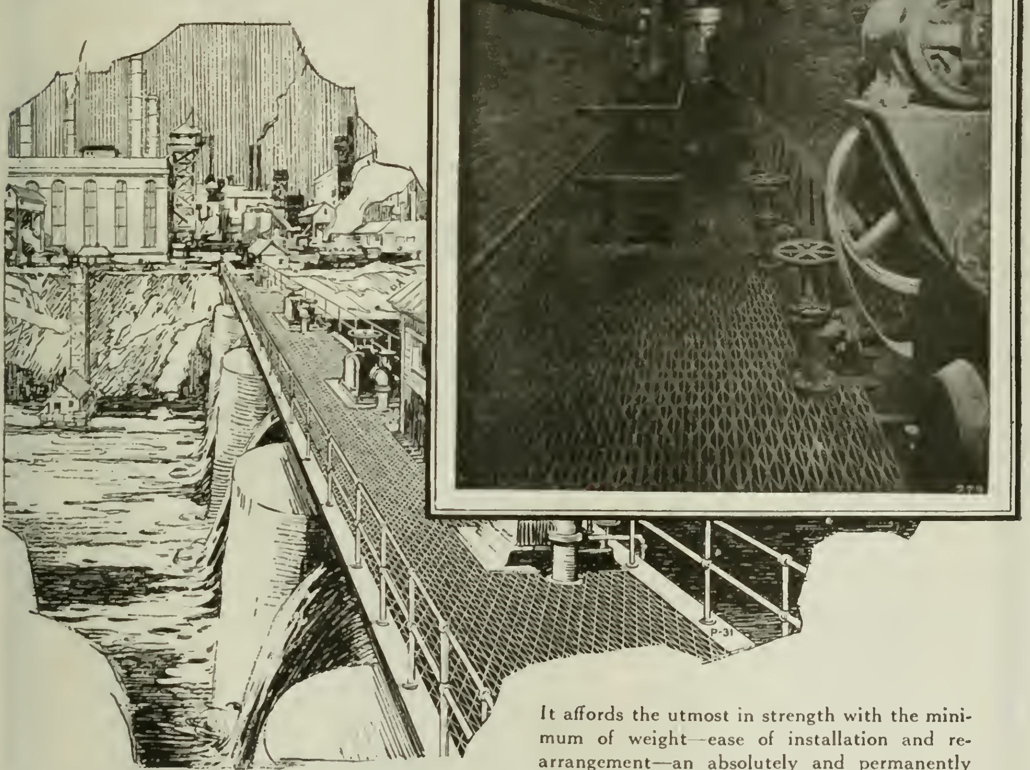
Address ______________ *City* ______________ *State* ______________

E. N.-R. 12-27-23

IRVING SUBWAY
TRADE MARK
(PATENTED) REG. U.S. PAT. OFF.

THE FIREPROOF VENTILATING FLOORING

Light, air, comfort, cleanliness, safety—all are assured in this runway back of the boiler battery, by its floor of Irving Subway.



In dark, cramped places or out in the open—for narrow runways and walkways or for wide spaces—for indoor service or outdoor exposures—for every industrial purpose where safety, durability and economy count—Irving Subway offers advantages no other flooring affords.

It affords the utmost in strength with the minimum of weight—ease of installation and rearrangement—an absolutely and permanently safe, non-slipping surface—a smooth, comfortable footing to walk or work or wheel upon—the time-proofness, wear-proofness of steel—and (biggest factor of all, in value) the experience and responsibility of the oldest and largest manufacturers of open metallic flooring. Write for Catalog 4A5 and specify Irving Subway.

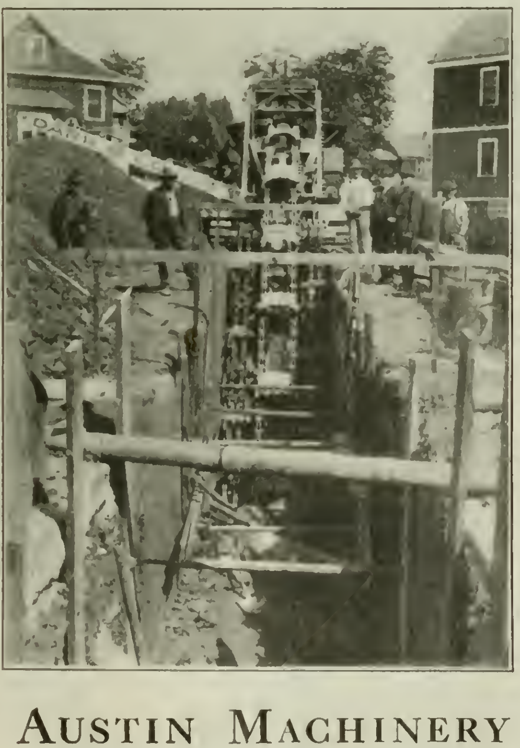
IRVING IRON WORKS CO.
LONG ISLAND CITY, N.Y., U.S.A.

AUSTIN MACHINERY

"MOVES THE EARTH—MIXES THE CONCRETE"

TRADE MARK

Economies in Trench Excavation are effected by the Equipment you employ



Efficiency comes from Experience. And experience is not gained on the drafting board but on the job under actual working conditions.

Every Austin Trench Excavator has back of it forty years of "On-the-Job" experience.

Economies are effected through the use of larger power units, safety features that avoid breakdowns, heavy construction, patented devices and ability to dig anything that is classed as earth excavation.

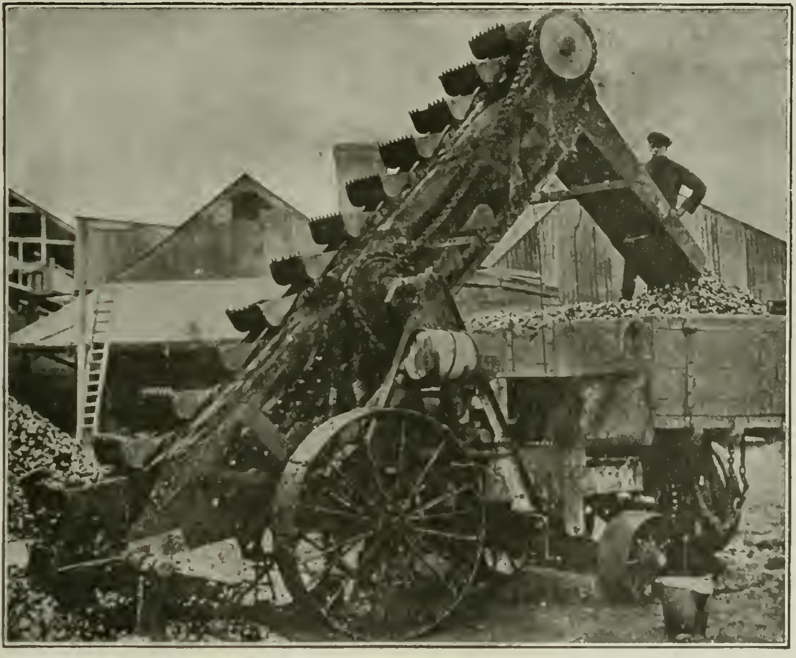
This is AUSTIN TRENCH DIGGING efficiency summed up and the guarantee of economy on every job.

Austin Machinery Corporation

MAIN OFFICES
3500 DORR STREET, TOLEDO, OHIO

On Some Jobs

The "Wheel" Machine's The Thing



Cross-country road building needs the "Creeper Type" Path Digging Loader—but city work or material yard handling is just as well done with the "Wheel Type" Machine.

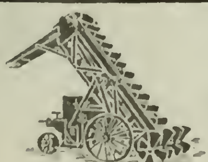
Has the wonderfully efficient Haiss Self-Feeding Propellers and a slow-speed drive of 30 inches a minute to crowd it against the pile. Self-propelling, of course.

Digs and loads 1 cu. yard per minute (and better) in crushed rock or other material—and does all the work with a labor cost of one operator only.

"The man who owns one" buys a second out of the first one's savings. Repeat orders on Haiss Loaders are a matter of course.

Catalog 523 describes
both Creeper and Wheel Machines
Send for a Copy

The Geo. Haiss Manufacturing Co., Inc., 140th St. and Rider Ave., New York

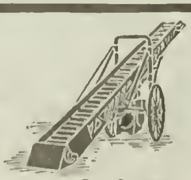


TRUCK LOADERS

HAISS

MATERIALS HANDLING EQUIPMENT

CLAM SHELL BUCKETS

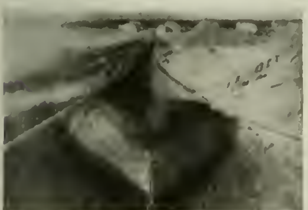


PORTABLE BELT CONVEYORS


Scraper in County Gravel Pit


Scraper and Travelling Tower


Scraper at Concrete Block Plant


Scraper on Cut-and-Fill Job


How Scraper Handles Stripping

The Brief Statement Below Gives You the Main Facts You Wish To Know Regarding

SAUERMAN Power Drag SCRAPERS

In excavating bank deposits of gravel, stripping overburden, making cuts and fills, cleaning out reservoirs, storing and reclaiming crushed stone, gravel or coal, Sauerman Power Drag Scrapers are money-savers because they possess large capacity, yet require no great outlay to install, operate and maintain. They show greatest economy in handling materials distances of 200 to 400 feet.

Description — There are three distinct types of Sauerman power scrapers. "Excavator," "LeClair" and "Crescent," each best suited to a particular class of work. All are bottomless, hence self-loading and self-dumping. The operation consists simply of dragging the scraper back and forth over the deposit or pile that is to be excavated or rehandled. When the scraper reaches the dumping point, the operator causes it to deposit its load automatically by putting the pull-back cable in operation; one man at the levers of a double drum hoist controlling the complete operation.

Sizes — Standard sizes of Sauerman Power Scrapers are from 1/3 to 5 cu.yd. Larger sizes can be built to order as specified.

A portable power scraper outfit, designed for light excavating and material-handling, is offered in two sizes, ¼ and ½ cu.yd., with operating spans of 200 ft.

Service—If the illustrations here do not give you sufficient evidence of the adaptability of Sauerman equipment for your conditions and requirements, submit your problem to Sauerman engineers. Their experience, gained through contact with over 1,000 installations of Sauerman cableways and power scrapers, is freely at your service.

Tell us what you want to accomplish, daily yardage you require and the surrounding conditions and we will suggest the type of equipment and general layout that will give you the desired result at lowest cost.

Sauerman Bros.
432 S. Clinton St., Chicago


Scraper Used With Crane

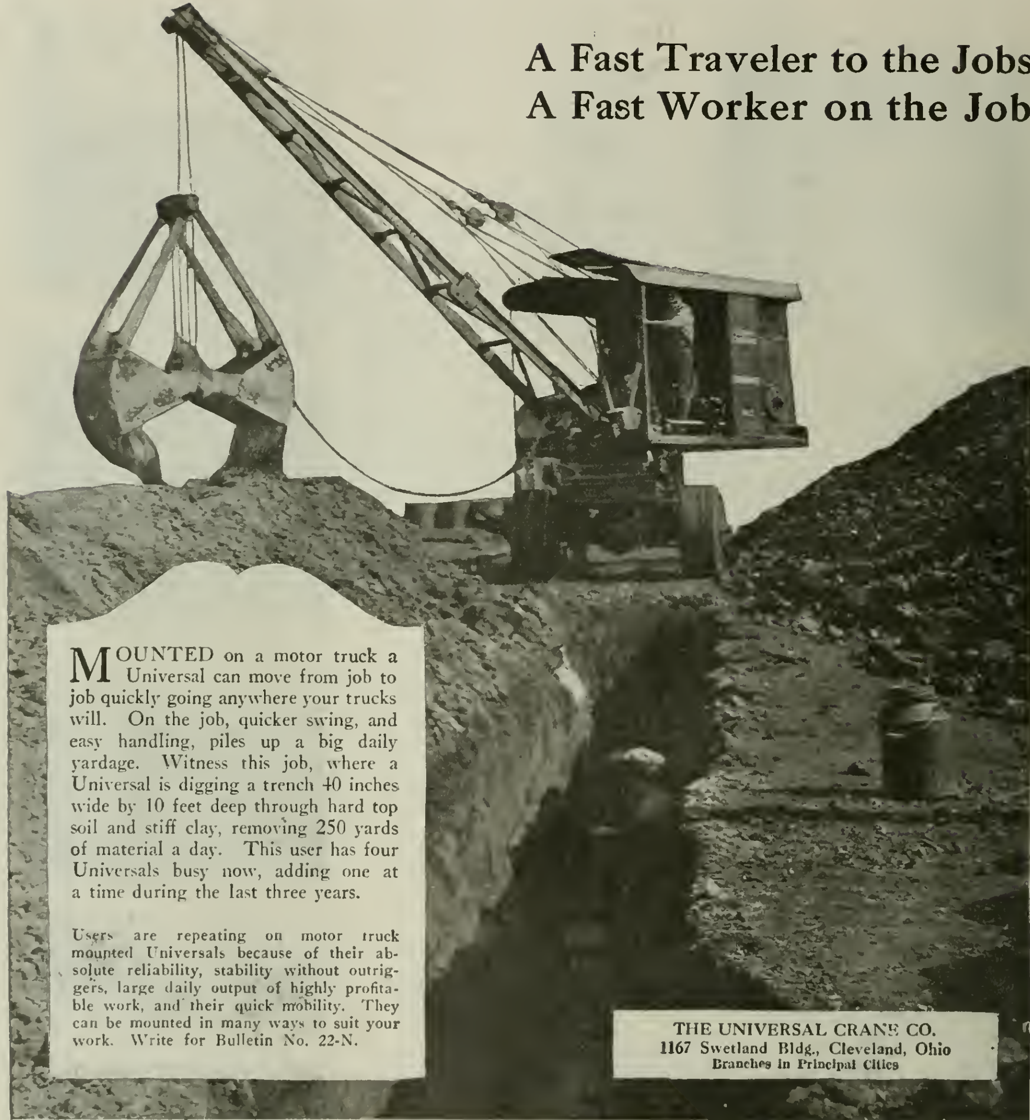

Scraper Cutting Through Hill


Grading Road With Scraper


Scraper Loading Stone Into Car


Loading Direct to Truck With Scraper

A Fast Traveler to the Jobs
A Fast Worker on the Job



MOUNTED on a motor truck a Universal can move from job to job quickly going anywhere your trucks will. On the job, quicker swing, and easy handling, piles up a big daily yardage. Witness this job, where a Universal is digging a trench 40 inches wide by 10 feet deep through hard top soil and stiff clay, removing 250 yards of material a day. This user has four Universals busy now, adding one at a time during the last three years.

Users are repeating on motor truck mounted Universals because of their absolute reliability, stability without outriggers, large daily output of highly profitable work, and their quick mobility. They can be mounted in many ways to suit your work. Write for Bulletin No. 22-N.

THE UNIVERSAL CRANE CO.
1167 Swetland Bldg., Cleveland, Ohio
Branches in Principal Cities

Every Batcherplant

a saver of TIME, LABOR AND MONEY

Some Users of

BLAW-KNOX Batcherplant

For Building and General Construction

Sanderson & Porter, New York City
West Penn Power Co Works at Springdale, Pa

American Construction & Securities Co Carrick, Pa
South Pittsburgh Water Co
Walls, Reservoirs, etc, for Water Works

Youngstown Sheet & Tube Co, Youngstown, Ohio
Concrete Trestle, Industrial Construction

Phoenix Utility Co, Alexander, Idaho
Dam Construction

John A Byers, New Castle, Pa
Railroad Overhead Crossing
Pennsylvania R R and B & O

The Tennessee Electric Power Co, Rock Island, Tenn
Power Development

S W Shoemaker & Sons, Harrisburg, Pa
Reinforced Concrete Bridge Job

Skinner Maxwell Bldg Co, Inc, Tuscaloosa, Ala
Building Construction

Boyajohn & Barr, Columbus, Ohio
Reinforced Concrete Buildings for Ohio State University

Metropolitan Edison Co, Philadelphia, Pa
Power House Construction

West Bros & Co, Pittsburgh, Pa
Juniata Railroad Shops for Pennsylvania R R, Johnstown, Pa

H J Spieker Co, Toledo, Ohio
DeVilbiss Building Construction

Heller Bros, Youngstown, Ohio
Reinforced Concrete Factory Building, Warren, Ohio

Everett Winters Co, Detroit, Mich
Building Work

C J Wacker Const Co, Indianapolis, Ind
Reinforced Concrete Building Job

Youngstown Steel Co, Youngstown, Ohio
New Industrial Construction, Foundations, Walls, etc

The Cranford Co, Washington, D C
George Washington Memorial, Alexandria, Va

G A & F M Wegman, Spring Valley, Pa
Reinforced Concrete Bridge Construction

T H Reynolds & Co, New York City
New York Subway Construction

Building contractors all over the country are eliminating from 5 to 15 men at their central mixing and distributing plant

—through the use of a time and labor saving ONE-MAN Blaw-Knox Batcherplant for the quick and accurate measurement of sand, stone and cement.

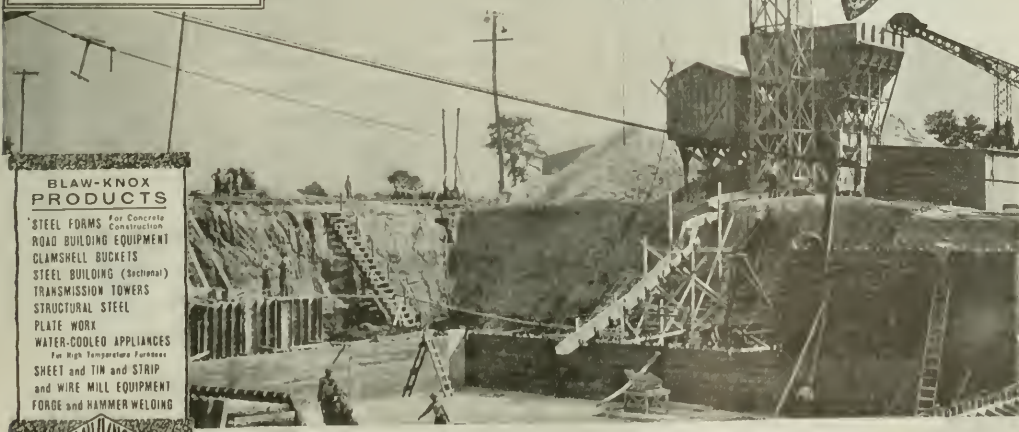
A Blow-Knox Batcherplant—as the nucleus for a central mixing and distributing system—is the height of economy. We can equip any job, and help plan the layout.

BLAW-KNOX COMPANY

601 Farmer's Bank Bldg., Pittsburgh, Pa.

NEW YORK 30 E 42nd St. — BALTIMORE Bayard & Warner Sts. — BIRMINGHAM American Trust Bldg
CHICAGO Peoples' Gas Bldg. — DETROIT Lincoln Bldg. — BUFFALO Genesee Bldg.
LONDON, ENG. Caxton House

FAST-EXACT proportioning of concrete aggregates

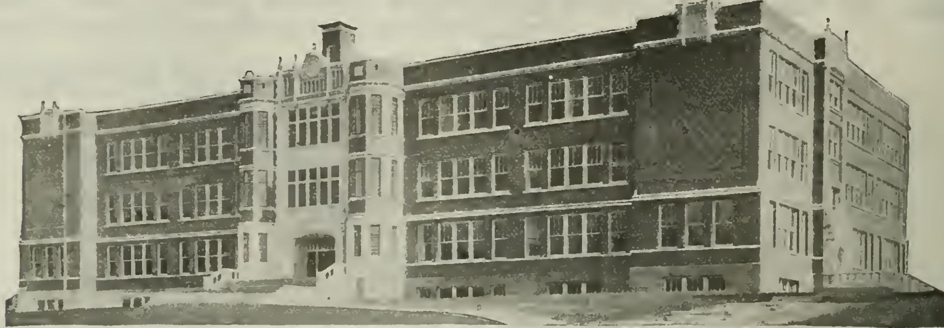


BLAW-KNOX PRODUCTS

- STEEL FORMS For Concrete Construction
- ROAD BUILDING EQUIPMENT
- CLAMSHELL BUCKETS
- STEEL BUILDING (Sectional)
- TRANSMISSION TOWERS
- STRUCTURAL STEEL
- PLATE WORK
- WATER-COOLED APPLIANCES For High Temperature Furnaces
- SHEET and TIN and STRIP and WIRE MILL EQUIPMENT
- FORGE and HAMMER WELDING

BLAW-KNOX

Batcherplant as nucleus for central mixing and distributing system—Metropolitan-Edison Co., Middletown, Pa. power plant.



Carney was specified for the McKinley Junior High School at Cedar Rapids, Iowa, as it is for hundreds of buildings throughout the country because it builds a better wall.

Architects: Rush & Zalesky, Cedar Rapids, Iowa.
Contractors: Theo. Stark & Co., Cedar Rapids, Iowa.

Carney Sales Increase Each Month

THE merits of Carney have brought it into general use. Hundreds of Contractors know from practical experience that it saves time, money, and worry. Carney sales are increasing by leaps and bounds, due entirely to its good and saving qualities. Carney always builds a better wall at final lower cost. That is why we are building new mills.

Carney Has These Exclusive Merits

It can be used immediately after mixing or left in the box over night. There is no waste to Carney. Five bags to a barrel. Four and seventy-five hundreths cubic feet to a barrel. Four parts sand carrying capacity. It requires no lime, which saves time and labor in mixing. It prevents loss and waste through carelessness. Being more plastic and smoother working, the mason can work faster and easier on the wall. It lays the maximum number of brick to the barrel. It is ideal for wall bearing buildings. It becomes harder than the brick and tile it binds, continuing to harden indefinitely as time goes on. It sets a creamy white, contrasting beautifully with brick and tile. The final cost of a Carney wall is always lower. Contractors bid lower, do better work, and make more profit with Carney.

This book tells the complete story of Carney. It will be sent free to anyone interested in building.

The Carney Company
Cement Makers Since 1883
Mankato, Minn.

District Sales Offices:
Leader-News Bldg., Cleveland; Chamber of Commerce Bldg., Chicago; Omaha National Bank Bldg., Omaha; Syndicate Trust Bldg., St. Louis; Book Bldg., Detroit; Builders' Exchange, Minneapolis.

CARNEY
for Brick and Tile Mortar

Specifications: 1 part Carney to 4 parts sand.
(due to refined process of manufacture.)

Insley Equipment for Handling Concrete

Marshall & Fox used INSLEY STEEL TOWER EQUIPMENT on the Drake Hotel job in Chicago, and now, on the addition to the Edgewater Beach Hotel are using the plant shown above. It consists of a 160 ft. Quick Shift Steel Tower, continuous line Insley Chutes, and an Insley Counterweight Chute which distributes the concrete.

Marshall & Fox are one of the many high class builders throughout the country for whom Insley Concrete Handling Equipment means complete satisfaction, as is best evidenced by the fact that they have used it not once, but several times.

INSLEY MANUFACTURING CO.

Engineers and Manufacturers

INDIANAPOLIS

INSLEY

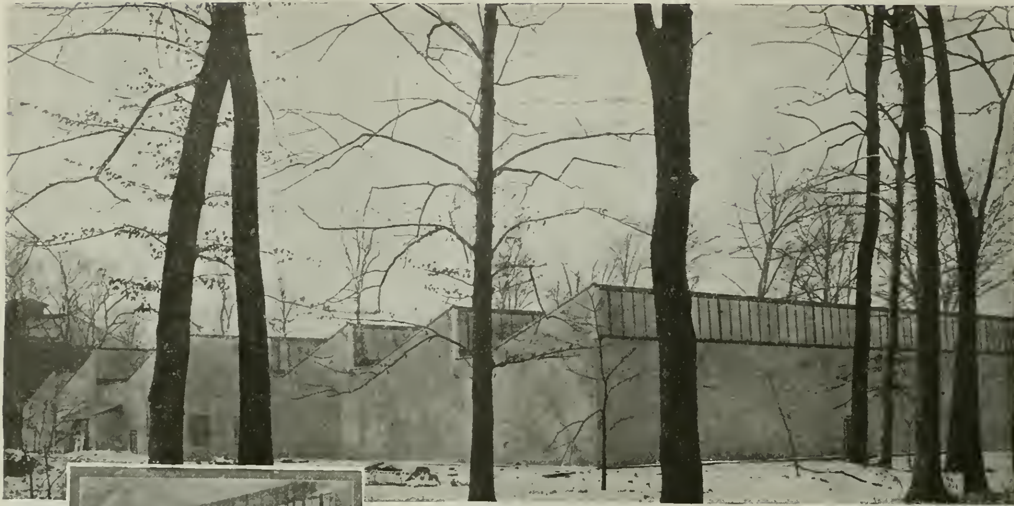
CONCRETE PLACING EQUIPMENT

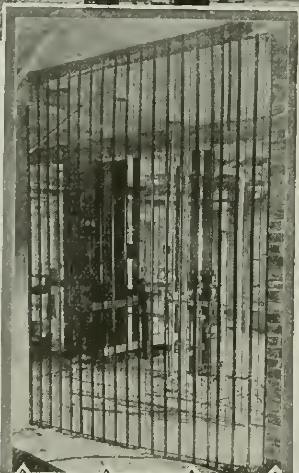
INDUSTRIAL CARS

STEEL DERRICKS

DUMP BUCKETS

321





Chemical Laboratory Building Ohio State University, Columbus, Ohio. Architect, Prof. J. N. Bradford. Contractors, D. W. McGrath & Sons. 35,000 sq. ft. Berloy ¾-in. Ribplex used in the 2-in. solid walls and partitions.

Two-Inch Walls and Partitions

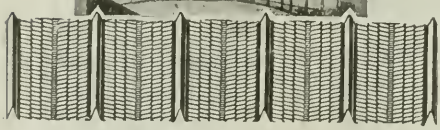
To the adaptability of reinforced concrete there is no end. Proper distribution of steel is one of the biggest factors in its success and for many forms of concrete work. Berloy ¾-inch Ribplex has proven to be a very effective type of reinforcement.

Walls and partitions two inches thick with the ribs of the ¾-inch Ribplex placed vertically were used to excellent advantage in the building shown above.

The same type of construction has been used in many other buildings in walls, partitions, floors, roofs, and in a wide variety of special concrete work such as bath houses, ornamental fences, drying ovens, hand-ball courts and, in fact, wherever a light, strong concrete slab is desirable.

Another very effective basis for two inch solid walls and partitions is the use of ⅜-inch Ribplex with ribs horizontal wired to Berloy cold rolled channel supports.

May we tell you more about this type of construction and its use? Please address Dept. F-24.



¾-Inch Ribplex

This is a stiff, expanded metal mesh with ¾-inch ribs, spaced 4.8 inches on centers. Covering width of sheets is 24 inches, the ribs nesting together at sides and ends to make a firm, even splice.

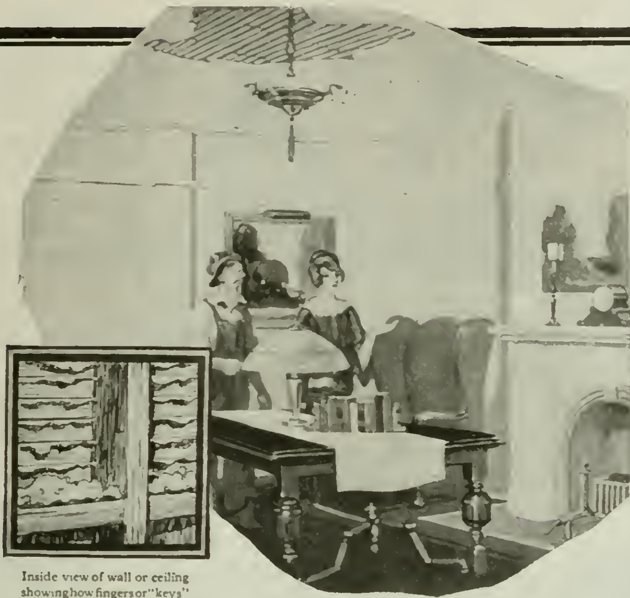
¾-inch Ribplex has been used extensively as centering and reinforcement for concrete floors and roofs as well as for walls, partitions and many forms of special work. Other Berloy Products include ⅜ inch Ribplex, Diamond Mesh Lath, Metal Lumber and Floor Cores.

The Berger Manufacturing Co.

Canton, O., Boston, New York, Philadelphia, Chicago, St. Louis, Kansas City, Minneapolis, San Francisco, Los Angeles, Dallas, Roanoke, Jacksonville.

BERLOY

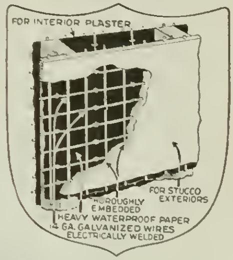
DIAMOND MESH LATH AND RIBPLEX



Inside view of wall or ceiling showing how fingers or "keys" hold plaster to wood lath.

NATIONAL

Stucco-Plaster Reinforcement



A combination plaster and stucco base and *reinforcement* which makes those materials permanent and enduring.

Why does PLASTER *crack?*

Plaster and stucco crack, and sometimes fall off, because expansion and contraction of lath causes the fingers or "keys" which hold it in place, to break off.

National Stucco-Plaster Reinforcement eliminates "keys".

This combination of base and *reinforcement* becomes an integral part of and thoroughly embedded in, plaster and stucco, and thereby prevents cracking and falling.

It provides very much stronger stucco and plaster than any other type of lath or base. It automatically "back-plasters" itself. It is fire-safe and sound-deadening. It eliminates dust streaks, lath marks, and rust marks.

It is applied either direct to studs and joists, or over sheathing or insulation It cannot be "skinned", yet takes less material because it eliminates "keys".

In all your work, use National Stucco-Plaster Reinforcement in place of lath, because it saves time, labor, and material, yet assures stronger plaster and stucco.

Our new catalog explains and proves *how* and *why* it is best to build with *reinforced* concrete, plaster, and stucco. Write for a copy—it is free.

National Steel Fabric Company

(Subsidiary of Pittsburgh Steel Company)

700 Union Trust Bldg., Pittsburgh, Pa.

OFFICES: Atlanta, Chicago, Cleveland, Denver, Detroit, Houston, Los Angeles, New York City, Philadelphia, Pittsburgh, St. Louis, San Antonio, San Francisco.
STOCKS: Chicago, Houston, Los Angeles, New York, Pittsburgh.

General Motors Building, Detroit, Mich.

Largest office building in the world.

Albert Kahn, Architect.

Floors temperature—reinforced with more than 2,000,000 square feet of National Steel Fabric.

There is a Style of National Steel Fabric for every type of concrete work.

Write for our "Building" Catalog.

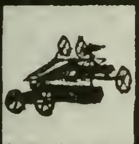
World's Largest Manufacturers of Welded Steel Fabric

NATIONAL STEEL FABRIC CO
Subsidiary of PITTSBURGH STEEL CO
UNION TRUST BUILDING PITTSBURGH, U.S.A

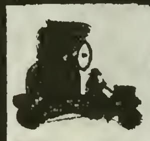
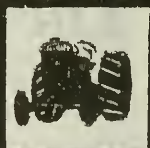

SPENCER
WHITE & PRENTIS
FOUNDATIONS
Book-Cadillac Hotel, Detroit, Michigan
Tallest Hotel in the World
Lynch Construction Co., Constructor
Louis Kamper, Architect
Foundation consists of 80 caissons, 130 feet
below curb, now being installed

NEW FEATURES IN CONSTRUCTION AND DESIGN

Ford
Fordson




1924

Make no mistake! The passing of another year has been marked by enormous changes in the value of methods and tools!

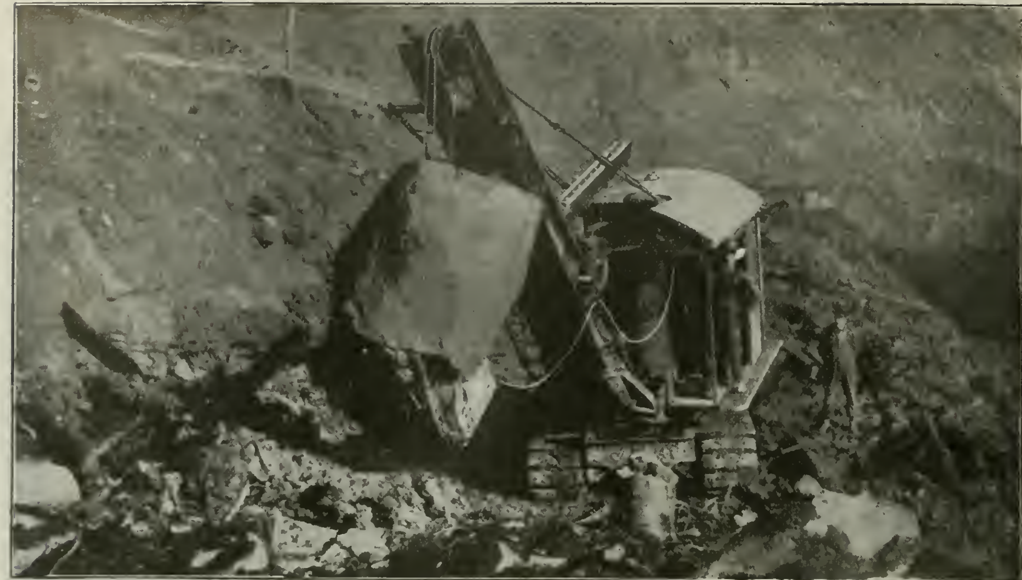
A visit to the FORD POWER EQUIPMENT EXPOSITION will keep you posted on the vitally important savings effected in adapting efficient, low-cost FORD POWER to industrial and commercial use.

Here are gathered exhibits by more than 78 leading manufacturers of industrial, commercial and agricultural equipment using the Fordson Tractor and Ford One-Ton Truck as power plants.

Proven money savers displayed side by side on a "brass tack" basis.

Men who know your needs—to give cold facts and figures—to show you why, when and where! Keep posted! Write now for a detailed list of exhibits and information on the application of FORD POWER in the solving of *your* problems'

FORD POWER EQUIPMENT
EXPOSITION
In the Ford Building, 54th St. & Broadway, N.Y.



There Will Be Other Jobs

You expect to work your shovel on future jobs too. Some of them will be tough work. You will need the best shovel you can get.

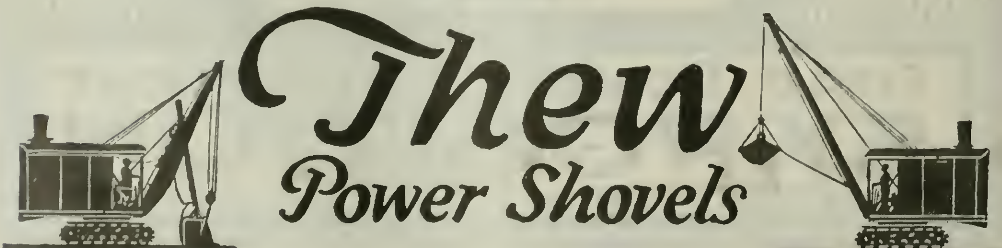
You can see records of all makes of shovels on all kinds of jobs. Some people get the idea that it doesn't make much difference what make of shovel they buy. They sometimes find out that in a few years it means the difference between a good dependable shovel and a wreck.

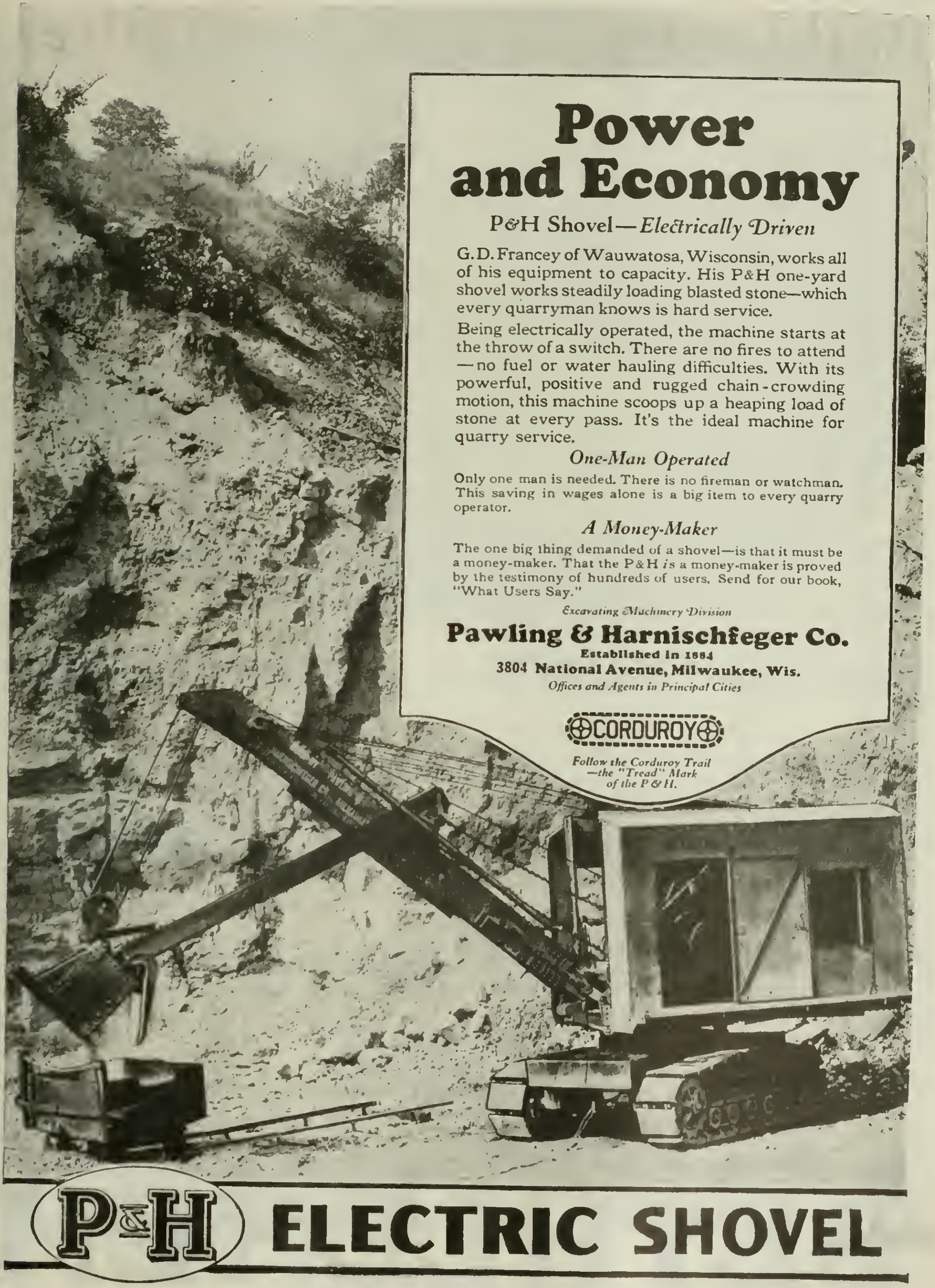
So don't take a chance. Don't buy for one job or one season. They all work fine when they are new but when you hear of a shovel ten years old and still doing six days a week, it is a Thew.

And Thews are made better today than ever before. New improvements. More conveniences. Added refinements.

Write us before you buy.

THE THEW SHOVEL COMPANY, LORAIN, OHIO

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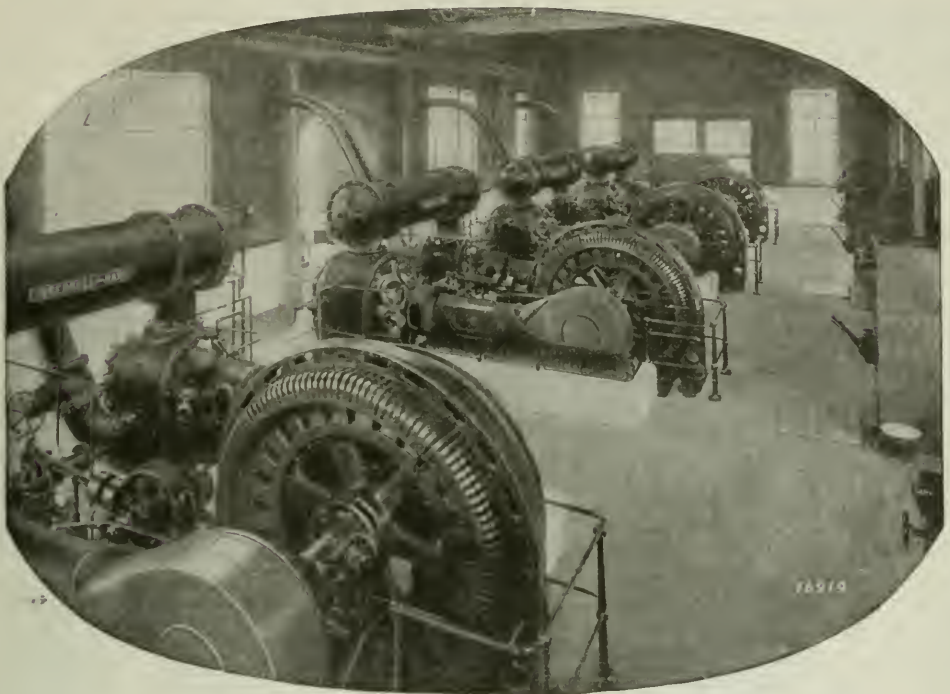

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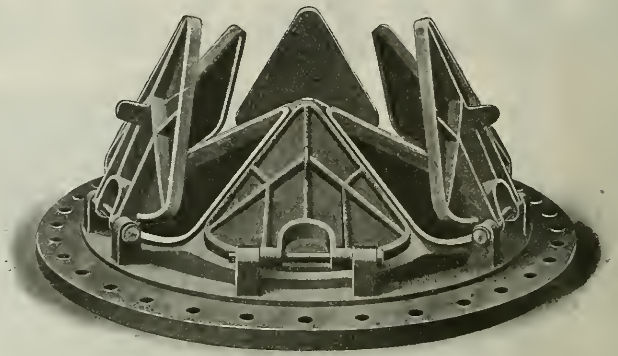
"One of the famous Coffin Products"

Coffin Foot Valve with strainer



Coffin Foot Valve with Shell removed. Note solidity.

SELF-SUPPORTING Foot Valves.

Note how the flaps are supported by their own HINGES—not by the water column.

They do not check the water flow.

The aggregate opening is 15% in excess of the pipe area!

All standard sizes with or without strainers.

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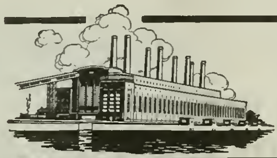

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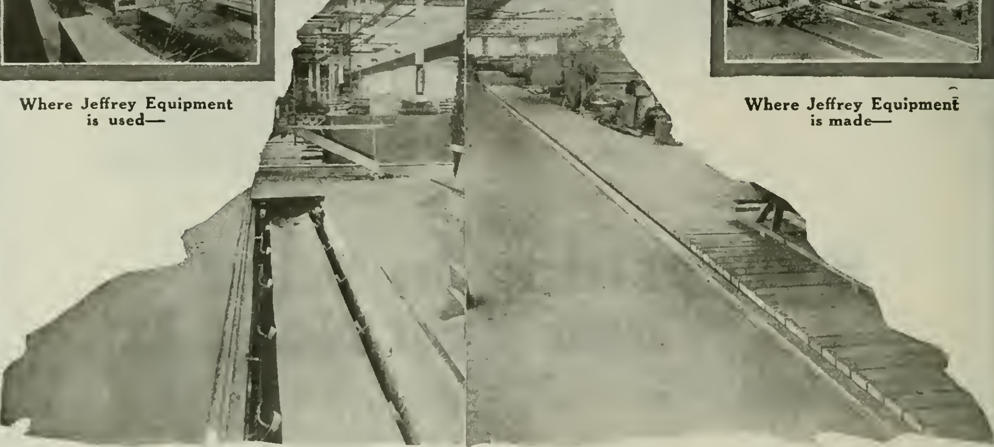
Jeffrey Material-Handling Equipment as used by the Fisher Body Corp'n

Wood Apron and Rubber Belt Conveyors

Where Jeffrey Equipment is used—

Where Jeffrey Equipment is made—



AT the Pontiac plant of the Fisher Body Corporation, the Jeffrey Belt Conveyor shown in the left hand illustration saves labor by handling waste wood or wood scraps from woodworking machines to storage.

This conveyor is 320 feet long, measuring 155 feet between centers; and travels at the rate of 100 feet per minute. It uses 24-inch four-ply canvas belting,—with 24-inch five-pulley troughing carriers mounted on wood base boards, and 24-inch standard flat belt carriers serving as return idlers.

The Jeffrey Conveyor shown at the right is part of a Jeffrey Wood Apron Conveyor System comprised of three units, employed to handle boards or finished wood shapes at the Pontiac plant.

One unit, 400 feet between centers, uses 1615 feet of Jeffrey No. 126 Malleable Roller Chain. Another unit 130 feet at centers, utilizes 530 feet of the Chain; and the third unit, which is 245 feet between centers, uses 990 feet of the Chain.

Dependable, continuous operation is expected of these Jeffrey Conveyor systems — and is given.

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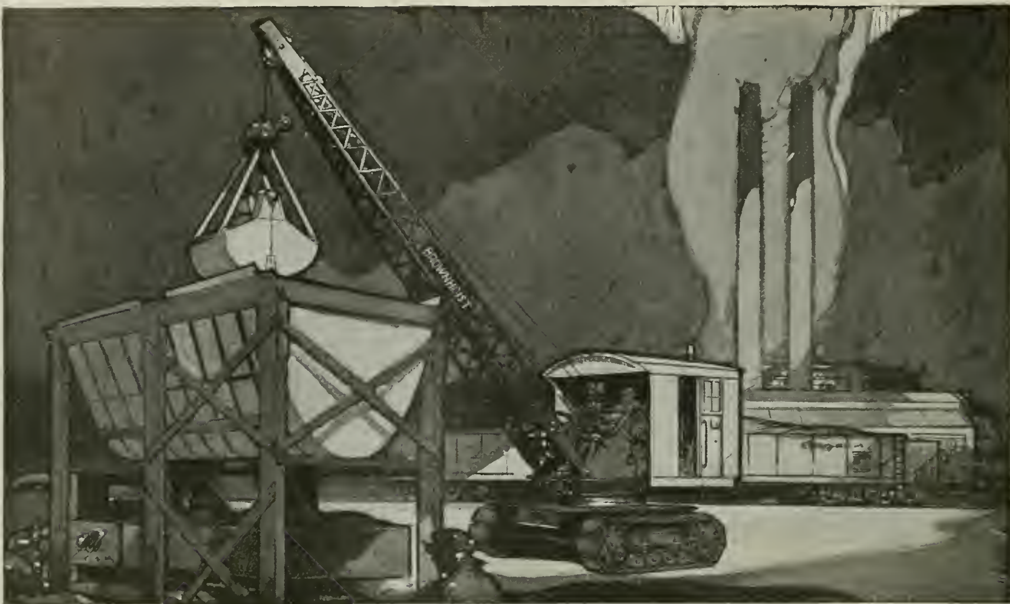
JEFFREY
MATERIAL HANDLING EQUIPMENT



No. 2 Brownhoist creeper truck crane equipped with 40 foot boom and Brownhoist one yard clamshell bucket

This Small Crane Will Cut Road Building Costs

Small in size and low in cost, this No. 2 Brownhoist Locomotive Crane has a remarkable handling capacity. It handles a one yard Brownhoist clamshell bucket easily and rapidly. The forty foot boom provides a wide handling radius and increased clearance for loading into bins.

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These different types are built so as to provide the most economical crane for the individual requirements of each user. We'll be glad to help you choose the one best fitted for your job.

Literature and complete data on request

Road Show

A moving picture showing approved methods of building roads in several states and also a No. 2 Brownhoist 8-wheel crane will be shown at the Road Show.

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1041

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

Volume 91 NEW YORK, DECEMBER 27, 1923 Number 26

Winter Building Facts

WINTER building possibilities assume an increasingly favorable aspect as records of fact are substituted for current opinion. Discussing, recently, steel-skeleton building construction before the New York Building Congress, J. Reid Kilpatrick, Vice-President, Geo. A. Fuller Co., announced that careful statistics covering the firm's operations from 1912 to 1922, a period of ten years, show that the average number of days a year when a winter building program "would be rendered impossible due to temperature conditions" is fourteen. Any increased hazard, because of ice and snow, of winter steel-building construction was not indicated by the firm's records. Nor was it indicated that there was any difference in cost between work begun in winter and that begun in summer. Advocates of a twelve-months-a-year construction industry have always been hampered by lack of quantitative data on winter building conditions. These figures and those published three weeks ago, being developed by the New York Building Congress, serve in a small way to supply the deficiency of facts. It would be a fine thing for the industry if other contractors' organizations would emulate the practice of the New York builders in amassing facts to strengthen the waste prevention arguments becoming somewhat dulled by repetition.

Railroads Using the Highways

AN INNOVATION in freight service put into effect on the Pennsylvania R.R. appears to be a reasonable start toward co-operation between rail and motor transport. On one of its busy lines the local business in less-than-carload lots of freight has been so reduced that the operation of way-freight in this special service is no longer profitable. Consequently the railroad company has abandoned the service and has made arrangements with a trucking organization to call at its stations for the small amount of package freight that is still offered to it for transportation. As a means of doing away with an unprofitable service, this arrangement is admirable. Advocates of store-door delivery may claim that the handlings of the packages should be reduced from four to two by having the trucking concern call for and deliver the packages rather than have the packages delivered to the railroad freight sheds before they are turned over to the truck for movement. Such an arrangement, however, would require the heavy truck used for the long distance moving to do a great deal of traveling in collecting and distributing the individual packages which can be, and now is done by light cars or carts which most concerns maintain for their local business. In addition, the new arrangement probably simplifies the bookkeeping in connection with payment for the shipping, as most concerns of any size have current freight accounts with the railroad company to which the cost of the smaller shipments can be added without the cost of individual collection or of a separate account, which would be necessary under the method of having the trucking company handle the shipment from origin to destination.

To Emphasize Progress in Concrete

IN 1904 the National Association of Cement Users was formed, in recognition of the need for some scientific study of the then infant concrete industry. Next year, in February and at Chicago, the society under its present name, the American Concrete Institute, will celebrate the twentieth anniversary of its founding. Twenty years is not a long time in history of most of the arts, but it comprises practically all of the maturity of the art of designing and making concrete. Because these twenty years have seen concrete rise from the position of foundation material to an almost universal medium of construction expression, the Institute is going to take advantage of the double decennial anniversary to emphasize the progress that has been made. One day of the meeting at Chicago, Feb. 27, is to be devoted to the story of concrete development. The committee which has the meeting in charge has outlined an excellent program with speakers who know the subject and with an exhibit in an adjoining room, both of which should be of exceptional interest. The regular meeting of the Institute will have its usual appeal to those who are concerned with concrete. The inspirational appeal of the one-day session of historic value in concrete should make the February meeting unusually attractive.

Too Big an Undertaking

THE Interstate Commerce Commission, in reversing its decision of last June in which it denied the Virginian Ry. the right to build a short branch line into a new coal field, has taken a step which would imply that it has seen the unwisdom of attempting to control production by determining which coal mines could or could not be opened. The unusual feature of that earlier decision was not that by declining to let the railway build tracks into the new mine the commission did indirectly prevent the opening of the mine, but that the commission specifically stated that in its opinion the mine should not be opened; giving as a further reason for its decision against the building of the spur the fact that the railway had been unable to supply sufficient cars for the mines already in existence along its lines. The far-reaching importance of such a decision is evident, for—lacking the powers of concentrating on coal suggested for it by the report of the Coal Commission—the Interstate Commerce Commission could not well undertake to regulate production in the coal industry unless it also were prepared to regulate production in other industries. It is well that it was able to seize upon the large increase which the

Virginian Ry. has made in its coal-handling facilities as a means of withdrawing from an awkward position in which it had placed itself by an ill considered attempt to improve the coal situation.

Flimsy Prophecies

PROPHECY was ever a precarious occupation, successful only so long as the prophet could preserve a Delphic impartiality or until some one took thought to check up the outcome of past prophecies. The numerous professional economists who have been earning a living for some time forecasting the trend of business have run up against the latter barrier. Someone in the Department of Commerce became curious enough a few weeks ago to compare the course of business with what a dozen or more forecasters said it was going to do. The results are not without humor. In an average of the prophecies of fourteen agencies, 40 per cent proved true and 60 per cent never occurred. The best record was made by a national bank which scored 85 per cent hits. The worst was the most celebrated—or notorious—of the prophets, whose forecasts are accompanied by charts of such astounding complication and color that we have always doubted whether the maker himself knew what they meant. He was right 15 per cent of the time! One ought to do better than that with a ouija board. Some day there may be enough statistical information available to enable one to outguess the future. But even then it will be merely outguessing and there will be so many ulterior and unpredictable influences at work that it will be subject to the failure always inherent in a guess. To claim that any prediction made on the limited information now available is more than an expression of judgment comes pretty close to soliciting money on false pretenses.

Restricting Business Information

GENERAL business forecasting is so doubtful because the subject is complicated and because, too, all calculations may be thrown out of joint by unexpected national and international actions. To take the most obvious example, no prophet in the spring of 1914 knew that an assassination soon to take place in an obscure Serbian town would throw into the discard all the carefully built up data of past economic performance on which might have been predicated the forecasts of the business situation in the coming summer. On the other hand forecasting of a single business is simpler, and while subject also to the major ebbs and flows of economic conditions is most dependent on existing conditions in the trade or business itself. For that reason statistics of his trade or business—authentic and prompt—are the most valuable aids a business man can have in judging how much to produce. Such figures do not forecast for him the demand for his goods; that is something he must learn from other sources, but they do give him a line on the total supply and make less possible the slumps and booms due to ignorance of supply conditions. It is unfortunate, therefore, that the consent decree formulated by the Department of Justice in the tile manufacturers' case apparently prohibits a trade from collecting such statistics and throws the whole onus of such collection on the government. Up to date the government has not been prepared to provide the machinery or the funds, both necessarily large, to carry on such work. The interpretation of the Sherman Act as to trade statistics is running to absurd lengths.

Federal Aid for Roads

ENGINEERS and contractors need to keep in mind that the Congress now in session has before it the task of continuing or, as may be considered, of changing, the federal-aid road law and also of providing appropriations, if federal aid is to be available beyond the present fiscal year. Acting officially in convention the Association of State Highway Officials has asked for an allotment to the states of $100,000,000 a year of federal aid for a period of three years from June 30, 1925. This amount is not too great for the states to absorb if they get about the task of building roads. Just now their delay, or, more accurately, the delay of some, in matching the federal-aid funds and placing work under contract is furnishing the best excuse that Congress will have that appropriations may be reduced and that the present law needs changing. There will be other influences to swing federal activity in road building to a separate system of national highways, to sectional highway systems or to some other object than is contemplated in the present federal aid law. Direction of Congress has to come from engineers and contractors. They are organized to furnish it. The general public, though wanting roads and aid in roadbuilding, may not be expected to take direct action. Contractors' associations and engineers' societies have the important duty this winter of seeing that our present efficient plan of organization for federal-aid road construction is not changed without real reason and that the present liberal appropriations for roadbuilding are continued.

Chances in Garbage Disposal

TWO narrow escapes from the fate so common to garbage disposal plants present themselves for record. The cities are Wheeling, W. Va., and Sacramento, Calif. At Wheeling, a Balmer incinerator, the first of the kind in this country, was put under contract early in 1923. About the time the plant was completed a local election substituted one faction of the dominant political part for another. Straightway began the attempt common under such changes to discredit what had been done by the previous administration. The new Balmer incinerator was beclouded for some weeks but although a test made under the new administration resulted in a report indicating that the plant was far below contract capacity the incinerator was finally accepted. Possibly the local authorities learned of the failure of new city administrations of San Francisco and Atlanta, some years ago, to throw new incinerators onto the hands of the contractors. Both cities were beaten. Atlanta recognized it and has used the furnaces since. San Francisco has tried to make victory of defeat by letting the new incinerator stand idle for many years, while continuing to use destructors of another British type, built in the nineties.

The experience at Sacramento was different in detail, although there also an incinerator came no one knows just how near to abandonment, soon after if not before completion. Just as the plant was nearly ready comes a "senator" of mystery with a proposal to enter into a contract for garbage collection and disposal. The city was priding itself on its collection system it had recently established, and on its new incinerator progressing towards completion and use. Apparently the "senator" had considerable support for his scheme, so concerned were some of the city officials lest it be adopted. Opposi-

tion and questioning led to a modified proposal. The plan was not without attractions, since on its face, an operating charge was to give place to revenue for the city. What seemed to be a joker appeared in the revised offer, in that the city was to stand ready to take whatever refuse the "senator" and his friends saw fit to turn over for disposal in the incinerator, evidently at the city's expense. While this would have put the furnace in use as a "standby" it would have been immediate partial abandonment, at the least.

Such are some of the garbage disposal chances being taken in considerable numbers all over the country by cities and contractors alike. They will continue until both see that it is for their interest to have garbage disposal put on a sound engineering basis.

Earthquake Construction

MUCH information is afforded by the views of Japanese earthquake damage printed in this issue. These views, supplied by a number of Japanese readers of *Engineering News-Record*, show the effects produced on civil engineering structures of different kinds, effects which range from the cracking of buildings to the shaking apart of earth masses and bridges. Broadly, the showing agrees with that of other earthquakes; but it is much more important, because of the greater variety of the effects as well as the greater violence of the earthquake. The effect on the railways, especially the culverts, fills, trestles and bridges, as shown in the views—only a few of which can be given for lack of space—is much more severe than most American engineers have realized.

In considering how all such effects may be guarded against by the designer and builder, it is well to bear in mind that earthquake action is dynamic, while the usual structural problem and the methods of analysis applied to it are exclusively static. The difference sets up a formidable difficulty, particularly because the structural engineer will hardly be willing to subordinate his static analysis, which deals with the important service needs, to a radically different kind of calculation, applicable perhaps only once in the lifetime of his structure. The ready way out of the difficulty is to convert the data of the dynamic action into static terms. This course has been followed by the Japanese students of the subject, and is reflected in the brief summary of design principles presented in this issue.

So long as the equivalent static analysis remains well within the range of experience and embodies a fair safety allowance, it should lead to satisfactory results. Accordingly we may consider the general case of buildings to be within reaching distance of solution. Extensive data are furnished by observations on city buildings of structural engineering type. Extending these data to dwelling houses and special types of building may require much careful study, but should be thoroughly feasible. Thus, we may hope to render building construction reasonably secure against earthquake ruin —at least in theory; in practice it may not be found economically desirable to incur the cost of providing this security.

Other structures are not in the same favorable condition, however. Chimneys, high bridges and earthwork constructions come in this category, and these all present special problems that do not appear to be amenable to an equivalent static analysis. The case of the chimney is the simplest of these, and it does not seem impracticable to apply dynamic analysis to this particular problem.

The problems encountered in bridges and earthworks, however, are decidedly more refractory. Such structures are affected in puzzling ways by violent earthquake motions, as some of the illustrations show. It appears that a great deal of further study of shaking forces and resistances will be required before this part of the earthquake problem can be considered on the way to solution.

Financing Subway Construction

FOLLOWING closely upon the report of the Detroit Transit Commission recommending that the cost of new rapid-transit facilities be paid for by assessing the major portion of the cost on the local property which the subway benefits comes an independent recommendation from property owners along Sixth Avenue in New York City that the Sixth Avenue elevated railway be replaced by a subway financed by the property owners along the line. The Sixth Avenue property owners believe that the increase in the value of their property due to the removal of the elevated structure would more than repay them for the increased assessment.

The theory of assessing the cost of subways on the benefited property is not a new one. It is written into the present Rapid Transit Act in New York, but this is the first time that it has been proposed as a means of financing a specific piece of new construction. Its advantage is just as clear in New York as in Detroit, for, as we said in commenting on the Detroit plan in the issue of Dec. 13, the city is so near its debt limit that it is not in a position to finance all the needed rapid transit, nor are the people anxious to have the interest on the city debt continually increasing. Under the bond-issue plan there is little possibility of the city undertaking the replacement of the elevated structure for years to come. What money it can spend will be spent on building aditional subways. Financing by assessment makes possible an otherwise impossible piece of construction.

It has still another advantage. The cost of construction is a direct charge upon the property of shrewd business men who can be depended upon to see that the money which they raise is not spent in the lavish way in which city money is usually spent, nor will they allow a large part of it to be absorbed in paying excessive prices for property rights or supposed damages to abutting property.

In the case of the Sixth Avenue elevated replacement there are many difficulties in the way of carrying out the proposition, but fortunately it is backed by a group of business men who realize that the removal of the noisy and unsightly elevated structure will make Sixth Avenue second only to Fifth Avenue as a business street. The stimulus which this realization has given their efforts is assurance that the project will be undertaken in the near future. Their efforts will be watched with interest by the advocates of more rapid-transit facilities in all our large cities. There is no reason why the same method cannot be applied wherever lack of city funds or disinclination to spend them for such purposes prevent construction.

Earthquake Characteristics and Building Resistance

A Summary of Basic Laws and Constants Deduced From Measurements of Earthquake Motions, and Checked by Observation of Damage Done by Recent Severe Earthquakes

By R. E. J. Summers
Assistant Chief Engineer, H. K. Ferguson Co., Cleveland

During the past year the writer made a study of questions bearing on earthquake resistance of buildings, in connection with the design of a new plant for the Shibaura Engineering Works of Tokyo, Japan, for which the H. K. Ferguson Co. was consulting engineer. No literature in English being available, reference was made entirely to works of Japanese investigators. The works of the Imperial Earthquake Investigation Committee during the past twenty-five years constitute a treatise on the subject. An abstract of what they indicate, when taken in conjunction with observations on actual earthquake effects, is given in the present article.

To explain the problem in hand, it should be said that the Shibaura Engineering Works, a Japanese-controlled organization affiliated with the General Electric Co. and manufacturing similar equipment, decided to build a new plant modeled on best American practice. Plans were to be made in their offices by their own staff, the writer acting as consulting engineer and supervising and checking the plans and specifications. The plant will cost 50,000,000 yen, or $25,000,000. The first of the three construction sections, drawings for which have been completed, includes a heavy machine shop, 304x850 ft.; a forge shop, 186x200 ft.; a pattern shop, 70x300 ft., two stories high; and a warehouse, 70x400 ft., three stories high; together with a central heating plant, sewage disposal plant, and minor items. The machine shop will be twice as large as any factory building in Japan, and will be of steel frame, with large high spans and heavy cranes. The two multistory buildings are of concrete flat-slab construction.

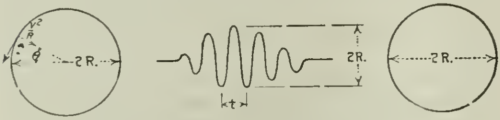


FIG. 1—SIMPLE HARMONIC MOTION IN EARTHQUAKE VIBRATIONS

Earthquake Period and Amplitude—An earthquake is a sort of simple harmonic motion (Fig. 1) similar to the projection of a circular motion on a straight line. If t is the time of travel of one circular motion, r the radius of the circular motion, v the speed of the circular motion, and a the acceleration toward the center of this circular motion, then

$$v = \frac{2\pi r}{t} \text{ and } max.\ a = \frac{v^2}{r} = r\left(\frac{2\pi}{t}\right)^2$$

Applying these terms to the earthquake movement, we have its acceleration, a, expressed in terms of its period t and its range of motion or double amplitude $2r$. Therefore, if from seismograph diagrams we read that with a period of 1 sec. the range of motion is 100 mm., then $a = 50\left(\frac{2\pi}{t}\right)^2 = 2{,}000$ mm./sec.^{2}

Should unsatisfactory seismograph records be secured, the horizontal acceleration of the earth motion can be calculated from observing overturned objects, such as pedestals, tombstones, etc., by using the formula $a = xg/y$, in which g is the acceleration due to gravity, y the height of the center of gravity, and x the horizontal distance between the c.g. and the edge about which the body is overturned.

The force exerted by an earthquake on any structure can be expressed in terms of the weight of the structure, W, by the basic formula $F = Wa/g$. The coefficient a/g is called the *seismic coefficient*, denoted by K; the earthquake force F equals the dead weight multiplied by this coefficient. For example, if $a =$ 2,000 mm./sec.^{2}, then $K = \frac{2{,}000}{9{,}800} = \frac{1}{5}$, so that the total force due to the earthquake $= \frac{1}{5} W$, or $\frac{1}{5}$ of the dead weight of the structure.

Seismic Coefficients—Before the last quake, the Tokyo Weather Bureau had established the maximum seismic coefficient to be used in design at $\frac{1}{10}$, which is that caused by an earthquake with an acceleration of 1,000 mm./sec.^{2} This is the recorded size of the great quake in Tokyo of June 20, 1894. The great quake at Nagoya on Oct. 28, 1891, however, had:

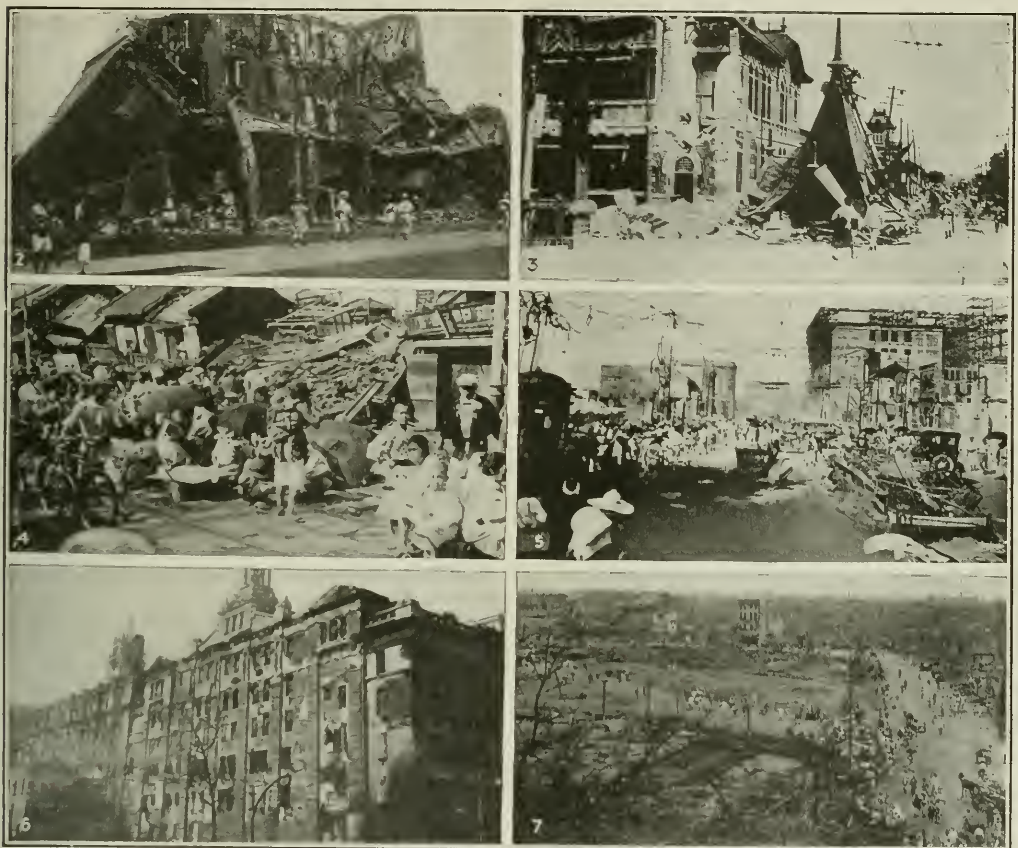
$$a = 2{,}600, \text{ or } K = \tfrac{1}{3}.$$

With these varying seismic coefficients, the designing engineer should consider the probable life of the structure on which he is working, the cost of it, and the cost of increasing his coefficient. Earthquakes in Japan occur apparently in cycles, with a great one every 60 years, like the one of Sept. 1, 1923, which was almost on schedule. With this in view it would seem probable that the use of $K = \frac{1}{3}$ would give ample protection for buildings now being built.

In a one-story building the force $F = KW$ is applied horizontally at the top of the sidewall, and stresses caused thereby are figured the same as for wind stresses. In a multistory building the lateral force is considered transferred by each floor and roof slab, and the stresses are calculated the same as for wind stresses.

It has been observed that an earthquake never occurs while the wind is blowing, but always in a dead calm. This was especially evident from reports of the latest quake, when the high wind prevalent in the morning quieted to a dead calm with oppressive heat just before the quake. Because of this it is not necessary to add the wind and earthquake stresses in securing the maximum stress.

Japanese Construction—From these considerations, it is evident that the lighter the building, especially in the upper parts, the less it will be affected by a quake. The typical Japanese building is exactly the reverse of this, and therefore is easily shaken down. They use a light, flimsy wooden structure, with a very heavy tile roof. The columns, joists and beams are mortised



FIGS. 2 TO 7—SIX VIEWS OF DAMAGE DONE IN TOKYO BY THE EARTHQUAKE OF SEPT. 1, 1923

Fig. 2—Maruzen Book Store, principal damage in upper part.
Fig. 3—Office of Andogumi; heavy tower thrown into street.
Fig. 4—Destruction of tile-roofed houses in Dozaka (street).
Fig. 5—Uninjured modern buildings; Ginza Building under construction.
Fig. 6—Stucco cracked off Mitsukoshi department store building.
Fig. 7—Asakusa ward; effects of fire after the earthquake.

together so that a column is so cut to pieces that one expects to see it break in two when being lifted into place.

As the streets are very narrow, the safest place to stand during a quake is under a lintel. Here one is protected from tile sliding off the roof, or from the roof collapsing inside. In a multistory office building the safest place is the center of the room, as the partitions are most likely to be thrown down, and the center of the room is equidistant from all walls.

Where Cracking Occurs—Every structure has a natural period of oscillation dependent on its shape, size and homogeneity. If this period of oscillation is longer than the period of the destructive earthquake motion, it can be classified as a tall column; if its period is shorter than that of the quake, it is a short column. The period of the destructive earthquake is 1.0 to 1.5 seconds. For a tall column, such as a brick chimney, the tendency to fracture will be at $\frac{2}{3}$ of the height above the ground; in a short column, the tendency to fracture will be at the base. The multistory office buildings recently built in Tokyo come under the latter category. In the usual building of this type, the first story is so massive and so integral with the foundations that it can be assumed as part of the foundations, so that fracture would tend to be in the second story.

This was first proven in the earthquake of April 26, 1921, when the Marunouchi Building, then under construction, had almost every pilaster in the second story cracked at an angle of 45 deg. Observation of the effect of the latest quake on the Palace Hotel, a building of same height, shows the steel column at the second floor offset 3 to 5 in. to the west and 5 to 10 in. to the north, and all of the second-story walls thrown down.

Overturning and Vertical Force—The stability of a building against earthquakes is proportional to its size and not its weight. If b and h are the breadth and height of the building, W its weight, and F the horizontal force tending to overturn, then the overturning moment is $\frac{1}{2}\ Fh$ and the stability moment is $\frac{1}{2}\ Wb$. Hence, when $Fh - Wb$ is greater than zero the building will overturn, and when it is less than zero the building will not overturn. Or, since $F = KW$, danger

or safety are indicated by K being greater or less than b/h.

Earthquake motion, though sometimes very violent, is continuous and does not consist of isolated jerks or shocks. The idea prevalent among laymen and some engineers that in destructive earthquakes buildings are first uplifted by the vertical motion, and then destroyed by being suddenly thrown downward is quite in error.

In ordinary cases the vertical component of the earthquake motion is much smaller than the horizontal. For instance, the severe Tokyo quake of 1894 registered a maximum horizontal motion of 73 mm., while the maximum vertical motion was only 11 mm. Therefore the damage was essentially due to the horizontal motion. This has been remarked in every quake recorded, so that we can assume that the vertical component is of secondary importance, and, except in cases of the foundation sinking, the entire damage is done by the horizontal motion.

The stability of a building is also affected less by the vertical motion than by the horizontal. This is shown as follows, using the same building and notation as above: If a' is the acceleration of vertical motion, then $\frac{W}{g}(g - a')$ is the effective weight when movement is down, and $\frac{W}{g}(g + a')$ is the effective weight when movement is up. The overturning moment due to horizontal motion $= \frac{Wa}{g}\frac{h}{2}$ or $\frac{1}{2}KWh$, while the minimum stability, when vertical motion is down, is $\frac{W}{g}(g - a')\frac{b}{2}$. Therefore $\frac{Wa}{g}\frac{h}{2}$ must exceed $\frac{W}{g}(g - a')\frac{b}{2}$ for danger from overturning, or danger is present when $\frac{a}{g - a'}$ exceeds $\frac{b}{h}$.

Orientation of Building—Due to the shape of the range of mountains on the main island of the Japanese Empire, the direction of earthquake motion at Tokyo is always east and west. In making the plant layout for the project in hand, it was possible to put the length of the buildings east and west, making the bracing a more simple problem. On the machine shop and forge shop the roof deck was made of 2-in. dressed and matched Oregon fir supported on steel purlins, in order to secure a light, rigid surface that cannot crack and fall, be shaken out of position or slide off. All monitors are provided with continuous top-hung standard rolled steel sash glazed with ¼-in. wire glass, being light and giving light, and the wire glass making for safety in case it should be cracked. This combination of light roof with heavy columns required for the cranes approaches the ideal as to relation of component parts of a building for best resistance to earthquakes.

Due to the excessive wind on the coast line at the building site, the structures were designed for a 30-lb. wind load. The Japanese code, by the way, allows no increase in allowable stress for combined wind and dead-load stresses. Using the usual designing seismic coefficient $\frac{1}{10}$, the total horizontal force proved to be less than one-third of the total pressure of the wind. These stresses not being coincident, the structure actually is proportioned for a seismic coefficient three times that assumed, or $K = \frac{1}{3}$, which is the same as that registered for the severe earthquake of 1891.

It is interesting to note that this checks the statement of the committee on buildings of the American Society of Civil Engineers which reported on the effects of the San Francisco earthquake of April 18, 1906 (*Trans.*, Vol. LIX, p. 208): "Sufficient evidence is at hand to warrant the statement that a building designed with a proper system of bracing to withstand wind at a pressure of 30 lb. per square foot will resist safely the stresses caused by a shock of an intensity equal to that of the recent earthquake."

Actual Earthquake Destruction—Generally the nonsynchronizing in horizontal motion of the walls and roof is doubtless the principal cause of the destruction of brick buildings. It has been noted that one-story brick buildings are most damaged at the junction of the walls and roof, and that the two-story ones similarly are damaged most at the junction of the upper walls and the roof while the lower walls remain uninjured or little affected. This is evidenced in Fig. 2, showing a three-story brick building located on the main street in Tokyo. Again, in Fig. 3 the top of the tower rests in upright position in the street, indicating that the heavy top failed to synchronize with the walls and, the range of motion being quite large, was projected bodily into the street.

In Fig. 4, note the usual Japanese style of building, with the heavy tile roof, flimsy walls, with windows of light frames covered with paper, and a typical failure from earthquake.

Fig. 5 is a view of the Ginza (the only paved street in Tokyo, and the main business street) taken from Owaricho, the main intersecting street. Note the burned street car in the foreground. The exposed steel frame on the right is the new Ginza Building, twelve stories high, just under construction, and apparently plumb and safe, with only the concrete hoist tower askew. Incidentally, this steel was erected and being riveted in December, 1922, when the writer arrived in Tokyo; with work apparently uninterrupted, riveting was still under way in August, 1923. The uninjured concrete and brick building on the near side of the Ginza Building is also new. The large building in the distance, apparently in the center of the street, is the office of the Yokohama Life Insurance Co., of heavy stone masonry construction, and is about opposite the building shown in Fig. 2. The small wrecked buildings shown were of poor flimsy construction, likely to fall down with small excuse.

Fig. 6 is a view of the Mitsukoshi Department Store, a very modern and popular store, the showplace of Tokyo. The structure is of reinforced concrete. Its exterior walls are heavily scored to hold the stucco. In pouring concrete, the Japanese use soft unplaned wood forms and take no care in rodding and tamping the wet concrete. When forms are stripped, the surface of the concrete is full of voids, very rough, uneven, and covered with small splinters. Over this is placed a ⅜-in. cement plaster coat, well troweled and painted with liquid hardener. As there are hundreds of small quakes every year, this plaster coat peels off every three or four years and has to be replaced. This picture also indicates the truth of the general observation that the main damage done in the recent disaster was by fire and not by earthquake.

Fig. 7 is a view of Asakusa ward in Tokyo, in which was located Asakusa park, Tokyo's Coney Island. Note the two concrete buildings and chimneys in the

background, with steel sash still in place. Also note that in all of these pictures the poles are still standing, being one piece of evidence that the quake was not so severe in comparison with previous ones. Thousands of buildings withstood the shock, only to be burned in the fire. This was especially true in Yokohama. The greater part of the homes on The Bluff (the foreign residential section) were much shaken by the quake, but still stood Saturday afternoon, only to burn later.

The writer is indebted for much of this information on earthquakes to the papers of the late Dr. F. Omori, Tokyo Imperial University, which were published in the Bulletin of the Imperial Earthquake Investigation Committee, and to his personal courtesy and help; also to Dr. T. Naitow, of Waseda University, Tokyo, for many of his articles and much advice and assistance in translation; and to P. K. Kishi, engineer for the H. K. Ferguson Co., for assistance in translation.

Earthquake Damage to Japanese Government Railways

Initial Injury to 68 Bridges Mostly Due to Failure of Piers and Abutments—Steel Structures, Rigidly Braced, Offered Greatest Resistance to Shock

By Mitsuo Nawa
Engineer, Government Railways of Japan, Toyko, Japan

FIRE, WHICH was so disastrous a consequence of the earthquake of Sept. 1 in centers of population, did little damage to property of the Government Railways of Japan, except to rolling stock. Most of the damage which spread over an area of 3,270 sq.mi. and made necessary reconstruction of 372 miles of line, was due to the shock itself. In this mileage were included 68 bridges which were injured. Thirty-two tunnels, of a total length of 2,855 ft. also sustained damage. Station buildings which burned included four of brick and thirteen of wood; twenty-two constructed of wood collapsed. An official report lists twenty-two train accidents caused by the quake, 53 locomotives burned or damaged, and 386 passenger cars, 817 freight cars and 31 electric cars burned.

Damage to Bridges—The damage to bridges comprised for the most part the cracking, displacement or complete failure of abutments and piers. Steel girders sustained slight initial damage. Typical of the shock's effect on bridges is what happened to the bridge over the River Banyu on the Tokaido main line. This consisted of two single-track structures each with 28 plate-girder spans 70 ft. long. The piers were of brick and hewn stone piled on elliptical hollow piers known locally as wells. These had a 12-ft. major axis and a 7½-ft. minor axis. Forty-four of these piers were broken at the point near the water line and fell downstream. The wells leaned and some of them shifted off center as much as 2 to 3½ ft.

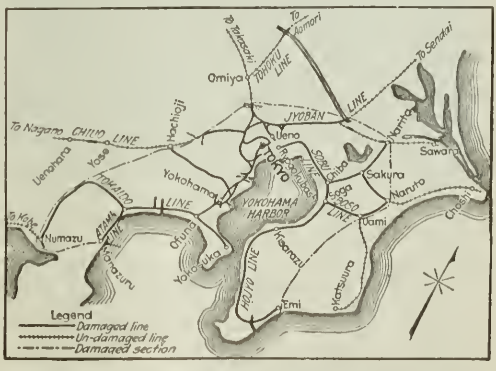
The bridge over the Sakawa River on the Atami line consisted of eight spans of double-track truss girders 150 ft. long, and two lines of 16 spans single-track plate girders 60 ft. long. The piers for the 150-ft. girders sustained no damage; the girders rested on reinforced-concrete cylindrical wells 14½ ft. in diameter and 30 ft. center to center, and the pier wells, sunk 50 ft. below the river bed, were concrete. Upon them concrete columns faced with masonry were built up to the bridge seat. The damage to this bridge, as shown in the accompanying photograph, was due to vibration, a span of truss girders 150 ft. long becoming unseated.

Considerable damage was sustained by bridges of the older type of construction where piers were connected by masonry arches. Absolute comparison of these structures with newer design was had at the crossing of the River Rokugo on the Tokaido main line. The railway bridge consisted of two lines of five spans of double-track truss girders 120 ft. long and four lines of 24 spans of single-track plate girders 44 ft. long. At the center an elliptical well with major axis of 21½ ft. and minor axis of 14½ ft. diameter was sunk and on either side a cylindrical well of 14½ ft. diameter on which piers, as in the case of the bridge over the Sakawa, had been separately erected. Of these piers only a single column was broken but slightly downstream on the Tokyo-Yokohama Electric Ry. Co. line all five piers were cracked at a point under the arch, that structure having piers connected by masonry arches.

There were no arch bridges of long span in the district sustaining heavy damage, but in the bridges of short span whether of brick or concrete, side walls were forced out by the lateral pressure and the arch ring was cracked usually longitudinally.

Damage to Embankments—Inasmuch as embankments and reclaimed land offered a very low resistance to shock, some which met the vibration at right angles were cracked longitudinally or wholly broken. In several instances earth and gravel behind abutments subsided, pushing abutments forward or making them lean so that at several points the track was suspended in mid-air. The subsidence of reclaimed land at the stations of Shimosoga and Odawara and at the wharves at Yokohama was remarkable. Due to this subsidence track was often bent vertically or sidewise and the buildings leaned or collapsed.

Landslides Produced—In some districts where severe tremors occurred as in the mountainous part of Hakone,



RAILWAY MAP OF JAPANESE EARTHQUAKE AREA; DAMAGE TO GOVERNMENT RAILROADS INDICATED BY SOLID BLACK LINE

steep mountainsides of rock or earth and sand cracked at several points. Cracks in turn led to permeation of rain water often causing landslides or flows of mud which buried or washed away houses, railways, forests and fields, and othewise inflicted serious damage. The Hakone mountain ranges which were covered with green before the earthquake, now show many barren patches.

The landslide which brought about the greatest disaster occurred just above Nebukawa station on the Atami line. It carried away the main station building, a passenger train then stopping there, plunging everything into the sea and killing more than 100 persons, including passengers and station staff.

The greatest mud flow occurred also near Nebukawa station, coming down along the upper stream of the River Shiraito and washing away the greater part of a bridge, together with its piers. This bridge was 105 ft. high and consisted of three 140-ft. truss girder spans and four 40-ft. plate-girder spans.

Damage to Tunnels—Greatest damage to tunnels consisted in cracks across the walls near portals produced by earth and gravel above the portal sliding down and pushing out the upper parapet wall. However, in some instances, the interiors of tunnels were damaged, though the damage occurred where there was a fault or where there was softer soil and less surcharge.

Elevated Structures Suffer—The elevated line of the Government Rys. through Tokyo in the downtown district is laid in soft ground. The greater part of the track has been built on arches of brick or reinforced concrete of 26 to 40 ft. spans, the foundation of which was made by driving in pine piles and reinforced-concrete piles about 50 ft. in length. Where the ground is weaker, reinforced-concrete slabs were put in instead of the masonry arches. Further steel plate girders were used over roadways and reinforced-concrete skew arches of 125-ft. span were built over the Sotobori Canal. This elevated line sustained practically no damage from the quake itself, a few plate girders alone being shifted. But as various articles were stored beneath the arches and slabs, these took fire and the inner bricks of the arches were affected by the intense heat losing their coherence and flaking off in thin layers. Fire damage to the slabs seems to have been very slight.

The elevated line at Yokohama was laid upon an embankment. In one section a vertical concrete retaining wall was used on each side and in another section a similar wall was used on the one side and the slope was sodded on the other. The intermediate fillings sank a few feet and the retaining wall either was forced out vertically or leaned slightly forward. Owing, however, to the fact that expansion joints were used at 33-ft. centers, no damage was suffered by the wall at any particular point.

Buildings—The main building at the Tokyo station, a three-story steel-frame structure with brick walls, sustained no damage in spite of its size. The main buildings of Manseibashi, Shimbashi and Yokohama stations were two-story brick structures. They were gutted by fire, but remaining walls show no trace of earthquake damage. The fan-shaped reinforced-concrete engine houses at Shinagawa and Yokohama were built upon reclaimed land and have been cracked at several points, as at beam joints.

The majority of the cast-iron columns supporting the roof over the passenger platforms at Tokyo station were broken and fell. There were many wooden main buildings, sheds or storehouses which collapsed at local stations, among which may be mentioned the reinforced-concrete freight shed at the Takashima yard.

Rolling Stock—Most of the rolling stock destroyed by fire was standing in the station yards of Ueno, Tokyo, Shiodome, Iidamachi and Akihanohara. Other chief damage to rolling stock was due to derailment caused by the earthquake.

Conclusions—Conclusions to be drawn from minute examination of damaged property are:

1. The extent of damage to works and structures varies with the distance from the seismic center, the topography and the nature of the soil of the locality affected, method and character of construction and material, etc.

2. The resistance to vibration offered by embankments and fills is low so that construction of any high earth dams or of any structures built upon embankments which span both firm and weak strata should be carefully executed.

3. Brick or masonry generally offers low resistance to earthquake shock. In Tokyo some brick buildings of less than five stories suffered no damage, but they were built upon good ground or upon satisfactory foundations.

4. Resistance to earthquake of plain concrete work seems to be nearly the same as that of brickwork.

5. In general, steel structures offer a high resistance to earthquake shock. Steel framed buildings with reinforced-concrete walls have offered excellent resistance to shock. Just below them are steel frame buildings with good brick or hard stone curtain walls. Any buildings having hollow brick or terra cotta curtain walls sustained severe damage and the walls between windows showed large cross-shaped cracks or else the bricks fell out completely. Where bracing was insufficient steel columns were often found bent. It seems that there were not a few steel structures wherein rigidity had not been fully considered, failure consequently resulting.

6. In point of resistance to earthquake, reinforced concrete comes next to steelwork. Generally, also, reinforced concrete proved excellent against fire.

7. Wooden houses, of less than three stories and those roofed with light materials, offer a fairly high resistance to earthquake shock.

* * *

Other Comments on Structural Damage

IN A brief letter to *Engineering News-Record* K. Koyanaga, engineer in the Yokohama harbor engineering office of the Japanese Department of Home Affairs, explains that about 3,500 ft. of the breakwater of that harbor sank beneath the low water line. The quay walls, of gravity retaining wall type and constructed principally of large-size concrete blocks, were overturned or shifted, resulting in some cases in complete failure of piers and pier sheds. Many of the sheds were burned.

One of the curious effects of the shock is shown in the view herewith, sent in by Mr. Koyanaga. The statue of Iikamonnokami was turned on its base through an angle of 45 deg., although neither base nor statue was badly damaged.

Several interesting findings regarding earthquake resistance were developed from an examination of buildings in the affected area by Daniel O. Larsen,

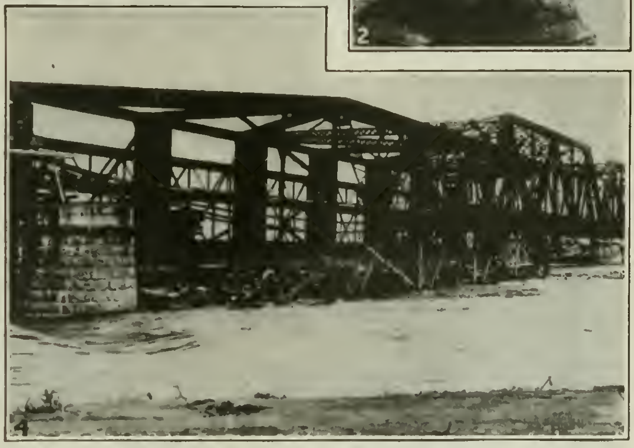


FIG. 1—BANYU BRIDGE ON TOKAIDO MAIN LINE
Structure of two single tracks of plate girders completely wrecked through pier failures.

FIG. 2—BRIDGE OVER ROKUGO ON TOKAIDO MAIN LINE
Broken pier supporting end of 120-ft. span.

FIG. 3—ARCH CULVERT ON TOKAIDO MAIN LINE

FIG. 4—BRIDGE OVER SAKAWA ON THE ATAMI LINE
Failure occurred through double track truss girder span, 150 ft. long, becoming unseated and falling on its side.

FIG. 5—SHIRAITO BRIDGE ON THE ATAMI LINE
Landslides caused the failure here of two spans of double track truss girders, 150 ft. long, and three 40-ft. spans.

FIG. 6—SHOCK EFFECT ON A FILL ON ATAMI LINE

The article by M. Nawa comes in reply to a letter sent its Japanese subscribers by Engineering News-Record. On page 1050 are shown photographs supplied by H. Sakakibara, manager for F. C. Kogiosho, reinforced-concrete designers and builders of Tokyo, and by K. Koyanagi, of the Yokohama harbor engineering office, Department of Home Affairs. Acknowledgment is also made of letters from Ichiro Goto, engineering department, Daido Electric Power Co., Nagoya, and from R. Ono, Morioka Ry. office. —EDITOR.

Views in left-hand column furnished by K. Koyanaga; those at right by A. Sakakibara

FIG. 1—COLLAPSED QUAY WALL, YOKOHAMA
FIG. 2—WRECKED BRIDGE SPAN, YOKOHAMA
FIG. 3—YOKOHAMA PIER; WALL ALONE DAMAGED

FIG. 4—RAILWAY STATION NEAR TOKYO
FIG. 5—PLATE-GIRDER RAILWAY SPANS OVERTHROWN
FIG. 6—RAILROAD SHOWS EXTENT OF UPHEAVAL

architect, of W. M. Vories & Co. Mr. Larsen's inspection was made in company with several engineers of the Takenaka Co. and the Truscon Steel Co., and covered about thirty modern buildings in Tokyo and Yokohama. Many of their observations were directed to fire resistance. As to earthquake resistance the following points developed:

Continuous-slab reinforced-concrete foundations stood

the effects of the earthquake in almost every case, whereas buildings with individual spread footings went to pieces. This was illustrated in the Kogyo Bank building, the Imperial Hotel, Mitsubishi building 27, several of the Marunouchi buildings, and others, which show practically no damage.

Exterior walls were not damaged above the sixth floor, even when hollow tile was used. Reinforced-concrete or solid brick curtain walls are necessary up to at least the sixth floor, however. The Kogyo Bank, which shows no damage, has a reinforced-concrete wall up to the third floor and all corners have reinforced-concrete curtain walls; other walls are brick. Another building which shows no damage has solid brick curtain walls.

Solid partitions are favorable to earthquake resistance. Partitions of reinforced concrete or brick running through a building seemed to add noticeably to its resistance. It was also concluded that ceiling heights should be as low as possible.

Exterior finish will crack in proportion to the strength of the structure. Two buildings which had granite finish in the first three stories and terra cotta above, the Nippon Sekan and the Kogyo Bank, were affected differently. The former was seriously damaged by cracking of both the stone and the terra cotta; its frame comprised steel columns incased in brick and hollow tile. The other building had steel columns incased in concrete (and a better foundation) and showed no cracks in the stone or terra cotta.

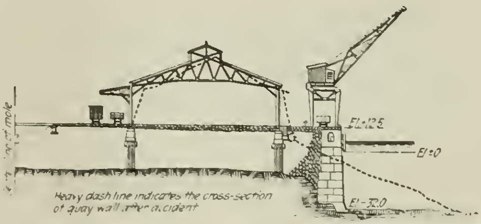
Conclusions as to earthquake resistance have also been given by R. F. Moss, vice-president of the Truscon Steel Co. of Japan. They are:

1. Floors and roof should be made as light as possible, to reduce the earthquake forces imposed on the walls and columns which carry them.

2. Walls and columns should be proportioned for transmitting the earthquake forces to the whole construction above.

3. Large open floor spaces unsupported by walls and partitions should be avoided, so that sufficient wall and column strength may be available. The Marunouchi building suffered less in the 1923 earthquake than in the much smaller 1922 earthquake; in the interim the hollow-tile partitions had been replaced by concrete and cement plaster partitions, the columns had been strengthened, and bracing added, the large floor areas thus being divided into small units each supported by strong partitions.

In steel-frame buildings the lateral strength of the steel columns is of secondary importance. Most of the work of transmitting the horizontal earthquake forces to the upper parts of the building must be done by the masonry walls and not by the steel columns. The buildings of the Nippon Oil Co. and the Nippon Yusen Kaisha had unusually strong columns, especially designed to resist earthquakes, but the walls of these buildings suffered more damage than did the walls of the Tokyo Marine Insurance Co. and Marunouchi buildings, which were designed much lighter but had stronger walls.



SECTION OF YOKOHAMA QUAY WALL AND PIER

4. Good workmanship is of primary importance. Well laid stone walls suffered little. The behavior of brick walls seemed to depend on the workmanship and quality of the brick and mortar. Well-built reinforced-concrete walls came through with practically no damage.

5. All parts of the foundation should be connected together by members strong enough to make the various parts act and move together. The partial failure of the fifteenth bank building in Yokohama is chargeable to violation of this requirement. All of the center columns were not connected to the outside walls, and the horizontal displacement of the foundations was not uniform.

6. In tile roofs, every tile should be individually secured so that it cannot slip during an earthquake.


YOKOHAMA STATUE TURNED 15 DEG. ON BASE

Engineers For Traffic Study

The Philadelphia *Evening Public Ledger* recently commented upon a problem of interest to engineers as follows:

"Mayor-elect Kendrick is wise in assuming that he might begin his administration well by submitting the whole problem of traffic congestion to a Board of Engineers. The traffic problem has been left to run rather wild. The police do their best with the facilities at their disposal, and, all things considered, they do amazingly well. But the pressure of motors in the narrower streets is leading to something like a deadlock.

"Neither automobiles nor trolley cars can move freely during the morning and evening rush hours. Indeed, the streets no longer serve the purpose for which they were intended. Business is being slowed up in many areas. It may be too much to suppose that engineers could find a prompt and easy way out of the dilemma in which the city finds itself. But they could at least lay the foundations of a scheme by which, as we go along, science may be applied to a problem which haphazard methods have failed to solve."

Hydraulic Tests of Flap Valves on Drainage Pipe Outlets

Determinations of Angles of Repose and Loss of Head in "Calco Gates" — Head Loss Slight and Leakage Small With Closed Gate

By Prof. Floyd A. Nagler

Department of Hydraulics and Mechanics, State University of Iowa, Iowa City

Gates of a flap or shutter type are often installed at the outlets of drains serving low-lying lands and tidal marshes. Manufacturers have claimed that such gates offer little or no obstruction to the normal flow of the water in the drains toward the water course since only a small force is required to open the gate. However, when the water in the main water course rises to flood stages and stands higher than that upon the land itself the gate is forced firmly against its seat preventing the inundation of the land by water from foreign sources.

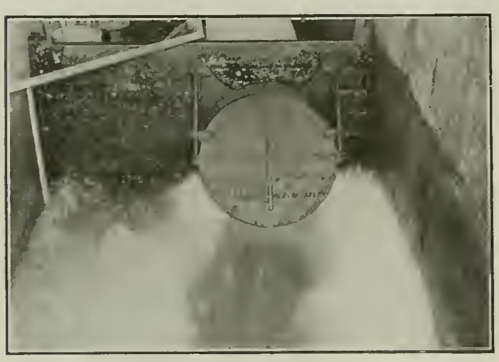


FIG. 1—A 30-IN. CALCO FLAP VALVE DISCHARGING 29.8 SEC.-FT. FREELY INTO AIR

During November, 1922, experiments were performed at the hydraulic laboratory of the State University of Iowa to determine the actual amount of head lost through gates of this type. Double-hinged cast-iron flap gates of the "Calco" type (manufactured by the California Corrugated Culvert Co.) were secured for these tests, in sizes 18, 24 and 30 in. in diameter. Fig. 1 shows one of these gates operating with free discharge at the outlet.

The loss in head through each gate was observed with outlet velocities of from 1 to 8 ft. per second, while the corrugated pipe to which the gate was attached flowed either partially or entirely full, and with the jet at the outlet discharging freely in the air or entirely submerged.

The gates were attached to the end of a 10- or a 12-ft. length of Armco corrugated-iron pipe of the corresponding diameter in the hydraulic canal. By means of piezometer connections at intervals of 2 ft. throughout the entire length of the pipe, and hook gages installed in the basin above the inlet of the pipe, the hydraulic gradient was observed when the shutter of the gate was raised clear of the jet issuing from the outlet. The gate was then lowered so that it floated in a natural position and the hydraulic gradient was again observed, care being taken that the same quantity of water passed through the outlet as in the first case.

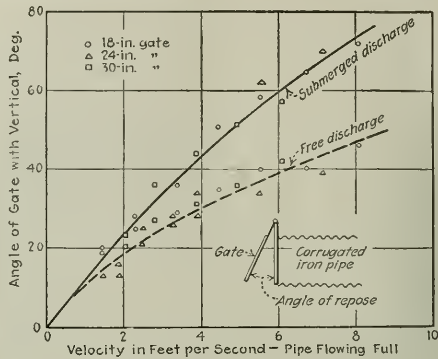


FIG. 2—ANGLE OF REPOSE FOR FLAP VALVES AT VARIOUS FLOW VELOCITIES

The difference in the elevation of the hydraulic gradient at points upstream from the gate was taken as a measure of the loss in head through the gate. The volume of water discharging through the gate was measured by a 5-ft. Bazin weir.

The loss in head caused by a gate of this type is obviously dependent upon the amount of obstruction caused by the shutter, and this in turn is dependent upon the angle at which it hangs. If water flows through the outlet at a high velocity the shutter is forced outward so that it rests almost horizontally, causing but little obstruction to the flow of water from the outlet; but if the water issues at a low velocity the shutter falls to a more nearly vertical position. The angle which the shutter makes with the vertical for the various gates tested was found to be practically identical and is shown graphically in Fig. 2 for the condition of both a free and a submerged outlet. Thus with the outlet flowing full with a mean velocity of 6 ft. per second the shutter rests at an angle with the vertical of 39 deg. if the jet discharges freely into the air, whereas the angle is 60 deg. if the gate is submerged. It proved possible to verify theoretically the results shown by these curves by computing the moment of reaction of the jet issuing from the outlet and equating it to the gravity moment of the shutter.

The loss in head caused by any gate proved to be less than 0.01 ft. under all velocities of flow when the water discharged from the outlet freely into the air. The loss in head with a submerged outlet (Fig. 3) is greater. For all three gates a maximum value was

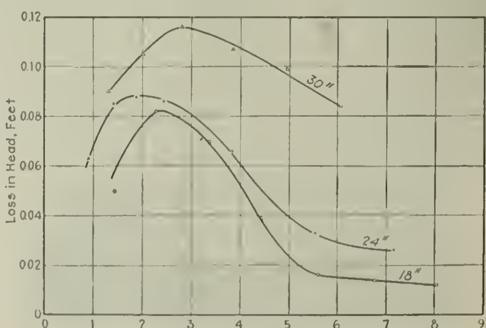


FIG. 3—LOSS OF HEAD DUE TO FLAP VALVES

reached when the velocities of flow were between 2 and 3 ft. per second, in which case the shutter hung at angles between 23 and 34 deg. with the vertical. The loss of head in all experiments proved small, reaching a maximum of 0.116 ft. for the 30-in. gate.

The 30-in. gate was tested for leakage when firmly held against its seat by backwater in a testing flume. The maximum leakage with heads varying from 1.6 to 4.5 ft. on the center of the gate was 0.015 ft. per second, the quantity decreasing with increase in head because the greater the pressure the more firmly was the flap held against its seat.

It may be concluded from these experiments that the loss of head through a gate of the Calco type is very small indeed and that such gates have but little effect upon the discharging capacity of drainage outlets. Also, if they are kept free from twigs and debris and properly installed, they may be depended upon to stop effectively the inflow of backwater.

Two Trips of Mixer Construct Four-Way Pavement

Fifty-Foot Reinforced-Concrete Park Road Pavement Has Three Longitudinal Construction Joints Doweled Every Three Feet

By John J. Murphy
Engineer, Park Department, Boston, Mass.

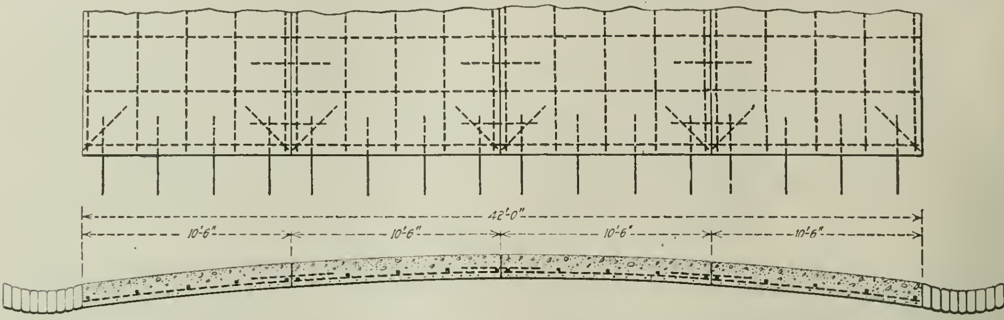
A 42-FT. concrete road has recently been constructed in four strips on a portion of Commonwealth Boulevard in Boston. This road carries practically all of the traffic between Boston and western Massachusetts and the pavement was made wide and thick and was heavily reinforced. Its construction was remarkably simple, only two trips of the paving mixer being required to build the four 10½-ft. strips. The 4-ft. gutters are granite block and make the road 50 ft. wide between curbs. Altogether 3,300 ft. of road were constructed.

The original road was crushed stone macadam with a Telford base and had a crown varying from 18 to 20 in. This excessive crown kept the motorists in the middle of the road with disastrous results to the central portion. It was decided to reduce this extreme crown so that the full width of the road could be used with comfort and no danger. Cutting down of the crown to 8 in. was accomplished by excavating at the center of the road and filling at the sides. This was a very difficult task on account of the Telford base, which it was desired to keep intact as a foundation for the new concrete road. It was accomplished with a shallow-cutting steam shovel which loaded into motor trucks. When shaped and rolled the old construction gave for the new concrete road a foundation of Telford and crushed stone with enough sand distributed on the stone to fill the surface voids.

The concrete was 7 in. thick at all points and was a 1:2:4 mix, using washed sand as a fine aggregate and washed gravel ¼ in. to 2½ in. for a coarse aggregate. The pavement was divided into four longitudinal strips, each 10 ft. 6 in. in width. These longitudinal strips were laid in alternate pairs. The mixer traveled on the subgrade and laid a strip on each side as it advanced. When the further end of the road was reached, the mixer was brought back and, traveling on the surface of one of the strips already in place and cured, laid the remaining two sections. The concrete was first screeded with a templet of wood, covered with tin, after which it was rolled with a light metal roller and them belted with a canvas belt. After the initial hardening had taken place, the surface was scored with brooms in order to roughen it and afford a better grip for traffic.

As the drawing shows in detail, the road was reinforced with ½-in. square steel rods, 2 ft. 6 in. on centers, both longitudinally and laterally. These rods were all placed in the bottom of the slab. They were made up in mats, all wired together, the transverse rods 10 ft. 2 in. in length, and the longitudinal rods 12 ft. in length. One-half inch square dowels 4 ft. long were placed in the center of each slab, 3 ft. apart, at the transverse and longitudinal joints. One-half of the dowel was left rigid in one slab and the other half was painted with asphalt. A ½-in. square rod 3 ft. long was placed in each corner and at the top of each slab. These corner rods were placed at 45 deg. to the joints. At each transverse joint elastite joint filler ½ in. thick and 8 in. wide was used. The transverse joints were placed 60 ft. apart. The faces of the first concrete strips poured were

TRANSVERSE JOINTS DIVIDE PAVEMENT INTO 10½X60 FT. SLABS



SECTION AND REINFORCEMENT PLAN OF FOUR-STRIP CONCRETE ROAD

painted with asphalt before the final two strips were poured. After being placed the concrete was protected by canvas and thoroughly covered with earth, which was kept moist for a period of ten days after laying, when this covering was removed. The road was finally opened for travel two weeks after the last section was poured.

A two-bag paving mixer was used and a day's run consisted of laying two parallel strips each 10 ft. 6 in. wide and 240 ft. in length, totalling 109 cu.yd. Metal forms were used throughout the work.

The road has been banked at one curve and the gradient at this curve is 7 per cent. This required considerable revision of old grades and much excavation in order to change the excessive crown to a banked section.

FOUR-STRIP PAVEMENT UNDER CONSTRUCTION

The result obtained is a very even riding surface, the pavement having riding qualities of remarkable excellence. The lowering of the crown, the elimination of crowns and depressions at intersecting streets and the banking of the sharp curve has made this section of the boulevard for its entire width, not only safe against skidding but pleasant to the man who drives a car.

The cost of the concrete road surface was as follows:

Concrete, per sq.yd.	$2.71
Steel, per sq.yd., 8 lb. at $0.05½	44

The cost of the entire improvement was $74,000.

The contract for the improvement was let by the Boston Park Department to A. G. Tomasello & Son of Boston. The work was started May 10, 1923, and the road was opened for travel August 2, 1923.

Investigates Power on Green River, Wyo.

Recent investigations of the water power resources of tributary streams to the Colorado River by the Department of the Interior have included detailed studies of the possible power site on the largest tributary, the Green River, which has its source in glaciers and glacial lakes on the west coast of the Wind River range near the Continental Divide. The investigations show that probably nine of these lakes, having a combined storage capacity of more than half a million acre-feet of water, may be utilized as reservoirs for irrigation or power generation. The basin of the river above the town of Green River, Wyo., covers about 18,000 sq.mi. of land in the southwestern corner of the state, ranging in elevation from a mile to 13,800 ft. above sea level. Some of this land is already irrigated, and about 400,000 additional acres may be brought under irrigation. The report, which contains maps and photographs, shows the physical features and the meteorological conditions in the basin and describes ten possible power sites. Copies of it are on file in tha Geological Survey office in Washington and at the district office of the Survey in Salt Lake City.

Reconstruction of Hell Gate Dam to Eliminate Silt

Silt Deposits from Montana Smelter and Mines Controlled by New Low-Level Sluice Gates— Replacing Eroded Wall Difficult—Mat Protection Placed in Front of Wall

PONDAGE silt back of the Hell Gate dam of the Missoula, Mont., Light & Water Co., had by 1919 reduced the storage capacity, in the dozen years the hydro-electric plant had been in operation, to such an extent that the peak-load carrying steam auxiliary was being called upon more and more frequently. Four large sluice gates were installed to draw water from the river-bed level in 1919 by means of which the silt deposit could be eroded away during flood periods. The concentrated flow and eddy currents from the gates led to serious undermining of a timber crib training wall between the tailrace and the gate discharge. Reconstruction of this wall in three sections was completed early in 1923. The difficulties encountered in maintaining the old crib wall from base erosion, and finally replacing the crib with a concrete wall and mat protection of the rock in front of the wall have kept the operating officials of the power plant and a consulting engineer busy almost continuously for the past three years.

FIG. 1—HELL GATE DAM WITH NEW SLUICE GATES AND WALL

Back eddies from discharge several times undermined old crib wall between river and tailrace. Finally new concrete wall was constructed and base rock protected by thick mat of concrete in front of wall.

The hydro-electric plant and dam is located just below the confluence of the Hell Gate and Blackfoot Rivers. The Butte copper mines and the Anaconda Copper Mining Co.'s smelter are located 120 miles upstream on the Hell Gate River. Mine-pump and wash-water discharge from these mines, tailings from the smelter together with soil eroded from the bed and banks of the river, nearly displaced the reservoir water capacity. The intakes ahead of the trash racks had become so clogged as to seriously cut down the flow of water to the turbines. In 1919 the company decided to undertake measures for disposing of this silt accumulation and keeping it down.

The mountainous nature of the drainage area above this dam and the heavy snowfall at high elevations result in occasional heavy spring flood discharges of long duration. On one or two occasions the discharge has been known to reach 9 or 10 ft. over the crest of the dam, approximately 35,000 sec.-ft. The dam is of timber construction with a spillway length of 274 ft., the crest of which is fitted with 6-ft. hinged flash gates.

Sluice Gates—It was decided to install in this dam four sluice gates 9 ft. wide and 14 ft. high, at the end nearest the power house where the gates would be accessible and one gate could draw its supply from in front of the trash racks. These gates with their supporting walls took up 53½ ft. of the spillway length, leaving a clear spillway of 220½ ft. Under a normal static head of 31 ft. the gates and the spillway were found ample to take care of flood waters. The gates discharged approximately 13,000 sec.-ft. and proportionally more as the head increased. The spillway under 10-ft. flood discharged approximately 28,000 sec.-ft. The full requirement of the prime movers is 1,600 sec.-ft.

The plans and photographs indicate the general type of construction of the gates. The right-angle turn given the intake for Gate 1 was for the purpose of drawing its supply directly from in front of the trash racks. The upper end of the opening leading to this gate was closed off with a wall built from the top down to within 14 ft. of the floor, thus producing a current at the bottom for clearing silt and débris from in front of the racks. The other three gates draw their supply directly from the pond.

The procedure for wearing down the deposit over the ¾-sq.mi. area of the pond contemplated the use of these

FIG. 2—CRIB WALL PROTECTED BY SHEET-PILING UNDERMINED

gates at intervals, when the accumulations warrant their use, during high river discharge periods only. The operation of these gates for silt cutting is as fol-

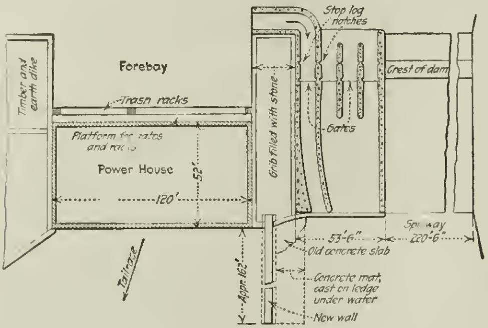


FIG. 3—TIMBER CRIBS AND NEW DIVERSION WALL

lows: Water in the pond is drawn down as quickly as possible to within a few inches of the silted surface, by dropping the hinged flash gates on the dam crest and opening the sluice gates. By manipulating the gates the pond surface can be brought to a ripple or to a high velocity over the silted area which tends to wear down the silted surface. This procedure lowers the head on the prime movers some 6 ft. for the time and during peak-load hours may call for the use of the steam auxiliary.

New Diversion Wall—Due to the location of the power house so far out in the river it was necessary to construct a diversion wall of some size to separate the tailrace from the river. This wall consisted of timber cribs, bolted together and filled with rock and gravel, and was supposed to rest on rock ledge, although no plans of its construction were on file. The crib had been repaired or rebuilt several times in the past fifteen years. About two years prior to the installation of the gates the second crib based on the native ledge was built alongside the original one on the river side. The new crib was filled with heavy rock, some of which weighed several tons, extending well above the surface.

In locating the gates at the power house end of the dam it was expected that the discharge might eventually dislodge a part of the new crib, although the discharge from the gates, due to the design of the guiding walls below the gates, was partially directed toward the middle of the river. Since the original crib diversion wall was supposed to rest on solid rock it was believed to be reasonably safe.

The first time the gates were used for the spring flood in 1920, their discharge proved to be much more destructive to the base ledge than was expected. The severe return eddies soon tore out the heavy stone protection crib addition last built and began undermining the main original crib. About this time the flood waters subsided and the gates were closed. Later in the year an attempt was made to stay temporarily further undermining, due to the action of the eddies, by driving steel sheetpiling along the river face of the old crib and pouring concrete back of the piles. When the gates were opened the next spring (1921) this sheeting was soon undermined by the ledge disintegrating and letting the water work up under the old crib. The gates were closed and a decision was reached that all further work should be of a permanent nature. As diamond drilling was deemed too expensive, it was decided to proceed with the work of unwatering the site and then accommodate the designs of the new concrete wall to the conditions found. From soundings the rock was found to be stratified and easily broken, but no knowledge was gained as to the thickness of its strata or its homogeneity. The water depth taken 40 to 50 ft. downstream from the gate apron and 10 ft. out from the old crib was 32 ft., and 4 ft. below the gate apron it was 16 to 21 ft. The old crib had a width of 32 ft., its top was 10 ft. above normal river level and its base 16 to 18 ft. below water level.

The designs called for a wall about 162 ft. long with an 8-ft. base, battered to 5 ft. at the top, and about 30 ft. high, on the assumption that the base ledge was 17 ft. below normal water level. The wall was to be cast in 33-ft. sections, separated by expansion joints and reinforced with steel bars partially for temperature strains but chiefly for surface protection from the pounding of logs. Due to the probability that the underlying ledge would prove insufficiently hard to resist the wearing action of the water, the original designs of the wall contemplated the use of reinforced

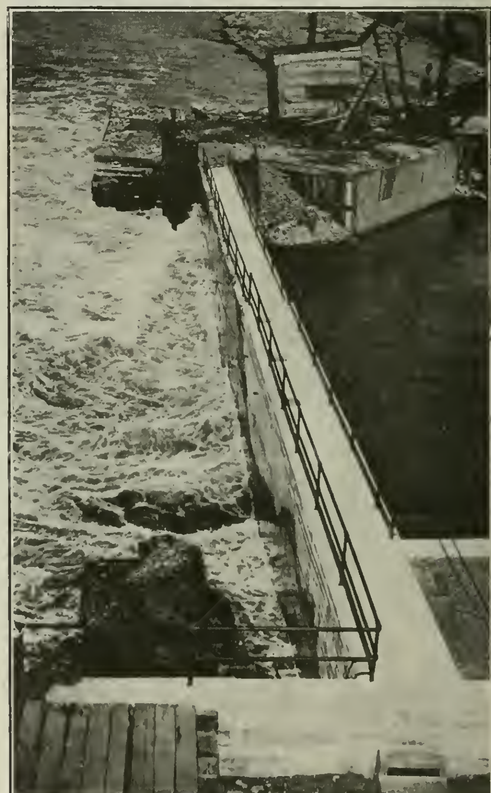


FIG. 4—NEW CONCRETE WALL WITH BASE PROTECTION

precast concrete piles 10 in. in diameter, varying in length from 8 to 14 ft. and spaced 6 to 8 ft. on centers, located on the river side of the center line of the wall base. Holes 12 in. in diameter were to be drilled in the base ledge and the piles dropped and grouted into

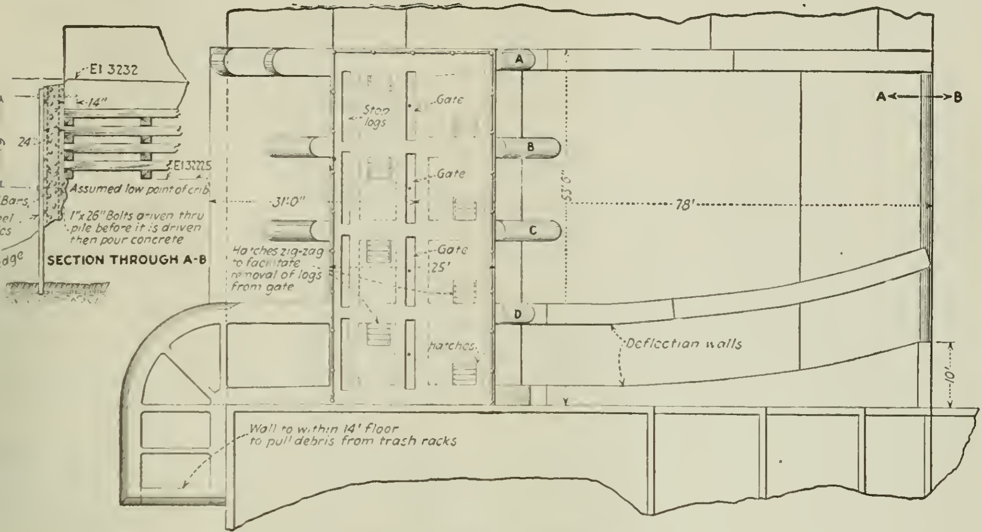


FIG. 5—NEW SLUICE GATES IN HELL GATE DAM

place, their function being to support the wall in case of partial undermining. Conditions at that time indicated that the river side of the wall base would be located about 8 ft. back from the edge of the rock ledge sloping rapidly downward toward the river. Should the rock prove to be of a nature easily disintegrated, the piles would render the wall stable until a concrete facing against the base ledge could be laid. The plan of using the piles was found to be impractical. No drilling in the base rock was done, but cores were provided in the wall itself from base to top, through which at a later date, if necessary, drill holes could be made and the piles used.

In the building of the new wall, three serious factors in its construction could be anticipated: (1) The old crib was in the way. (2) It was sure to be difficult to get through the crib to the base rock and exclude the water in the meantime. (3) Security must be provided against further underwash after the wall was completed.

The first section of the new wall was started about 50 ft. downstream from the end of the dam apron. The old crib at this point was torn down to river level.

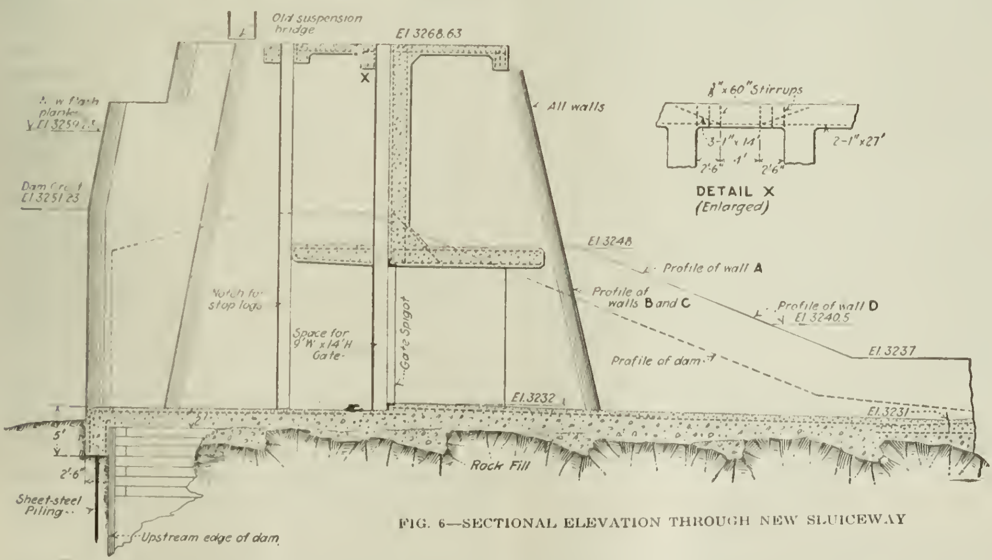


FIG. 6—SECTIONAL ELEVATION THROUGH NEW SLUICEWAY

The steel caisson was now started, using 14-in., 42-lb. steel piling, driven with a heavy steam hammer. On the tailrace side of the old crib, this piling was driven

in the open water outside of the crib. On the river side of the crib and at the two ends of the caisson it was driven through the crib timbers, bolts, rocks and slabs of concrete. Much of the piling had to be withdrawn in a badly battered and twisted condition and repaired, greatly retarding the work. One 10-in. horizontal-shaft and one 6-in. vertical-shaft pump were installed, driven by 75- and 50-hp. motors, respectively. As the driving and excavation proceeded it was found necessary to drive another row of sheetpiling on the river side, outside of the old crib. This added resistance to the water for the time enabled the pumps to keep the water down inside the caisson.

This first section of wall was hardly completed when a flood came down and the gates were opened for a few days. Before the flood subsided it was discovered that the base ledge had been eroded up to and immediately under the new wall section. The gates were closed.

The second (down-river) section of wall was now undertaken. When excavation had reached a point about 10 ft. below water level, leakage under the two courses of caisson steel piling on the river side became so great that the pumping capacity was inadequate, and about 1,000 cu.yd. of gravel was deposited on this side which greatly improved the situation, until the second section was finished.

For the third and longest (up-river) section the progress was slow and tedious, due chiefly to slabs of old concrete 2 to 10 ft. in thickness imbedded in the old crib. It was too close to the power house and dam to permit the use of explosives, consequently "bull points" and picks were used in wearing down the old slabs, which slowed up the work. Little difficulty was experienced with water.

For protection of the base ledge from erosion a concrete mat was laid under water along the base of the wall as a permanent protection. The bedrock was first thoroughly cleaned with a clamshell bucket and a high-pressure water jet. A wall of steel sheetpiling was anchored 20 ft. out from the wall for shutting out all river currents and stilling the water for submerged concrete casting. A wall of sand-filled bags 3 ft. high was laid 15 ft. out from the concrete wall to stop the outward flow of concrete. A mixture of 1½ per cent calcium chloride was used with the cement to hasten its initial set. The concrete was heated to a high degree and a tremie was used for deposition, as the depth of water varied from 18 to 32 ft. Work was commenced at the upstream end so that the laps, if any, would lie with the direction of the water eddies, and was prosecuted vigorously day and night until finished. This mat averaged 5½ ft. thick at the base of the wall and from 3½ to 4 ft. thick 15 ft. out. It was tied to the wall by reinforcing bars previously cast in the wall for this purpose.

The work was done by the Missoula Light & Water Co., of Missoula, Mont., for which C. H. Christensen is general manager. The gates were installed under the field superintendence of H. L. Bickenbach, superintendent of street railways, Missoula. The concrete wall construction was superintended by John A. Hedlund, of Minneapolis, and Mr. Huwe, power station superintendent, rendered valuable assistance through his familiarity with the old structures. The gates and wall were designed by the Power Engineering Co., consulting engineers, Minneapolis, and all construction procedure was carried out under their instructions.

Why Reclamation Costs Differ from Original Estimates

Facts Suppressed in Secretary Work's Comparison of Estimated and Present Costs—Projects Extended on Plea of Land Owners

IN A PARALLEL-COLUMN statement of original estimated cost and construction cost to the present year of the various federal reclamation projects, just issued by Secretary Work of the Department of the Interior, present costs are shown to be far in excess of the original estimate. The statement implies that engineering planning and management of reclamation have been grossly at fault. Inquiries directed to competent authorities indicate that the statement is seriously misleading, and that it suppresses facts which are essential to a proper understanding of the cost figures. The facts as to cost are therefore briefly reviewed here, on the basis of what these authorities have said.

Secretary Work's entire statement is based upon the assumption, which he uses throughout and evidently intends the reader to believe, that the original estimated cost is for the identical structures included in the column of net construction cost. This is not true in the case of any project.

Originally the Reclamation Act was intended to apply to the construction only of such projects and features or parts of projects as were too expensive and difficult for private enterprise. It was assumed and generally promised that the projects benefited by the construction of such large features as reservoirs and main canals would build their own canal systems and distribution systems.

In many instances they already had these systems, and enlargement and extension to adapt them to the new conditions were to be made by the water users themselves. In some cases this was made a specific requirement of the contract. It was found that the water users were unable or unwilling to carry out the extensions and enlargements expected of them or even to acquire title to the canal systems which were necessary for utilization of the water. Under these circumstances the government was requested to undertake large additional work, and did so, with the approval of the Secretary of the Interior and sometimes by his own initiative.

The Salt River project is a typical case in point. In this case Secretary Work lists the original estimated cost at $5,650,000 and the net construction cost to June 30, 1923, as $10,548,119.28. The figure given for estimated cost is questionable. The estimated cost of the Roosevelt dam as built was $3,850,000 and it was built for about this amount. This was the only structure originally contemplated. The valley had a large number of canals which, though poorly constructed and badly maintained, could be used for the delivery of water to the lands already cultivated, and the people were supposed to be able, when a reliable water supply was secured by the reservoir, to improve, enlarge, and extend the canals to the new lands. But while the Roosevelt dam was under construction a great flood washed out the water users' diversion dam 40 mi. below, and the water users being unable to finance its reconstruction, made urgent appeals to Secretary Hitchcock to rebuild it and offered to co-operate in acquiring canals that could use it. Of his own motion, without recommendation from the Reclamation Service, Secre-

tary Hitchcock determined to purchase the canal systems dependent on this dam and rebuild the dam and enlarge and extend the canal systems.

The contract for the reservoir had been drawn in such way as to cover any work the Service might do, and give the Secretary of the Interior the authority to determine the cost, and the water users' association on its part was required to contract to repay to the government such part of the construction cost as the Secretary should assess against its shareholders, thus leaving him in a position to take in some public land and assess a portion of the cost to that and the balance to the private lands which were in the association. This proviso was made the basis of contract on practically all of the early projects, and under it additional work often was taken up, on urgent and persistent pressure from the project people, without a new contract. The various systems of canals in Salt River Valley were purchased for cash and greatly enlarged, improved, and extended to cover new lands.

The original estimate included only the storage works, which were all that were contemplated at the time the project was undertaken. According to the 11th annual report of the Reclamation Service, page 51, these have cost \$3,802,897.06, while the other expenses, not included in the original estimate, but built on urgent requests from the water users' association and landowners, amount to 6 or 7 millions and include the following items:

Power system	\$2,491,593.04
Granite Reef diversion dam	622,784.04
North side canal system, construction	1,102,005.52
South side canal system, construction	696,541.03
Pumping plants	126,548.64
Real estate purchased	32,028.05
Telephone system, construction and betterments	68,892.49
Roads, construction and maintenance	603,941.03

Yet Secretary Work's statement carries the impression, as it evidently is intended to carry it, that the same works that were estimated to cost \$5,650,000 have really cost about double this amount. This is absolutely false.

All the other projects are similarly affected. On two of those projects, the Boise and the Yuma, this identical question has been the subject of protracted and hard-fought litigation, and in both cases the court was convinced that statement of the original cost did not apply to the project that was built because of the great extensions made. For example, on the Boise project, the Arrowrock Dam was not contemplated and never mentioned; in fact, it was not even conceived at the time the contract was entered into with the water users and the canals were built. But it was built as an extension at the urgent request of the water users, who made strenuous efforts to secure the largest reservoir they could induce the government to build. On the Yuma project, the result of the litigation was exactly the same. These two lawsuits occupy such a large portion of the files, in correspondence, briefs, and decisions which were handed down, that it would be impossible for any one examining the files of the Service to overlook them.

The Salt River case and the Uncompahgre case have been so much discussed and the files contain such complete statements that it is equally impossible for the real facts to have been overlooked in these cases. The additional work on the Salt River project was dealt with in the public hearings in 1913, and presented in Congressional hearings at a later date.

In the later years, with the approval of Congress, on a large number of projects drainage works have been carried out which were never contemplated in the original estimates.

As time passed, however, the Reclamation Service learned that those upon the projects desiring to escape their payments were prone to use the same words that Secretary Work has here used to deceive the public by speaking of the original estimates of the "project" and the ultimate cost of the "project" as though they applied to the same works and the identical project, using this argument to prove waste and to discredit the Service and thus escape their payments. Partly for this reason the policy was adopted of requiring a new contract for each additional feature the government was requested to undertake, so that in many cases the additional work is represented by separate, additional contracts. This statement would apply to more than half of the projects. The new work being represented by different contracts, it can not be confused with the works contemplated by the original contract; but Secretary Work's statement does so.

Statements of discrepancies between the estimated and the actual costs widely published by an official as high in responsibility as the Secretary of the Interior (and attributed at least by implication to extravagance, waste, and graft) will encourage those who advocate repudiation of payments. It will tend to diminish the chances of recovery of the cost of the projects.

The Secretary says in his statement on costs: "This intensive study of reclamation as a business is the first ever made. It should have been made ten years ago." The fact is that the Reclamation Service has been under investigation nearly half the time since it began operations, by several Congressional committees, including the Appropriations Committee, and many inspectors from the Secretary's office and from the Treasury Department. In 1910 it was thoroughly investigated by a board of army engineers, which among other things reported that "In its inspection the Board was impressed with the ability of the employees occupying positions of responsibility and desires to record its appreciation of the assistance rendered by them." The most exhaustive examination of all was made by a series of boards of review instituted by Secretary Lane in 1914. Reports by these boards were passed upon by a central board of review consisting of Dr. Elwood Mead of the University of California, Gen. W. L. Marshall, ex-Chief of Engineers, U. S. A., and I. D. O'Donnell, a successful irrigation farmer. Nearly a year was spent in this investigation, and it eliminated two items of cost charged on the books, one from the Salt River project and one from the Uncompahgre project. Yet, in spite of this adjudication, the Secretary asks for authority to reopen all these cases and "make adjustments" between the government and the projects.

Strength of Limestone in Tension

Tension tests on samples of Indiana limestone recently made at the Bureau of Standards, in connection with the design of lifting devices for hoisting large blocks of stone, showed values ranging from 300 to 715 lb. with an average of 535 lb per square inch.

Chicago Heavy-Traffic Street Tests Asphalt Mixtures

Stiff Mixture Stands Up Under Traffic of 16,000 Vehicles a Day While Softer Mixture Ruts and Rolls Badly

By Hugh W. Skidmore
Consulting Engineer, Chicago Paving Laboratory, Chicago, Ill.

Two distinct mixture designs were employed in street asphalt pavement laid on Michigan Boulevard in Chicago, in 1919 and in 1920. One design failed and the other was a success. As the comparison was unusually fair, these results warrant analysis. Also the conditions represent about the maximum of density of street traffic—that of the famous "link" over the Chicago River and connecting "north" and "south" Michigan Avenue.

Both traffic and foundation conditions are identical over the entire length of this pavement. The traffic is fully as dense as on any pavement in the world. As high as 60,000 vehicles per day pass over the pavement. These are by no means all swift-moving pleasure cars;

TWO TYPES OF FAILURE—RUTS AND WAVES
Note the seriousness of these waves, also the ruts toward the center in the line of travel of light vehicles. The mixture plainly shows its excess of bitumen.

a large number of heavy motor buses ply back and forth night and day. The former tends to roll or wave the pavement transversely, while the latter tend to form longitudinal ruts in the surface. Both of these types of defect are very much in evidence in that portion of this pavement which was laid in the spring and early summer of 1920.

A comparatively small portion of the pavement being considered was laid in the late summer and fall of 1919. The wearing surface mixture was especially designed to overcome any tendency toward distortion under traffic. The mixture was designed for a maximum density, comparatively "dry," i.e., with absolutely no excess of bitumen, and with what was considered by some entirely too much mineral filler. The penetration of the asphalt cement was set as low as was considered entirely safe from the standpoint of cracking, viz., 30 to 35. An analysis of the mixture was as follows:

	Per Cent
Bitumen, by weight	10.6
Mineral passing 200	18.0
Mineral passing 80	26.8
Mineral passing 40	31.7
Mineral passing 10	10.7
Mineral passing 4	2.2
Penetration at 77 deg. F.	33

The maximum amount of bitumen in a large number of samples tested was 10.8 per cent and the minimum was 10.1 per cent; the majority showed about 10.5 per cent. The minimum of filler passing the 200-mesh screen in these samples was 17 per cent while the maximum was 20 per cent; the maximum penetration was 35 and the minimum 31.

No rutting has developed in this portion of the pavement, and the only evidence of any forward displacement occurs to a slight extent at a corner where the heavy motor buses have come to a sudden stop, on a slight down-grade. Even this is as yet of minor consequence and is thoroughly localized. No cracks have occurred, except in one or two instances of surface reproduction of contraction cracks of portland cement concrete base, which appeared during the first winter. It is altogether possible that these also might have been largely overcome by traffic, were it not for the fact that this portion of the work was closed against traffic during the first few months after it was laid. One of the most striking and significant things in this entire stretch of pavement is the joint between the work laid in 1919 and 1920. The softer mixture of 1920 can plainly be seen rolling down over the more stable 1919 work

The character of mixture laid in 1920 is radically different from that of 1919 in two fundamentals; first it carries on the average more than 10 per cent more bitumen by weight, i.e., where the 1919 contained an average of 10.6 per cent, the 1920 mixture showed an average of 11.7 per cent; second, the average penetration of the asphalt cement used in 1920 was over 40, in fact ranged from 36 to 46 with the average at 41. Also the average amount of 200-mesh filler was slightly less than in 1919. All of these things combined to produce a much softer and consequently much less stable mixture than was produced by the 1919 design. The great increase in bitumen content was undoubtedly the principal factor. An average analysis follows:

	Per Cent
Bitumen, by weight	11.7
Mineral passing 200	17.0
Mineral passing 80	27.5
Mineral passing 40	35.2
Mineral passing 10	8.1
Mineral passing 4	0.5
Penetration at 77 deg. F.	41

Numerous samples showed more than 12 per cent and one more than 13 per cent bitumen; and in several samples the content of 200-mesh mineral was 12 to 14 per cent. The variation in these two very important items was much wider than in 1919.

To the careful student of asphalt mixtures, it will be immediately apparent that 12 per cent is entirely too much bitumen for such a severe traffic condition, regardless of the penetration. The low penetration of the asphalt will not cure the tendency to distort under traffic, unless it is accompanied by a proper relation between fine mineral and bitumen. Low penetration in such cases most certainly assists, but it does not alone accomplish the result, in fact it is considerably secondary to the bitumen content in its relation to the filler. During recent extensive repairs to the section laid in 1920, pieces of the original pavement plainly showed an excess of bitumen.

It is not known why the radical departure from the 1919 design was made. Possibly some official may have been unduly alarmed at the foundation cracks which appeared during the winter of 1919-1920, think-

ing the asphalt was too hard. It is now certain that the change which was made spoke failure for the altered type of mixture. It is also of interest to know that this failure was predicted by those who were most instrumental in the design of the 1919 work. Signs of the coming rutting and rolling were evident only a few months after the pavement was completed.

There is no question but that the real predominant cause of the extensive rolling and rutting of the 1920 work is the very decided excess of bitumen in the sheet mixture, assisted by a penetration which was at least 10 points higher than it should have been. Bitumen content of not to exceed 10.5 per cent accompanied by a filler content of from 16 to 22 per cent would have prevented this disturbance. The movement of this pavement has been confined to the sheet top, at least in the beginning, and until waves were sufficient to produce an ever-increasing impact sufficient to distort the binder course as well as the top. During the recent repair work, the old pavement from a number of the badly affected areas was carefully examined and no evidence of binder movement could be noted.

Many large cities have examples of pavement disturbance under dense traffic. The remedy is an easy one, but it must divorce entirely the old ideas of asphalt mixtures that were in vogue before the day of extensive motor traffic. The standard sheet asphalt specifications of the city of Chicago have for many years called for 11 to 13.5 per cent of bitumen, with a maximum of 15 per cent of mineral passing the 200-mesh screen Michigan Avenue is only one of several examples of failures that will continue, unless the standards undergo a very decided change.

Truss Maintains Equilibrium in Load on Footings

Load Carried to New Outside Columns for Wide Opening—Transferred Back to Old Footings by Truss

By Charles Carswell
Philadelphia, Pa.

An unusual structural problem, involving the removal in the first two stories of the intermediate columns of one bent, and the transfer of the loads the columns had supported through a new system of steel work to the same foundation on which the columns had rested, is a feature of alterations now being completed on the office building formerly known as the Penn Square Building in Philadelphia. These alterations are part of the extensive changes being made in the building including the addition of two stories, the construction of an entire new front, and interior alterations to link up the building with the Finance Building, adjacent to it on the west, of which the altered structure becomes a part.

The Penn Square Building was a twelve-story structure, built in 1900, and first known as the Levy Building. The two new stories are added without any extensive alteration of the old steelwork, a feature made possible by a change in the building requirements of the city of Philadelphia. The old building was designed for a live-load of 100 lb. per square foot, whereas the present requirement as established by the law of 1919 is for 60 lb. per square foot. The possible increase of load under this condition is therefore about 480 lb. per square foot, which would be approximately equivalent to the load requirements for three floors. The present design is based upon a dead-load of 95 lb. and the live-load of 60 lb. per square foot for all floors from the second to the fourteenth; the first floor is designed for 110 lb. dead load and 120-lb. live load per square foot.

The frontage of the building is 36 ft. 1 in., and its framework comprises wall columns and two intermediate

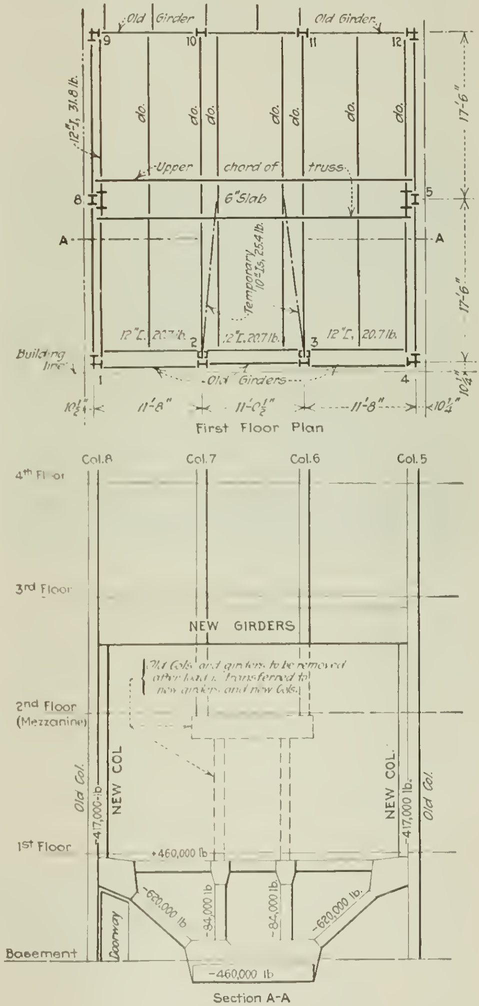
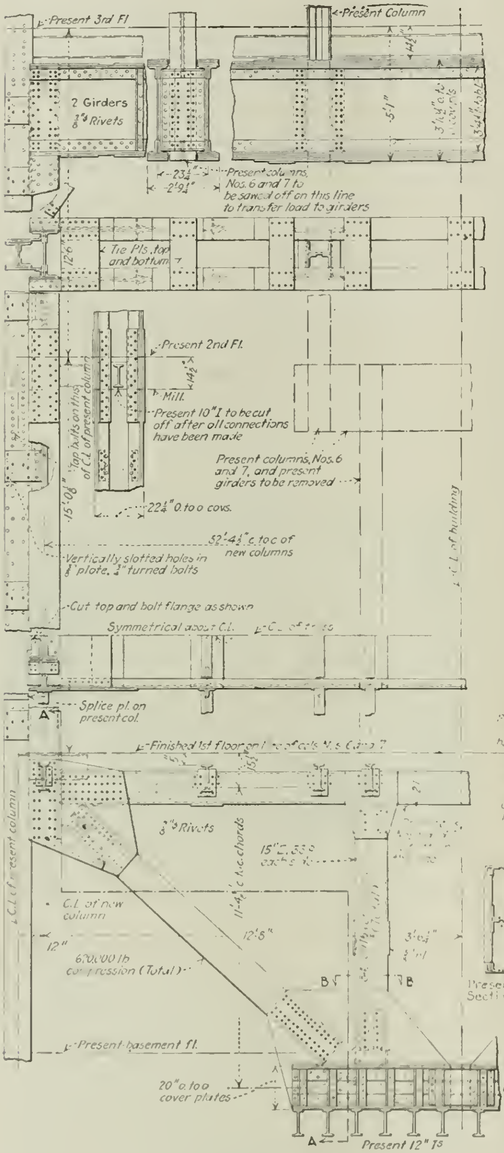


FIG. 1—PART PLAN AND SECTION

rows of columns inside the building, making four columns to each bent. The interior columns are spaced 11 ft. ½ in. apart, and are symmetrical about the center line of the building, except in the second bent. In this particular bent the same arrangement is followed above the second floor level, but in order to secure a better arrangement of store space in the first floor, the two interior columns, in the basement and first tier, were each set 2 ft. nearer the center line of the building, making them 7 ft. ½ in. apart. At the second floor level,



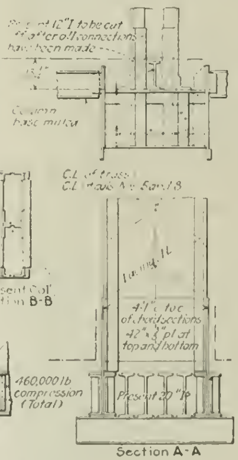


FIG. 2—DETAILS OF THE COLUMNS, TRUSS AND GIRDERS

a girder was connected to the tops of these two columns, and extended out on each side to support the upper tiers at the 11 ft. $\frac{1}{2}$ in. spacing.

In the remodeling it was desired to do away with the second floor in the front portion of the building from the front wall to the third bent of columns. This requirement made necessary the removal of the intermediate columns of the second bent up to the third floor, and for this purpose a system of steelwork was designed to support the columns above that level and to carry the loads to the same foundation on which the columns had been supported. The steelwork consists of a pair of girders placed just below the third floor lever, two new side wall columns, and a split truss in the basement.

The girders span a distance of 32 ft. $4\frac{1}{2}$ in. between centers of the supporting columns, and are composed of $40 \times \frac{1}{2}$-in. web plates, with $6 \times 4 \times \frac{3}{4}$-in. flange angles and necessary cover plates, as noted in the detail of Fig. 2. These two girders are connected to the old columns by diaphragms made of $38 \times \frac{1}{2}$-in. plates with $4 \times 4 \times \frac{1}{2}$-in. flange angles and $8 \times 6 \times \frac{1}{2}$-in. connection angles. This construction is also shown in Fig. 2. The girders are supported by the new wall columns placed on the inside of the building, directly alongside the old wall columns in the second bent. The columns have $20 \times \frac{1}{2}$-in. webs, four $6 \times 6 \times \frac{5}{8}$-in. angles, and two $14 \times \frac{1}{2}$-in. cover plates. They are connected to the old columns by $\frac{3}{8}$-in. batten plates, with slotted holes. This type connection secures lateral support between the columns, and at the same time permits of their independent action as columns. Below the first floor level the new columns are connected to the split truss whose diagonal struts are designed for a total compression of 620,000 lb. They each consist of $14 \times \frac{5}{8}$-in. cover plates with two $6 \times 6 \times \frac{5}{8}$-in. angles, and the members are cross-laced with $3 \times 3 \times \frac{5}{16}$-in. angles. The bottom chord members are spaced 4 ft. 1 in. on centers, and bear directly on the old column grillage. Channel struts at the location of the old columns support the top chord of the truss and the loads of the first floor.

Erection—The new steelwork was erected complete before the old columns were removed. The truss in the basement was erected first, and the new side wall columns were then erected on it and connected to the old columns. The diaphragms for connecting the columns to the girders at the third floor, were next riveted in place on the old columns. The two girders were brought in on the second floor of the building through the windows and riveted to the diaphragms and to the new side wall columns. These connections made the new steelwork complete, ready to support the column loads. The old columns were sawed off at the bottom of the new girders, sawing being used instead of burning in order to transfer the load gradually.

When the supporting steelwork was in place, the floor beams of the second floor were removed. Removal of these beams made too great an unsupported length in the intermediate columns of the front wall so they were each reinforced by a new section composed of two channels extending from above the first floor to the bottom of the third floor steel, and placed on the inside of the old columns and riveted by $\frac{3}{8}$-in. batten plates.

The building is owned by the Finance Company of Pennsylvania. The architects are the Hoffman-Henon Co. of Philadelphia, and Percival M. Sax is engineer.

From Job and Office

Hints That Cut Cost and Time — For the Contractor and the Engineer

Precast Concrete Units Used for English Footbridge

IN THE recent rebuilding of a footbridge over the tracks at a country station of the Southern Ry., England, a novel design consisting of precast concrete units was adopted. This is shown in the accompanying view. The two 38½-ft. girders have their 7½-ft. end panels inclined downward to carry stairways, and the girders are seated on four-post braced towers, the tops of which form landings for stairways parallel with the tracks. Floor beams fit into sockets on the bottom chords of the girders and upon these are laid the floor slabs. The lower stairway girders rest on the towers and the stairs rest on the lower chords of these girders. The units were made at Exeter, where the railway has a yard for the manufacture of various concrete articles. All the girders were cast on their sides. The units were erected by a locomotive crane.

FOOTBRIDGE BUILT OF CONCRETE UNITS
Above: Locomotive crane erecting one of the 38½-ft. girders. Below: completed structure.

Demolition of the old wooden bridge was commenced at midnight on a Saturday and completed by 6 a.m. next morning. The erection of the towers, girders, stairs and other parts was interrupted occasionally by the necessity of clearing the tracks for trains, but the entire work was completed by 7 p.m., except for the grouting of some connections. The cost is said to be less than that for a steel structure, even including the forms, which will be used for similar bridges.

The designs were prepared under the direction of A. W. Szlumper, chief engineer, and the structure is described in the *Railway Gazette*, London, by W. H. Shortt, district engineer.

Sightly Construction Gallery Protects Sidewalk in Chicago

THE UNUSUALLY elaborate sidewalk gallery shown in the accompanying view is not a permanent arcade but is erected simply for the convenience and protection of the public during the construction of the 32-story Straus Building at Jackson St. and Michigan Ave., Chicago. Since it was felt by S. W. Straus & Co., the owners of the building, that the usual rough timber gallery or shelter would not be in harmony with the building or its surroundings, the architects were instructed to provide a sufficiently artistic structure and the design was submitted to the South Park Commissioners for consideration. Arches and ornamental railings are placed in the openings between the posts which support the working deck over the sidewalk, and an

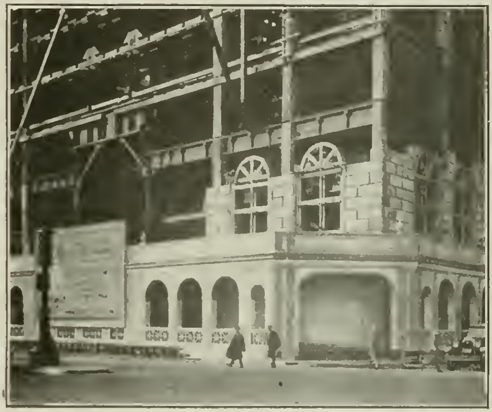


FIG. 1—SIDEWALK GALLERY AT STRAUS BUILDING, CHICAGO

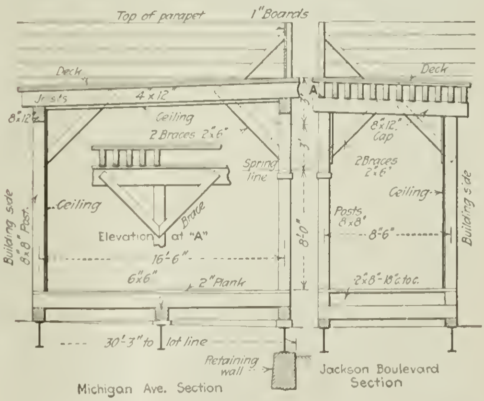


FIG. 2—STRUCTURAL DESIGN OF SIDEWALK GALLERY

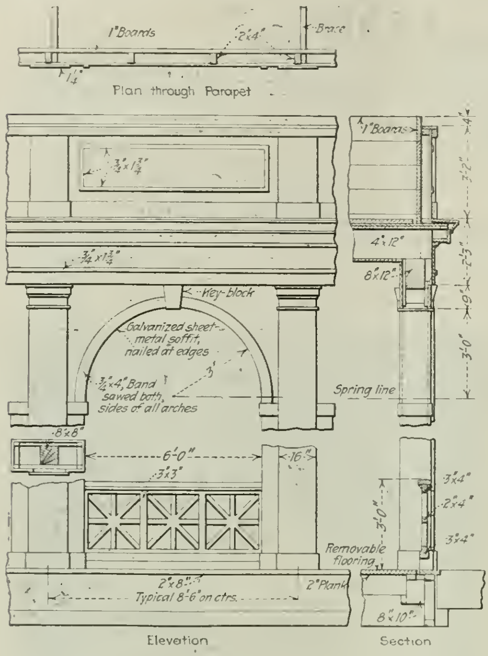


FIG. 3—ORNAMENTAL FEATURES OF GALLERY

ornamental parapet surrounds this deck. The structure is painted in two shades of light buff or stone color, and on each street face there is a large panel with a reproduction of the architect's design for the completed building. At first the floor was above the sidewalk level and was reached by two steps, but this floor was removed after completion of the permanent sidewalk.

In its structural design, shown in Figs. 2 and 3, the gallery consists of two rows of 8x8-in. posts spaced 8½ ft. c. to c. on the Jackson St. side and 16½ ft. for the wider Michigan Ave. sidewalk. Longitudinally the spacing is about 8½ ft. c. to c., with archway openings of 6 ft. clear width, but at the corner and at the contractor's driveway entrances the clear width is 15 ft. On the Michigan Ave. side the posts carry two lines of 8x12-in. stringers on which are transverse 4x12-in. joists spaced 10 in. c. to c., but on the Jackson St. side the posts carry 8x12-in. transverse caps with longitudinal joists of the same size and spacing as above. Knee braces are attached to the joists in the former case and to the caps in the latter. The deck which slopes down towards the building, consists of two courses of ⅞-in. boards with a layer of roofing paper between them and 2-in. plank battens on top. The posts rest on 8x10-in. sills carrying 2x10-in. joists, 18 in. c. to c., with a single layer of 2-in. plank to form the sidewalk. The 42-in. parapet has four rows of 1-in. boards, with braces at intervals. Sheathing is applied to the posts and under the joists.

This structure is designed for a live-load of 500 lb. per square foot on the working deck. Although the design might appear to be somewhat expensive for a temporary structure, the cost was found to be only slightly greater than that for an ordinary rough and unpainted shelter or gallery. The general contractor is the Thompson-Starrett Co., and the architects are Graham, Anderson, Probst & White, Chicago.

From Job and Office

Hints that Cut Cost and Time

Device Removes Sand from Gravel Wells

By C. K. Calvert
Assistant Sanitary Engineer, Sewage Disposal Plant, Indianapolis, Ind.

IN FINISHING wells which will supply water for the new sewage disposal plant at Indianapolis the old air-lift idea to clear them of sand was used but the operators became disgusted with the hand-operated discharge valve and a home-made automatic control was devised. Condenser water for the main power plant of the disposal works is to be supplied mainly from these gravel wells on account of the low temperature of the water. Since it will be used in surface condensers, it must be reasonably free from sand.

The sand is removed by air-lift as follows: When the pump pit excavation is completed, an air-lift is installed with its discharge passing through a special flange which makes the casing head airtight so that pressure may be built up and held in the casing. Air is delivered to the ejector head continuously. Manipulation of a valve on the discharge line causes periods of pressure to alternate with periods of pumping. The pressure forces water and air through the screen, dislodging and agitating the sand and gravel, and on release the water rushes back into the casing, carrying sand which the air-lift discharges with the water. The sand so removed is replaced by gravel piled around the casing on the excavation floor and is replenished after settling.

Extensive tests determined the optimum duration of pressure and pumping periods. Operation of the ordinary gate valve on the air-lift discharge line is time consuming, and a quick-opening valve was substituted. As hand operation was erratic and not dependable, the

FIG. 1—HOME-MADE VALVE CONTROLLER
Bucket on right end of lever arm up and receiving a portion of water from sand tank.

From Job and Office

For Contractor and Engineer

automatic valve control shown in the illustration was devised to reduce the time of sand pumping and eliminate the cost of an operator.

On starting the air-lift, the mechanism is in the position shown in Fig. 1, the counterweight on the left of the arm is down. This holds the water bucket on the right up and in position to receive water from the sand tank overflow. The rod on the right end of the arm holds the air-lift discharge valve open.

Water now flows through the sand-tank overflow line, a controlled part of it going to the water bucket. When the counterweight is overbalanced, the water bucket falls, clearing the stream of water which filled it, and closing the air-lift discharge valve. During this period the water and air rush out of the casing through the screen and disturb the sand and gravel. This position, shown in Fig. 2, is maintained until the water in the bucket runs out through a bottom valve. In this position the air pressure is released, the water, carrying the fine sand, rushes back through the screen into the casing and is raised to the sand tank by the air-lift. The operations are repeated as long as air is supplied to the air-lift.

By manipulation of the valve into and out of the water bucket, the time of filling and emptying, and consequently the period of pumping and pressure on the well, may be varied widely. When adjusted to any rate, the operation is constant and needs little attention.

The sand tank is baffled and provided with a cone bottom which facilitates sand removal. It is usually removed and measured once in 24 hours.

The installation has proved satisfactory. It clears the well of sand in the shortest possible time and gives an opportunity to observe the rate of sand removal and its total volume.

FIG. 2—SECOND POSITION OF VALVE CONTROLLER

Bucket full descends and angle coupling diverts discharge away from bucket. Rate of flow from pipe in side of bucket near bottom determines the interval before light-colored bucket (left) and counterweight lifts empty bucket and opens valve.

How Dynamite Is Used in Ice Blasting

By N. D. Rand

Technical Division, Atlas Powder Co.

During the winter months ice forms so quickly that at times shipping is bottled up. To relieve icebound boats a channel must be opened and the most practical and quickest way, as well as the least expensive, is to blast the channel out with explosives.

There are two methods of opening up a channel: (1) by placing light charges along the edge of the ice the width of the desired channel and (2) by placing charges along the center line of the channel. The former will break the ice into small cakes, and the latter must contain charges heavy enough to break the ice the entire width of the channel. An experiment in both methods will determine which is the better for the particular conditions encountered.

In order to open a channel holes should be cut through the ice with an ice spud, a splicer bar, or a crowbar. These holes should be from 6 in. to 1 ft. in diameter and cut through the ice to the water beneath.

A good blast does not throw ice and water high up into the air. If that happens, the next charge should either be decreased or lowered further into the water. Distance apart at which to place holes can be determined from the area broken, though the usual distance is from 15 to 25 ft. If there is a current sufficient to carry out the ice charges may be so placed as to break the ice into large cakes. Where no appreciable current exists, ice must be broken into small sizes.

In preparing a charge a rule-of-thumb method which will be successful calls for the use of three times as many cartridges as the thickness of the ice is in feet, and a depth below the ice of one-twelfth of the diameter of the area to be broken. The required number of cartridges should be tied together after having primed one with a waterproof electric blasting cap and smeared a waterproofing compound over the hole where the cap enters the cartridge in order to exclude water from the powder. The cord used to tie the cartridges together should have a free end long enough to lower the charge to the required depth. To hold the charge at the proper depth, tie the free end of the cord to a stick of wood placed across the top of the hole. Dependence should not be placed upon electric blasting cap wires to hold the charge in place. The following table indicates the quantity of explosive to be used and the depth under the ice at which it should be placed for best results in ice of varying thicknesses:

TABLE OF CHARGES

Thickness of Ice in Feet	Number of Cartridges of 40% Gelatin Dynamite	Depth Below Ice in Feet	Diameter of Area Broken in Feet
½	1	1½	20
1	3	2	25
1½	4	3	35
2	6	4	50
3	10	5	60
4	20	6	70

Charges should be fired electrically as it enables several charges to be fired at the same time, the combined force of which will break up more ice than if each charge is fired independently.

Large cakes of floating ice may be broken by laying a large charge of dynamite on top of the cake and priming with cap and fuse. The amount of the charge may be determined after a few trials, starting with one or two cartridges. The following table shows the approximate number of 1¼x8-in. cartridges of 40 per

cent strength necessary to break cakes of varying thicknesses:

Thickness of Ice in Feet	Number of Cartridges
½	1
1	2
1½	4
2	6
2½	8
3	10

If it is impossible or unsafe to get on the large cake of ice in order to place the explosive, the dynamite may be tied to a stone or stick of wood, the fuse lighted and the charge thrown upon the cake of ice in such a manner that it will land as near the center as possible. Such charges are primed with cap and fuse, the fuse being lighted just before dropping the explosive to the ice, and of a length sufficient to permit the cake of ice to float away before the charge detonates. Safety fuse burns at an approximate rate of 2 ft. per minute. Therefore, it should be cut to a length corresponding to time it is desired to fire the charge after lighting.

Another use to which dynamite may be put is in breaking up ice jams at bridge abutments or narrowed river channels, etc. Under such circumstances timely action may prevent considerable damage to construction work. The size of charge is dependent upon the thickness of the ice piled up. In this class of work it is advisable to use a blasting machine and electric blasting caps because of their greater safety. If the ice has piled between piers of a bridge the explosive charges should be placed in the ice midway between piers and all charges fired simultaneously with a blasting machine. Place the charge as near the front of the jam as possible, because there is where the cakes have become locked. If the ice does not break at the first charge successive heavier ones should be used until it starts to move. Where gorges have formed to a considerable thickness making it difficult to dig a hole through the ice with the tools at hand, a small hole can be cut into the ice as far as possible and one or more cartridges exploded to cut the hole deeper. This operation can be continued until a hole is cut either through the ice or to the desired depth.

To prevent the formation of a gorge where it is liable to appear every year at the same point, begin at a short distance downstream and honeycomb the ice all the way upstream by successive charges. When the thaw comes the broken ice will go out in a body with less likelihood of jamming.

Explosives have also been used on occasions to cut through deep snow drifts and to start snow slides on hillsides.

The proper explosive to use for ice blasting when the charge is placed beneath the ice is a low-freezing, strong, fairly quick acting explosive not readily affected by water. Low-freezing extra dynamite and low-freezing gelatin dynamite are well adapted for the purpose. If the charge is placed on top of an ice floe, a quick-acting explosive should be used, either low-freezing straight nitroglycerin dynamite or non-freezing dynamite of 50 per cent strength or sometimes stronger. Unless a non-freezing explosive is used, particular care should be exercised to see that the dynamite is not frozen. A low-freezing dynamite will not freeze during the short time that it is in the water, but if it is previously frozen it must be thawed before being used.

The materials for ice blasting can most conveniently be carried over the ice in a box fastened to a sled. Full instructions for priming a charge, either by the cap and fuse method or by the electric blasting cap method, may be obtained from literature published by any explosive manufacturer.

From Job and Office

Hints that Cut Cost and Time

Contractor's Sign at Large Building

ON EXTENSIVE construction works, especially on building erection, it is becoming general practice to display large signboards bearing the names of contractors and sub-contractors. In this way adequate publicity is given, while the unsightly appearance of numerous individual signs of various sizes and styles is avoided. A combination sign of this kind, erected by the Wells Brothers Construction Co. at the new Fur-

SIGN ON CHICAGO STRUCTURE DURING ERECTION LISTS ARCHITECTS AND CONTRACTORS

From Job and Office

For Contractor and Engineer

niture Mart Building, Chicago, is shown in the accompanying view. It is about 8x30 ft., built up of sheet-metal panels. As a rule, these signs are made and placed by the contractor, but in the case of the Furniture Mart a sign company made an offer to the contractor to erect a satisfactory electrically-lighted sign and as the price was considered favorable this offer was accepted.

In arranging for this sign, the contractors knew that not all of the sub-contractors wished to have their names posted, but on the basis of the expected number the cost was divided between architect, contractors and sub-contractors on a pro-rata basis according to the space used. One form letter was addressed to all sub-contractors telling about the proposed sign and asking them to forward copy if they desired to participate. No further solicitation was used. It is believed that this plan accomplished the desired end satisfactorily, with less trouble to the contractors and no greater expense to any of the participants than if the sign had been made in the usual way. Any method which requires or compels sub-contractors to take space is evidently undesirable. The cost of a large sign is no small item and logically it should be paid for by those who desire to benefit from it.

Construction of a 9-ft. Pipe Line Six Miles Long

THE OAK GROVE hydro-electric project of the Portland Railway Light & Power Co., now under construction on the Clackamas River in Oregon, has a 9-ft. pipe line six miles long. This line will supply the first of three 35,000-hp. generating units which will operate under an effective head of 860 ft., the static head being 925 ft. When the other units are added a second pipe line 11.5 ft. in diameter will be laid paralleling the one now being built. Work on the project is advancing rapidly and the pipe line is expected to be completed by February, 1924, about two months before the plant is scheduled to go into service. A note on the general features of this development appeared in *Engineering News-Record*, Aug. 2, 1923, p. 197.

The distance between intake gates and turbine is 36,334 ft. traversed as follows: 32,900 ft. of 9-ft. steel pipe, which is kept below a controlling hydraulic grade of 2 ft. per 1,000; 2,150 ft. of concrete-lined tunnel, and 1,300 ft. of penstock down a steep incline, the pipe diameter here varying from 8 ft. at the top to 6 ft. at the bottom.

The steel plate for the pipe, varying from $\frac{5}{8}$ to $1\frac{1}{8}$ in. in thickness, was produced at Sparrow Point, Md. and delivered by water to Portland where it was formed into pipe sections 40 ft. long. These sections, weighing about 9 tons each, are transported on flat cars to unloading stations established on the construction railroad at convenient points along the pipe-line grade. Most of these unloading stations are at higher level than the pipe grade and sections are snubbed to the grade on skids with the aid of a cable. On all plate thicknesses of $\frac{3}{4}$ in. or less the pipe is reinforced by outside stiffener rings made of 5x3x$\frac{3}{8}$-in. angles spaced 2 ft. 9 in. apart. These angles have been of material assistance in making the pipe rigid for handling.

Laying the Pipe—In the construction program as planned at first, overhead cableways were to be used for moving the sections along the grade from unloading station to final destination. This plan was abandoned in favor of a gantry traveler that would straddle the pipe line and move sections along the grade as required.

The device built for this purpose and shown in the accompanying picture is a structural steel frame mounted on wheels set for track of 11 ft. 8-in. gage. It has a wheel base of 16 ft. and is 12 ft. 8 in. high. The operator's station is on the "upper deck" where the motor, cable drums, etc. are located. Power is supplied by a 50-hp. gasoline motor taken from a 5-ton truck and this is geared down so that a maximum speed of about 250 ft. per minute is made along the track.

When a pipe section arrives on the grade it is rolled between the gantry rails; the gantry moves over it and the section is picked up by cable slings from drums

GANTRY CRANE PICKING UP 40-FT. SECTION OF PIPE

directly overhead. To facilitate rapid handling of the pipe without danger of damage, pieces of old automobile tire casings are fastened to the wood stops over the pipe-way in the traveler to serve as cushions. On delivery the gantry does no exact setting in place, but leaves the section in its approximate position on the grade.

The riveting gang uses a traveler similar to the one already described except that power is supplied by a 7x10-in. steam donkey mounted on top of the steel frame. With this traveler the pipe section is lifted by slings from a boom that can adjust the position of the section as may be required.

With this plan of operation, as many as 16 pipe sections have been placed in 8 hours. The traveler crew consists of five men in addition to which are the crew that snubs sections down from the railroad and the gang that picks up and re-lays track. Track is moved ahead by the gantry and is set by use of the two booms shown in the picture. The rails, in 20-ft. pieces, are spiked to 8x16-in. timbers of the same length, no cross-ties being used.

The pipe distribution is being done by the Hurley-Mason Co., of Portland, who are the general contractors on the project. The J. G. White Engineering Corp., New York, are the consulting engineers. H. A. Rands is construction engineer for the Portland Railway Light & Power Co.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Should Concrete Swimming Pools Be Emptied in Winter?

Sir—In replying to the question, "Should Concrete Swimming Pools Be Emptied in Winter?" asked by Adams & Ruxton Construction Co., in *Engineering News-Record*, Nov. 22, p. 858, the editor advised that, so far as his experience went, such pools were always emptied. While the usual custom is to empty concrete pools, we do not believe it is necessary to do so, and in fact we know of three such pools, located in cold climates, that are not emptied and no trouble has resulted.

If concrete pools are allowed to stand empty and without protection throughout the winter, we suppose that it is done to protect the walls from the horizontal pressures which a sheet of ice on the surface is presumed to exert. We say "presumed to exert" as there seems to be little or no conclusive evidence or positive knowledge as to whether such pressures actually develop in comparatively large bodies of still water contained in rigid walls, and if so, how much pressure actually develops.

As suggested by Adams and Ruxton, we are inclined to believe that a penetration of frost through an unprotected concrete floor slab into a more or less saturated subgrade to a depth of 4 ft. or more would be likely to cause some displacement of the slab with a possible injury to it.

The vertical walls of a pool are designed to resist the normal pressures of the soil when the pool is empty, but they are not designed to resist pressures of frozen earth as the knowledge of such pressures is inadequate for accurate design. A discussion of the formation of ice may shed some light on this interesting problem.

When freezing weather comes, ice forms first around the edges of the pool and as the sheet of ice builds out toward the middle, the thickness at the edge increases. Finally a closure is formed at the middle of the pool and the sheet of ice increases in thickness by building downward. Each additional inch of ice formed on the bottom of the ice sheet displaces approximately 0.1 in. of water. The displaced water finds relief through the path of least resistance which in this case is upward through the sheet of ice, causing it to bulge up slightly at the middle. Thus, if ice were formed with a uniform thickness of 10 in., it would be bulged up into a slight dome shape by approximately 1 in. of displaced water over the surface of the pool. The maximum horizontal pressures against the sides of the pool will be limited by the strength of the slab of ice in resisting the uniform load imposed by the upward pressure of the water. Now if the pool has a minimum width of 25 ft. and the ice a thickness of 12 in. the sheet of ice may be considered as an unreinforced flat slab 12 in. thick with a 25-ft. span uniformly loaded by the upward pressure of the water. If we assume that ice has a tensile strength of 150 lb. per square inch, a slab 12 in. thick having a span of 25 ft. would resist pressure of only 46 lb. per square foot. The increased pressure against the sides of the pool would be approximately equal to that of an additional 9-in. depth of water.

In view of the above considerations, we believe that there is less probability of injury to a well designed pool having minimum dimensions of 20 ft. or more where it is left filled with water to a depth of 1 ft. below the normal level than where it is completely drained for the winter.

A pool at Garden City, Kan., 218 x 345 ft. in plan, with three sloping walls and one vertical, has been allowed to freeze with no apparent damage. A rectangular pool at Abilene, Kan., 60 x 120 ft., with four vertical walls, has been allowed to freeze every winter since 1914 without damage. Some winters the ice was more than 18 in. thick on this pool. A 63 x 155-ft. rectangular pool with all walls vertical, at York, Neb., has been allowed to freeze several times without injury.

Experience and observations of other engineers and managers of pools would add to the knowledge on this subject. Most assuredly, if it is possible to utilize concrete swimming pools as winter skating rinks, such use should be made of them, thereby adding several months per year to the period of their utility.

C. D. Hale,
Civil Engineer.

Chicago, Ill.,
Dec. 4, 1923.

Shoddy Building Work Briefly Reviewed

Sir—I have just read in the morning's paper of the dismissal of three of the four indictments which grew out of the collapse of the American Theater building in Brooklyn on Nov. 29, 1921, and am prompted to suggest that this item of news affords an opportune occasion for your paper to review the conditions which preceded and surrounded this conspicuous illustration of the ineffectiveness of existing methods of controlling building operations, in the interest of elementary public safety right here in Greater New York.

The following quotations from statements published in the Brooklyn *Eagle*, reporting actual court testimony, ought to prove illuminating in this connection and help to keep alive an interest in all efforts made to improve the underlying conditions responsible for this disaster.

The architect is quoted as testifying that he had employed a relative of the Superintendent of Buildings "to draw up the plans for the steelwork and facilitate the passing of the plans by the Building Department." He is also quoted as testifying that these first steel plans were not used in construction, but that plans made by the steel contractor were later substituted. The architect's connection with the work, however, apparently ended with the furnishing of plans.

The plan examiner in the Department of Buildings is quoted as testifying that he had made 21 objections to the plans submitted by the steel contractor, and that the changed plans were not finally approved until Nov. 2, 1921, a date about two weeks later than the date sworn to by the steel erector as that on which he completed his work. In other words, the steelwork had been erected about two weeks at the time the steel plans were approved.

The steel erector is quoted as saying that he had no working plans, but erected the work "just by putting things where they seemed to fit," and after being shown the approved plans said they were not followed in the work.

The same erector is reported as testifying that he knew the main column was not plumb, that the base plate was too small and that he had forced wedges under it "to take up the slack," and, further, that an excavation was made alongside the column footing and where jacks were used to force the column into an upright position.

The Superintendent of Buildings is reported to have said, "No permit had been issued and I did not know that the building was in course of construction until I received news of the collapse."

The iron inspector of the Department of Buildings is quoted as saying, "I don't think there is an exception in the whole borough where the theater has not been allowed to go ahead before the steelwork has been approved."

Much more of the same sort could be quoted, but the whole situation is well summed up in the memorandum filed by the presiding judge as follows: "There was no architect in charge of the work. There was no competent supervisor. There was no responsible engineer. There was no approved plan for the steelwork. There was no official permit allowing its erection." In spite of all this it has proved impossible to fix responsibility for the loss of life, and the incident will probably be forgotten until the next similar disaster recalls it to attention.

J. B. French,
Consulting Engineer.

New York, Dec. 7, 1923.

Bending Action in Bascule Bridge Counterweight Failures

Sir—Your article of Nov. 29, p. 872, on two accidents to bascule bridge counterweights attributes these failures to the excessive distortion developed in the members of the steel frame of the walking-beam. The distortional or so-called secondary stresses in the members of this frame are undoubtedly very high, but it seems equally probable that the cause of these failures may be due to the design of the truss members embedded in the concrete counterweight.

This trussing is relied on to pick up all the weight of the concrete by its adhesion to the steel which is embedded in the concrete. The members of this trussing are only designed to take direct stress, and therefore all the adhesion must take place at the panel points or in a plane parallel with the members, if bending in them is to be avoided. The former is of course impossible without developing infinitely high adhesive or bearing unit stresses, and it seems very doubtful if the latter condition can be fulfilled for all the positions of the counterweight. The stiffening effect of the concrete on the embedded members, to enable them to take cross-bending, cannot be effective if the steel is not capable of taking shear in itself, which is the condition here.

Should excessive bending be developed in the embedded members of the counterweight trusses adjacent to their connection to the walking-beam frame, they in turn must exert a moment in the connection, which would produce a tearing action on the chords of the walking-beam and cause them to break at the same point where they would be most severely strained by distortional strains of the walking-beam trussing itself.

Another point to consider is the excessively high range of unit stress in the embedded trussing. It seems questionable whether concrete can permanently adhere to steel that has a frequent strain range of 20,000 to 30,000 lb. per square inch.

The nature of the break at the Lachine bridge would seem to indicate a progressive failure of the bond between the concrete and steel near the point where the trusses deliver their loads to the walking-beam frame. The bond between the concrete and steel being a maximum at the outer edge may have broken down and the fracture continued to spread every time the bridge was operated and the stresses reversed, until this part of the steel frame which had lost the stiffening effect of the concrete was overstressed and failed. The adjoining views show the break in the embedded truss connection which first gave way. It will be seen that the break occurred at the point in the member where it is weakest to resist local cross-bending.

Taking off the side plates on the two bridges should not have weakened the structure, as the bolts passing through these plates and the concrete were not designed or constructed to take any shear, and the value of any adhesion between these plates and the concrete could not be relied on. It was generally thought at the time of the first accident that, if the plates did partly support the counterweight, the eccentric position of the plates was a real danger to the structures and may have contributed to the cause of the break in the chord.

The correct analyzing of the stresses in the counterweight trussing is a most confusing and complicated problem, and until it is clearly understood the causes responsible for these failures cannot be decided. BRIDGE ENGINEER.

Dec. 4, 1923.

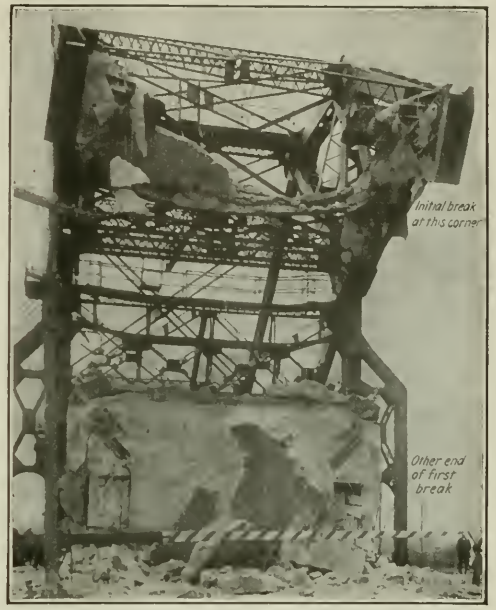


FIG. 1—LACHINE CANAL BASCULE SEEN FROM BACK OF COUNTERWEIGHT AFTER FAILURE

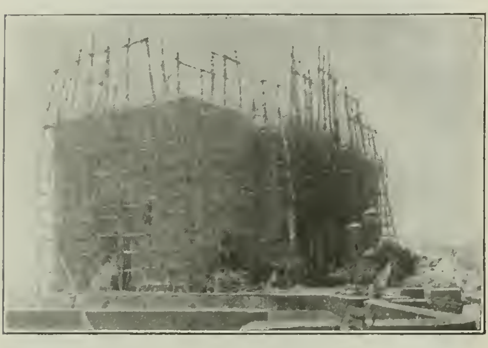
Rear edge of counterweight lies on ground, front end is at top. Right hand side was place of initial failure.

FIGS. 2 AND 3—CLOSE-UP VIEWS OF INITIAL BREAK AT TRUSS AND COUNTERWEIGHT ENDS

Construction Methods in India

Sir—In the East labor is plentiful and said to be cheap. It would appear to be so, if we may judge from the methods adopted in the construction of the "Gateway of India" now being erected on the Apollo Bunder, Bombay. If such a building were being erected in the West, a large crane would have been placed in a suitable position, and worked by some kind of power. But in India, no! Man-power is cheaper, and the contractors follow the primitive method of elevating material by means of pulleys and ropes.

About twenty men hold the rope, and pull up the stone



BUILDING THE "GATEWAY OF INDIA"

a short distance, chanting a kind of sing-song all the time. There are several men stationed on the bamboo scaffolding to direct the course of the stone as it steadily rises to the top of the building. It seems curious that modern methods of hauling should not more quickly be adopted in India.

Hassan, India, "AJAX."
Oct. 2, 1923.

Providing for Secondary Stresses

Sir—Your editorial of Nov. 29, p. 872, in regard to the danger of failure from secondary stresses, seems to me to be very timely and likely to be very useful. American structural practice in the last 25 years has developed more and more the use of large riveted joints instead of the pin joints used in earlier designs. Probably this tendency has been due partly to the pneumatic hammer, which drives a good field rivet so cheaply. Partly also it has been due to the great increase in stiffness secured by using rivets instead of pins for joint connectors.

We have all known that in some way the structure pays for that increase of stiffness. But there are two considerations which offset a loss of ultimate strength due to secondary stresses in a bridge truss: (1) Impact or vibration is reduced by the increased stiffness, and girder action reduces the stresses from truss action. The total direct stress on the members is thus relieved. (2) The induced secondary stresses before causing failure tend to relieve themselves by permanent bends in the members. The second consideration taken at its face value would seem to indicate that no member could pass the elastic limit from direct and secondary stress alone.

There is a third consideration however, that should make us fearful of the repetitive effect of strong secondary stresses on compression members. Suppose that under a severe loading the given member has such bending from secondary stress that some fibers pass the elastic limit. The member will then take a permanent bend. Under the next application of the same loading the stress from secondary action will not be so large as before, but there will be an increase of eccentricity in the member which might cause the stress in the same extreme fibers again to pass the elastic limit, and cause a further bending. Relief of secondary stress by the bending of heavy tension members might overcome the effect of additional eccentricity in the compression members, but we should not cheat ourselves into security by maintaining that secondary stresses can never cause failure.

It seems very clear that the exact computation of secondary stresses in minor structures cannot be undertaken or recommended. We have progressed to the point of regarding them in large structures, and even of attempting to remove by initial bending those caused by dead-load. We might, by introducing initial eccentricities in the large compression members, perhaps halve the secondaries from dead-load. In minor frames, if the designer understands secondary stresses and keeps them in mind in laying out his structure and in designing its members, he can keep their effects to a minimum without going through long and tedious calculation. He should make the compression members as shallow in the plane of the truss as other design considerations will permit. He should make gusset plates as small as possible.

Many of us cannot help feeling that a wide gusset plate strengthens a structure. Even in mill-building trusses where a stout kneebrace must take nearly all the wind stress, a big gusset plate riveted into the column makes the structure look more secure. There is no reason, however, why the coming generation of structural engineers should not have the advantage of a clear mental picture of secondary stress action and an understanding of the factors which influence it.

"Modern Framed Structures," Vol. II, contains considerable data from computation of secondaries. Maney's short cut of the slope-deflection method is the most rapid method I have seen in print, but that is not generally available for class-room use. Nevertheless the instructor in structural engineering could send his men out fairly well prepared to analyze secondary stresses or to minimize them in design, if it were not for the chorus of successful graduates of the middle ages, who tell the young engineer, "we never compute them." In late years, this has been somewhat overcome by the publicity given the secondary stress computations on several large bridges, and the interest that the design offices of large bridge companies are showing in the subject.

Your editorial and more discussions in the future will do much to help the instructor who is trying to make a class look upon secondary stress calculations not as advanced drill in calculus trigonometry and algebra but as a fundamental for men who are going to make structural design their life work.

ALBERT SMITH,
Chicago, Dec. 13, 1923. Consulting Engineer.

Public Service Discouraged

Sir—I have been reading with a great deal of pleasure the articles that you have been presenting from time to time relative to the irrigation problems of the West, and more particularly with reference to the present "business attitude" of the Secretary of the Interior in his dealings with the Reclamation Service. As I have devoted much time in the past to the passage of the original Reclamation Act, and served thereunder for a term of years, and live in arid America, I am, of course, keenly interested in the present situation.

To my mind, the most serious aspect of this Reclamation situation lies in the fact that if high-grade men like Arthur P. Davis and F. H. Newell can be utilized for the creation of a great, meritorious organization, which subsequently is seized by politicians to be operated as a part of a machine for party benefit, then it is basically discouraging to attempt similar organization efforts with such institutions as federal roads, swamp reclamation, harbor improvements, forestry and the like. This discouragement not only applies to competent young men entering the public service, but to such work as we are endeavoring to do through our great commercial organizations. For instance, the Los Angeles Chamber of Commerce has very active committees that are endeavoring to build up legitimate public sentiment in favor of such projects as the Colorado River development, and when they are confronted with a situation such as has been developed, they naturally are discouraged in their efforts.

For these and other reasons, I think that you are fully

justified in using the great influence of your paper in persistently and vigorously condemning any such action on the part of public authorities.

J. B. LIPPINCOTT,
Consulting Hydraulic Engineer.

Los Angeles, Calif., Dec. 5, 1923.

Ethics and Success

Sir—Your editorial, "An Experiment Worth Trying," of some weeks ago prompts certain reflections.

Probably the yet-to-be-unearthed Tel-el-Amana clay tablets, or the picture writings of prehistoric races, will on deciphering be found to contain well-meant advice to the aged engineer and architect, on how to get a job honorably, and the high ethical standards that ought to prevail in securing it.

The doctor, the lawyer, the dentist, all would starve to death if they lived according to the old theory of occupying a chair in their office and patiently waiting for customers. The practising engineer is in the same category: he must *get* the business.

Assuming "fitness" and "character," he must *make friends*, not alone those of family and boyhood, for rarely can they be counted upon; but the friends made through personal worth and their willingness to introduce, where introduction is of value, and in some cases even personally provide the start.

Competition is the keynote of the day, and that is inevitable throughout every year of the engineer's life, but there can be proper competition and *indecent* competition, and engineers have themselves most to blame for the latter.

A municipal board awakens to the need for an improved water plant, sewage works, refuse disposal system, modern pavements, etc. A local engineer may be quite worthy and even competent, but at the last election he worked for Councilman Jones, so as said Jones is in the minority, Mr. Engineer is out of it. Informal word goes out through the press and the board is swamped with letters from 1,000-mile range, "Me"—"Our Firm"—"My Esteemed Friend"—"We will be glad to advise you briefly without charge"—"Our experience is superlatively beyond that of all our confreres"—etc., ad nauseum.

What happens? The board is drowning; some active member says, call for engineering proposals; and that there may be a semblance of fairness, they do so upon a "Specification of Needs." And what a specification!

Then the deluge; every good-for-naught engineer (and unfortunately a few good) files his proposal and supporting data, and begins his drive to secure votes in the board. The board, usually an unremunerated body, has neither knowledge nor time for real investigation of merits, and with the fear of voters at the next election, if attention is given to other than the lower bidders, either throws up the job, or selects chiefly on the basis of insistent nerve and cheapness, thereby failing often to secure the competent man, and in the long run, putting the community to much greater gross expense.

This is no fancy picture, but a common occurrence.

The writer offers no cure, though absolutely out of sympathy with the method, which possesses no redeeming feature.

If engineering is to be considered a profession, and if the engineer is to be looked upon as one worthy to give, and charge for, advice, such practices must end.

The card in technical journals, papers before professional societies, experiments made and written up, attendance at and participation in engineering meetings, all help, but do not bring much bread and butter.

Membership and active service in civic organizations, appearances before municipal bodies, for other than self-exploitation, are excellent.

Letters of introduction to parties having work in charge, or responsibility for it, are perhaps the most powerful aids to landing the job, while in absence of such possibility a frank request for interview, or dignified offer of services and simple statement of qualification, with a few names for reference, may sometimes bring a reply and once-in-a-while land a job.

One piece of work well done usually leads to others.

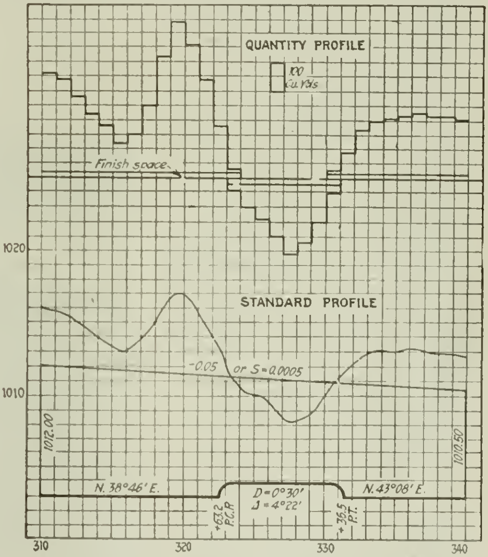
In closing, at the risk of the senile charge, let the writer say, while much unfortunate fact exists as to contrary practice: "Ye cannot serve two Masters."

New York City, Dec. 20, 1923.

LOUIS L. TRIBUS,
Tribus & Massa, Engineers.

Quantity Progress Profiles

Sir—The disadvantages of showing monthly progress of railroad or canal construction in colors or hatching on the standard profile platted on either plates "A" or "B" are well known. The distorted relation between elevation and volume, necessity of showing "finishing" as well as bulk movement of material, different methods of construction under different conditions, irregularity in application of force in different months, and the different free-hand styles or personal equations of the various resident engineers who compile the progress are the most conspicuous of these.



QUANTITY PROGRESS PLATTED SEPARATELY

Some fifteen years ago when the writer was in Idaho he was shown a progress profile in use on irrigation construction, of which the enclosed is a rough sample, made from memory. The system used was different hatching for each month's progress on the upper or quantity profile, made on transparent paper. Prints were taken from this, as required.

It seems that the quantity profile will give a more accurate view of progress than to hatch or color the lower profile; that the method is feasible for use on canal construction, and on plate "B" is adapted to railroad construction on light grades and not to irregular ground, but for mountain work would be impractical or would require the full width paper instead of the usual half width.

It is also evident that the quantity profile could not be platted until after the quantities had been computed and that probably considerable extra work and expense are involved.

In some twenty years of construction experience, the writer has never seen a satisfactory progress profile using the standard platting, and would like to learn from actual users their ideas on the "quantity profile" and whether the benefits from this same have warranted the additional trouble before putting it to actual use.

Nov. 24, 1923. Cope Rand Means Co., Engineers.
San Francisco, Calif., H. S. MARTIN,

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

The Municipal Docks and Terminals of Jacksonville, Fla. will earn a net profit of $80,000 this year according to an estimate made by the general manager.

The Annual Convention of the County Commissioners of Ohio will be held at the New Southern Hotel, Columbus, Feb. 5 and 6. This meeting will be followed by the convention of the Ohio Engineering Society, which will be held at the same hotel Feb. 7 and 8.

Col. Frederick Stuart Greene, New York State Superintendent of Public Works, it is understood will advocate in his recommendations to the legislature a tax on the sale of gasoline, which it is estimated would provide a fund of $20,000,000 yearly which could be used for maintenance of state and county highways, and render unnecessary legislative appropriations.

Report From the Contractor's construction camps at the Moffat Tunnel in Colorado stated that on Dec. 4 a total of more than 1,000 ft. had been driven in the two headings. The pioneer heading at the west portal had been advanced 654 ft. and the pioneer heading on the east end 400 ft. At the west end the bore is now in hard rock and since passing the point where timbering was necessary much more rapid progress had been made.

A Resolution Adopted by the Senate provides for extending the scope of the special deeper waterway committee of the Senate so as to provide for House participation in its membership. The resolution authorizes such a joint committee to continue the work already done by the Senate committee in investigating the problem of the 9-ft. channel from the Great Lakes to the Gulf of Mexico. Included in the proposition is the matter of the navigability of the Ohio and the Missouri rivers.

The Presidential Nomination of George K. Burgess to be director of the Bureau of Standards was confirmed by the Senate on Dec. 18. The Senate also confirmed the nomination of C. L'H. Ruggles to be assistant to the Chief of Ordnance with the rank of brigadier-general and of John W. Joyes to be assistant to the Chief of Ordnance with the rank of brigadier-general, and of Samuel McRoberts and John R. Delafield to be brigadier-generals in the Officers Reserve Corps.

The Spavinaw Water Project under construction to furnish water from the Ozark Mts. to Tulsa, Okla., is 70 per cent complete. The gravity concrete dam of 55 ft. maximum height on the Spavinaw Creek is nearly finished, the 10,000-ft. 84-in. tunnel will be completed by Feb. 15, 1924, and the 53 miles of 54- and 60-in. reinforced-concrete pipe line and pumping station at the end of pipeline should be completed in May, according to W. R. Holway, engineer in charge of the construction.

Accident on London Tube Subway Stops Traffic

In enlarging the diameter of the City & South London R.R., one of the first of the "tube" subways of London, England, an old storage well or cistern was pierced, causing an inrush of sand and water. This flow of material caused a great cavity to form, so that water and gas mains and electric conduits were broken. The gas finally exploded and blew up a section of the street, Newington Causeway, about 30 x 20 ft., but no harm was done before the broken main was shut off. The 18-in. tunnel enlargement was being carried on while traffic was maintained in the original tube, but after the accident all traffic stopped, arrangements being made to handle the passengers on adjacent bus lines.

Traffic was also interrupted temporarily on the Southern Ry., which crosses the street at this point, in order that the bridge foundations might be inspected, but it was found these had not been disturbed by the slide or the explosion.

Philadelphia Sesqui-Centennial Plans Suspended

Work for the sesqui-centennial exhibition in Philadelphia has been definitely suspended until after Jan. 1, 1924, when the new city administration in Philadelphia goes into office. Col. John Price Jackson has resigned as executive director of the Exhibition Association, and the salaried personnel has been reduced to three persons. Suspension of all work came during the unsatisfactory campaign to raise $5,000,000 by popular subscription, in addition to the $1,000,000 previously subscribed. It was precipitated by Mayor Moore's opposition to the plans of the Association. The mayor declared that the Association's plans (*Engineering News-Record* of Sept. 6, 1923, p. 403) though modified from the original proposals for an exhibition, were still too elaborate and extensive. Mayor-elect Kendrick has intimated that he is favorable to the sesqui-centennial exposition.

Agreement Makes New Construction Possible at New Orleans

By an agreement with the City of New Orleans the Louisville & Nashville R.R., has ceded to the Dock Board property along the levee at St. Joseph St., which has been the subject of dispute as to title for a number of years. In return, the railroad company receives assurance of undisputed rights to the land which it occupies back of St. Louis St., upon which it will now erect a storage warehouse at an estimated cost of $750,000.

The New Orleans Dock Board will erect a wharf and shed along the levee property which it has acquired, and which is expected to cost about $1,000,000.

New Hudson River Bridge Project For New York City

Plans for a highway bridge across the Hudson River in the upper part of New York City have been submitted to the Port of New York Authority by Governor Silzer, of New Jersey. The project was developed by O. H. Ammann, formerly deputy chief engineer of the New York Connecting R.R. It provides a single-span suspension bridge at Fort Washington Point, on a line lying between 178th and 179th St., New York, reaching the New Jersey bank at Fort Lee. The main span is 3,400 ft. long and the side spans each 700 ft. Double eyebar chains are the carrying members. They are spaced 90 ft. apart and provide for a roadway width of 80 ft. on the main deck, with footwalks outside. This main deck is assigned to highway use, and accommodates eight lines of vehicles. Four electric-railway tracks are placed on four narrow cantilever lower decks formed by bracketing out to either side of the posts in both stiffening-truss planes. The truss depth is unusually small, being only 35 ft.; the top chord is at the level of the main deck and the bottom chord at the level of the lower edge of the trolley brackets.

Mr. Ammann estimates the cost of the structure at $30,000,000 and its time of construction at four years. He claims that it will give quicker relief to cross-river traffic than any other crossing proposed. In conjunction with the existing Washington Bridge across the Harlem River it will provide a direct connection between New Jersey and the Westchester and New England regions without carrying the traffic through the congested midtown section of New York. Tolls are estimated to be sufficient to pay fixed and operating charges even in the first year after completion.

Kansas Engineering Society Holds Convention at Wichita

Outstanding features of the annual convention of the Kansas Engineering Society held in Wichita, Dec. 11-13, were an address by P. L. Brockway, city engineer of Wichita and president of the association, and a talk on aerial photography by Major L. B. Roberts. Mr. Brockway urged greater participation in civic affairs by engineers, asserting that engineering was closer related to business than any of the professions. Major Roberts explained in detail the use of aerial photography in reconstructing existing maps. Another interesting speaker was Clark Jacoby whose discussion of flood protection was directed mainly to rivers near Wichita.

The first day of the convention was devoted to various officers' and committee reports. Committee reports occupied most of the morning and afternoon sessions of Dec. 12. A highway symposium was the principal feature of the third day's session.

Dr. Elwood Mead Returns From Extended Trip Abroad

Returning from a nine-months trip to Australia and the Holy Land where he served as reclamation consultant for the British Government, Dr. Elwood Mead of Berkeley, California, noted irrigation engineer, began to serve Dec. 20 as a member of the special advisory committee appointed by Secretary of the Interior Work to study government reclamation.

Dr. Mead arrived in New York Dec. 19 from Jerusalem and went to Washington the next day, calling upon Secretary of the Interior Work before joining the committee. Dr. Mead was employed by the Australian Government for many years to organize the settlement activities on its irrigated lands and during his recent trip served on a British Commission to investigate the difficulties that have developed in connection with Australian reclamation. He also spent a month in Palestine where at the request of the Zionists he traveled over the country with a view of passing on the advisability of reclamation projects in the Holy Land.

Dr. Mead left Dec. 20 for Berkeley where he is a professor of rural institutions of the University of California and will join the special advisors when its members begin next month a tour of a number of reclamation projects in the West. Following this visit of the committee he will return with them to Washington and assist in the preparation of the final report of the committee that will be made to the Secretary of the Interior to be later submitted to the President and to Congress.

Convict Road Force of 102 Men Moved to New Job

The California Highway Commission on Dec. 5 and 6 moved 102 prisoners several hundred miles from a road camp on the Klamath river in Siskiyou county to Briceburg on Merced river where the convicts will begin a two-year job in building the state highway through the rugged Merced river region into Yosemite National Park.

The men and their equipment were moved from their Klamath river camp in trucks to the railroad station where two day coaches and two baggage coaches were waiting on a siding. Baggage, camp equipment and commissary were loaded into these cars which were then attached to a regular Southern Pacific train about noon. At Merced they were transferred to the Yosemite Valley R.R. arriving at their destination on the afternoon of the second day.

To Eliminate Grade Crossings

Following a joint conference between the state highway commissioner, the governor of Alabama, and officials of practically all railroads operating in Alabama, an agreement has been reached where the highway department will inaugurate a grade-crossing elimination program, in which the state will pay 50 per cent and the railroad 50 per cent of the cost. The agreement require only the formal approval of the chief executives of the railroads before it can be put into effect.

Minnesota Metropolitan Planning Commission Scheme

Progress on the formation of a Metropolitan Planning Commission for Minneapolis, St. Paul, and vicinity was made at a second meeting devoted to the subject held on Dec. 13 under the leadership of the Northwestern Section of the Am. Soc. C. E. With G. H. Herrold as acting chairman, the meeting on Dec. 13 arranged for two committees, one on organization and one on a tentative boundary line for the district, the latter consisting of E. H. Hewitt, Minnesota Chapter, A.I.A., A. M. Best, assistant to the vice-president, N. P. Ry., representing the Northwestern section, Am. Soc. C. E., and James T. Elwell, president, Minneapolis City Planning Commission. The plan is to have Metropolitan Planning Commission self-organized, but with a view to getting legislative legalization of the commission and its work.

Highway Traffic Officer

This is one of the Pennsylvania State Highway Department's motorcycle patrolmen. The innovation of detailing a special highway police force under the highway and not the police department, has but recently been established.

Milwaukee Zoning Ordinance Upheld by State Court

The constitutionality of the zoning ordinance of Milwaukee, Wis., was upheld by the State Supreme Court on Dec. 11. The decision upholds zoning as an exercise of the police power and denies that it results in taking private property for public use in such a way that compensation should be paid. The plaintiff sought to compel the building inspector of Milwaukee to grant a permit for a dairy building in a residence district from which business is excluded by the zoning ordinance. The opinion in part, was as follows:

"If, in the prosecution of governmental functions, it becomes necessary to take private property, compensation must be made, but incidental damages to property resulting from governmental activities or laws passed in the promotion of the public welfare is not considered a taking of the property for which compensation must be made.

"This is no new idea, although it has but recently taken the form of legislation. Everyone who has observed the haphazard development of cities, the deterioration in the desirability of certain residential sections by the encroachment of business and industrial establishments upon and into such sections, resulting in the consequent destruction of property values and in the ultimate abandonment of such sections for residential purposes has appreciated the desirability of regulating the growth and development of our urban communities.

"Fresh air and sunshine add to the happiness of the home and have the direct effect upon the well being of the occupants. It cannot be denied that a city systematically developed offers greater attractiveness to the house seeker than a city developed in a haphazard way. The one compares to the other as a well ordered department store compares to a junk shop."

ArmyEngineers Report Adversely on Tombigbee Deepening

Washington Correspondence

An adverse report has been made by army engineers on the project to deepen the Tombigbee River in Alabama and Mississippi and connect it by a canal with the Tennessee River. As a result of a preliminary survey made in accordance with the rivers and harbors act of 1922, the engineers have reported to Congress that the project would be costly, that 63 locks would be required, thus making it cumbersome, and that the proposed waterway would practically parallel the Mississippi River without material benefit to commerce.

While the item for the survey was included in the rivers and harbors act on the suggestion that commerce would be benefitted by the improvement, one of the other suggestions put forward by advocates of the project was that by connecting the Tombigbee and Tennessee rivers a means of relieving floods in the Mississippi River would be provided as flood waters from the Tennessee could be diverted to the Gulf through the canal. No mention of this subject is made in the engineers' report.

Work Progresses on Camden Terminal of P. & R.

Company Officials Confident New Terminal Will Be Ready for 1924 Seashore Season

Special Correspondence

Rapid progress is being made on the construction of the new Camden, N. J., terminal of the Philadelphia and Reading Ry.'s seashore lines. Work on the laying of tracks, construction of the fill-in, the piling, erection of steelwork, used in connection with the terminal, signal tower and battery house to be butterfly shelters, and building of the has progressed so satisfactorily that officials of the company are confident the terminal will be ready for service by the opening of the seashore season in 1924.

The new terminal will be a thoroughly modern two-story structure of steel frame and brick with stone trimmings, on a concrete foundation built on piles. It will house the electrically-operated ferry slips, the trainshed containing 14 tracks, a concourse 328 ft. long and 105 ft. wide, waiting rooms for men and women, a restaurant, and the offices of the Delaware River Ferry Co. and of the Philadelphia and Reading Ry.'s seashore lines. The office building, on the land side of the terminal, will be a two-story structure 115 ft. long and 42 ft. wide. A brick power house is located at the opposite end of the concourse.

The hydraulic fill of 319,388 cu.yd. under the station proper, and the fill of 30,000 cu.yd. at the Jackson Street end of the terminal are now practically completed. Most of the creosoted wood piling used in the ferry slips is in place. All of the structural steelwork over the concourse has been erected, and a portion of the steelwork over the headhouses has been erected. All tracks, both those in the train shed and those in the yard adjacent, have been laid, and work has been completed on the intricate switches where the terminal tracks converge. The butterfly shelters over the train platforms are well under way.

The signal tower and battery house, which will be the largest on the Reading system, is about 50 per cent completed. It will be a three-story building of brick and concrete, 53 ft. long and 17 ft. wide. The first floor will be used for the storage of signal equipment and for the heating plant. On the second floor will be the generator and battery racks, the relay racks, and the general working apparatus of the tower. The third floor will be occupied by the lever room containing 75 lever frames which will control all of the traffic in and out of the terminal.

The ferry slips at the foot of Chestnut Street, on the Philadelphia side of the river, have been electrified in anticipation of the opening of the new terminal.

ARTIST'S SKETCH OF PHILADELPHIA & READING $3,000,000 CAMDEN TERMINAL FOR SEASHORE LINES

Wheeling, W. Va., Accepts Balmer Refuse Incinerator

The 70-ton garbage and refuse incinerator of the Balmer type, the first of the kind in the United States, has been accepted by the city authorities of Wheeling, W. Va. Some weeks before acceptance the plant was tested by H. L. Campbell, city engineer, and G. R. Kress, of Clark & Kress, a local engineering firm. In the report on this test it was stated that during a trial extending through a period of five or six days 14.84 tons were burned in 8 hr. or at the rate of 44.5 tons in 24 hr. —against the guarantee of 70 tons. The report contained no recommendation as to acceptance. Between the time the contract was let and the test made a city election resulted in a change of administration, including the mayor, at least a majority of the city council, and subsequent to the election, the city manager and city engineer. This change was considered locally to be unfavorable to the incinerator but, as stated, the plant has been accepted by the city.

Right to Double Wanaque Water Development Granted

The right to develop the Wanaque water supply storage to its full capacity of some 100 m.g.d., doubling the original amount, has been granted to the North Jersey District Water Supply Commission by the New Jersey Board of Conservation and Development. The commission has built the foundations for a dam at Midvale designed to store water to give 50 m.g.d. and work is well along on a contract for an 8-mi. tunnel to form a part of the conduit from the reservoir to Newark, for which city the Commission is carrying out the work. Recent decisions of Paterson and other municipalities to join the Wanaque project led to the application for the enlarged development just granted.

Drainage Congress Announces Program for Meeting

Papers listed for the program of the National Drainage Congress, at St. Louis, Jan. 16-17, are numerous and of varied character, as shown by the following partial list: "Drainage of Horicon Marsh," E. R. Jones, University of Wisconsin; "Drainage in Iowa," C. C. Ayers, Iowa State College; "Future Work in Louisiana," A. T. Dusenbury, New Orleans; "Results in North Carolina," Dr. J. H. Pratt; "Drainage Development in Relation to Rainfall and Wild Animal Life," E. V. Willard, Minnesota Commissioner of Drainage; "Adapting the Method of Reclamation to the Land," J. T. Stewart, St. Paul; "Expansion of Farming Area," Dr. L. C. Gray, U. S. Dept. of Agriculture; "Improved Methods of Long Term Financing," H. C. Wallace, Secretary of Agriculture; "Relation of Colonization to Reclamation," F. H. Newell, Washington, D. C.; "Cost and Cost Finding," L. S. Hidinger, Memphis, Tenn.; "What Drainage Has Accomplished," S. H. McCrory, U. S. Dept. of Agriculture; "Crops on Peat and Muck Lands," G. R. S. Elliott, University of Minnesota; "Fluctuation of Ground Water Level," S. A. Norling, Denmark; "Outlet Drainage," E. R. Jones, University of Wisconsin; "Land Reclamation and Game Reserves," C. H. Young, Muscatine, Iowa; "Wing Dams and Levees in the Mississippi Valley," Col. Potter, Mississippi River Commission; "Oil Engines for Dredges and Draglines," Geo. B. Massey, Chicago; "Drainage Legislation," R. B. Oliver; "Progress in the Everglades," F. C. Elliott, chief engineer, Okeechobee Project; "The Policy of the Interior Department in Regard to Western Reclamation," D. W. Davis, Chief of Bureau of Reclamation; "Value of Reclamation to the Railroads," Wm. Sproule, president, Southern Pacific R.R.

Highway Course in Tennessee

A short course in highway engineering for highway engineers is to be held at the University of Tennessee Jan. 7 to Feb. 2. The course is to be given under the joint auspices of the university and the state highway department. The course will include mathematics, computation and drawing, highway surveying, materials testing, a general course in highway engineering, highway economics, transportation, and highway organization.

Demolition Contracts Awarded for Delaware River Bridge

Award of four contracts for demolition work was made by the Delaware River Bridge Joint Commission at its meeting in Philadelphia on Dec. 21. Three of the contracts will be performed at a total cost to the commission of $17,863, while the fourth contract is on a basis that the contractor will pay the commission the sum of $2,812, making the net cost of the four contracts, $15,051. The demolition is to prepare the sites of the approaches for the bridge on the two sides of the river. Bids were received on nine sections, four being on the New Jersey side of the river and five on the Philadelphia. Three of the Philadelphia bids and two of the Camden bids were rejected, and these portions of the work will be readvertised for bids to be received on Jan. 16, 1924.

Sacramento's New Water Filters To Be Started Dec. 31

Sacramento's new 48-m.g.d. water filtration plant is to be put in operation New Year's Eve. President Coolidge will press a button in the White House connected by wire with the control board at the filter plant. A three-day celebration in Sacramento will follow.

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 10-11, 1924.

AMERICAN ROADBUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 14-18, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York, Jan. 16-18, 1924.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington D. C.; Annual Meeting, Chicago, Ill., Jan. 21-24, 1924.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 22, and Ottawa, Jan. 23, 24, 1924.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Meeting, Chicago, March 13-15, 1924.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, New York City, May 19-21, 1924.

The Minnesota Federation of Architectural and Engineering Societies will hold its third annual convention Feb. 1 and 2, 1924 at Duluth.

The Dayton, Ohio, Section of the American Society of Civil Engineers has elected the following officers: J. H. Kimball, president, for one year; and J. K. Grannis, vice-president, for two years. C. D. Putman, vice-president, and C. H. Eiffert, secretary-treasurer, remain in office for another year. At this meeting, E. W. Lane, who has just returned from three years' work in China, gave an interesting talk on "Flood Problems on the Huai River."

The Engineers' Club of Trenton, N. J., announces the opening of its new headquarters in the Stacy-Trent Hotel, Trenton. H. G. Acock is secretary of the club.

The Engineers Subdivision, Chicago Association of Commerce, Dec. 19, elected the following officers: J. L. McConnell, chairman, and Frank D. Chase, vice-chairman.

The South Dakota Engineers' Society will hold its annual meeting at Huron, So. Dak., Jan. 9 and 10. The annual dinner and some of the sessions will be held jointly with the Associated Contractors of South Dakota. R. E. Bragstad, Aberdeen, So. Dak., is secretary of the engineers' society; H. Rettinghouse, of Sioux Falls, is president.

Personal Notes

RIVERDALE CONSTRUCTION CO. announces change of address from 1440 Broadway, New York City, to 2511 Grand Central Terminal, New York City.

IVAN E. GOODNER, Olympia, Wash., chief engineer of the department of conservation and development in the state of Washington, has resigned to go into private practice in California, and his resignation also severs his connection as chief engineer of the Columbia Basin state survey. Mr. Goodner has served as chief engineer of the Paradise Irrigation District in California, assistant division engineer of the Miami Conservancy District, Dayton, Ohio, and chief engineer of the Columbia Basin irrigation project in Washington.

ALLEN CLARDY has been appointed county road engineer for Christian County, Kentucky, with headquarters at Hopkinsville, Ky. He succeeds J. H. Dillman who had been county engineer for a year.

D. W. COLE, formerly of Marietta, Ga., who was in the U. S. Reclamation Service from 1904 to 1919, is now connected with the engineering department of the Electric Bond & Share Co., New York City. In the U. S. Reclamation Service, Mr. Cole was engineer on the construction of the Shoshone Dam in Wyoming, engineer in charge of the Truckee-Carson irrigation project and construction of the Lahontan Dam in Nevada, and senior engineer and resident manager of the Boise project, at which time he was senior engineer of the Western district of the Reclamation Service. He has also been engaged in various municipal water-works and in power developments.

P. F. AUER, who is now located in Little Rock, Ark., as resident engineer for James Stewart & Co., general contractors, changed to this work from being field engineer for the St. Louis Coke & Chemical Co.

CLAIR A. INSKEEP has changed location from county maintenance engineer of Logan County, Ohio, to civil engineer on surveys and construction for the Biscayne Engineering Co., and his new address is Miami, Florida.

JAY J. MORROW, Corps of Engineers, has been made a brigadier general in the Engineer Officers' Reserve Corps. General Morrow is governor-general of the Canal Zone. He has served as chairman of the Alaska Railroad Commission, and as chief engineer of the First Army, A. E.F., in France.

QUINCY B. NEWMAN has been appointed chief engineer of the U. S. Coast Guard, and his appointment was confirmed by the Senate on Dec. 19.

LEWIS E. ROBERTS, formerly resident engineer on levee and drainage work with T. N. Jacob of St. Louis, Mo., has gone into private engineering practice in Peru, Ind.

JAMES H. RYAN is now bridge design engineer for the Missouri State Highway Department. He was formerly structural draftsman with the Shoemaker Satterthwait Bridge Co. at Pottstown, Pa.

CHARLES H. OSBORNE, builder and consulting engineer, has been appointed building inspector for Baltimore by Mayor Howard W. Jackson. Mr. Osborne held the same position several years ago. He succeeds J. Frank Crowther.

J. H. BRAY, recently assistant engineer for Red River County, Texas, has been appointed county engineer of Van Zant County, at Canton, Texas.

Obituary

JAMES FINLAY, for many years erector superintendent of the Dominion Bridge Co., in Canada, died in Vaancouver, B. C., Dec. 11. One of Mr. Finlay's most notable achievements was the placing of the two large spans of the Canadian Pacific Ry. bridge over the St. Lawrence River at Lachine, Que., in 1913.

LIEUT.-COL. GEORGE E. GIBSON, engineer, Albany, N. Y., died at his home in that city Dec. 19, aged 43 years. Colonel Gibson served through the war as engineering instructor at Madison Barracks.

JAMES E. HOOD, Mack, Colo., general manager of the Uintah Railway Co., Colorado, died Dec. 16 from an accident received on the line Dec. 13. Mr. Hood was born in Pennsylvania in 1869 and was a graduate of Allegheny College. Pittsburgh. His early service was in the engineering department of the Erie R.R., for which road he was rataed division engineer. He entered the service of the Great Northern Ry. and worked on the construction of that line into Spokane and Seattle from Havre, Mont. In 1910 he was appointed superintendent of the Chicago, Milwaukee & St. Paul Ry. During the war he was commissioned a lieutenant, going to Siberia where he was promoted through the various grades to major. He was made general manager of the Uintah Ry. in 1921.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Income Tax Returns Show Size of Various Industries

Corporation returns to the Bureau of Internal Revenue show that 356,397 concerns made tax returns in 1921. Of that number, 171,239 had a net income of $4,336,047,813. On that amount they paid a total tax of $701,575,432. There were, however, 185,158 of the corporations reporting that had deficits rather than income. The aggregate of those deficits was $3,878,219,134. Detailed figures for certain industries related to the engineering field are as follows:

Industry	No. of Corporations	Net Income	Total Tax
Chemicals:			
Paints and varnishes	664	$7,591,201	$1,217,053
Quarrying:			
Stone	493	5,955,125	894,934
Clay, sand, gravel	720	5,428,312	920,448
Stone, clay and glass:			
Cut building stone, etc.	1,495	28,304,171	4,724,338
Brick, tile, terra cotta	1,600	20,300,342	3,586,023
Glass and glass products:			
Plate and window	552	20,423,723	3,611,746
Combinations, of stone, clay and glass manufacture	34	738,263	109,521
Rail transportation:			
Steam railroads	609	291,113,607	29,650,857
Electric railroads	458	33,843,158	3,847,446
All other railroads	394	30,861,445	3,816,544
Total rail transportation	1,461	355,818,210	37,314,847
Other public utilities:			
Electric light and power companies	1,900	61,207,294	7,754,355
Gas companies	569	22,008,381	3,173,271
Telephone and telegraph companies	3,949	113,040,515	12,912,536
Waterworks	1,459	11,827,922	1,193,438

The gross income of corporations in the various groups is shown by the following:

Industrial Groups	Total No. of Corporations Reporting	Gross Income
Mining and quarrying	17,660	$3,888,876,370
Transportation and other public utilities	19,105	9,000,656,163
Chemicals	5,924	3,878,880,302
Stone, clay and glass	3,681	953,756,897
Metal and metal products	15,536	9,805,138,797

Lumber Standardization Adopted By Unanimous Action

The national conference on lumber standards, held in Washington, D. C., Dec. 12 and 13, agreed to a generally satisfactory compromise on the vexed questions of the dressed thickness of standard boards and dimension. It was unanimously voted to set up a standard of 25/32 in. for standard boards, with 26/32 in. as extra standard; and a standard of 1 5/8 in. for dimension and 1 3/4 in. for extra standard dimension.

The recommendations of the Central Committee on Lumber Standards provided for a minimum standard. The adoption of the "extra standards" was made to meet the views of the retailers who favored 26/32 in. as the single standard for boards and 1 3/4 in. for dimension. Secretary Hoover characterized the action taken as "the greatest forward movement in the direction of public service ever made by the lumber industry."

The remainder of the Central Committee's recommendations were adopted with minor changes and the committee was instructed to proceed with the consideration of the question of short and odd lengths, rough-dry sizes, box lumber, mouldings and other subjects and report again next May.

Big Output of Motor Vehicles

Production reports totalling 325,125 cars and trucks made in November, submitted at the directors meeting of the National Automobile Chamber of Commerce Dec. 6, bring the 11 months output to 3,717,709 which indicates that the year's total will reach 4,000,000. This will be a gain of more than 50 per cent over 1922, which was in itself a record year.

Register Trade Marks Abroad, Commerce Dept. Urges

It has been one of the regrettable features of American trade abroad, according to the Department of Commerce, that until recently insufficient attention has been given to the means of protecting and reserving to the original owner the value attaching to a brand mark. Under the United States law a right in a trade-mark is obtained simply through continued use, without any further steps on the part of the originator of the trade-mark. In the majority of foreign markets, however, the right is regarded as being vested in the first person who makes public claim to the mark through registration with the local patent office.

Even in those countries where consideration is given to the fact of prior use, and infringements may be contested under common law, the simple and relatively inexpensive process of registration of a trade-mark is a desirable thing, since it creates prima facie evidence of ownership in case of dispute and affords a basis for obtaining damages from infringing concerns. Trade-mark registration is decidedly less expensive than trade-mark litigation, and there should be included, as part of every enlightened export program, an examination of the means for protecting the value of the trade-mark in the new mark. is just as soon as the article begins to show promise of appreciable sales in the particular country.

Lining Up Turbine-Driven Pumps To Kill Vibration

Practical Suggestions Made for Leveling Bed-Plate and Securing Even Bearing of Coupling Faces

GEARED turbine-driven centrifugal pumps now used for supplying cities with water are less heavy than reciprocating pumps, and as they contain no unbalanced reciprocating masses they are also less apt to produce vibration, generally requiring less costly foundations. Because of their high rotational speed, however, great care must be applied to insure correct alignment. The following notes on testing for alignment embody practice recommended by the De Laval Steam Turbine Co., Trenton, N. J.

In handling a large bed-plate for the support of a geared turbine-driven centrifugal pump care should be taken to avoid distortion by shock in handling. Although the bed-plate may have ample depth and rigidity for its purpose when properly supported, cast-

LINING UP UNITS WITH "FEELER" BETWEEN COUPLING FLANGES

iron, like all other metals, is flexible and will distort appreciably under stress. It may even receive a permanent set so that it will be difficult to pull it back into its original alignment. It is therefore advisable to keep the machine on the skids on which it was originally shipped until it is placed on its foundation.

Leveling the Bed-Plate

An easy way to level the bed-plate on its foundation is to place small steel plates with taper wedges under the edge of the bed-plate, driving up on the wedges until the proper alignment and level are obtained. These wedges should be placed from 12 to 15 in. apart on small machines, and 24 to 30 in. apart on large machines. The planed surfaces of the bearing brackets may be used as leveling pads after removing the bracket caps. After the leveling has been completed, however, tests should be made for correct alignment by examining the two halves of the flexible coupling to see that their faces are parallel and that the center lines of the shafts coincide. The couplings used in De Laval pumping units, as shown in the accompanying photograph, are accurately finished on the periphery and on the inside surface by means of a grinding machine at the factory so that they run perfectly true and can be depended upon in correcting alignment.

Checking Coupling Alignment

When checking the alignment of a coupling the bolts can be removed so that the two halves are entirely free. First insert a leaf-gage or feeler between the two halves at a number of

points; the space should be uniform around the circumference or should not vary more than 0.002 in. A steel straight-edge can then be placed across the two coupling halves and should have an even bearing on their surfaces. This checking by means of a straight-edge should be done at not less than four points evenly spaced around the circumference. If the coupling is not in correct alignment, it will not operate satisfactorily at high speeds, and will tend to produce vibration and strain in the bearings and shaft. Excessive wear of coupling pins or bearing is an indication of poor alignment.

When the alignment has been completed the bed-plate should be filled partly or wholly with cement grout in order to maintain alignment and prevent distortion by piping or other strains. Foundation bolts are not necessary, but may be advisable to assist in maintaining alignment. After the grouting has set the alignment should again be checked, as in rare cases the swelling of the cement causes a slight distortion.

In attaching piping to the pump care should be taken to see that the flanges fit properly. If they do not come parallel and do not meet they should not be pulled up with flange bolts, as this may strain the pump casing, bedplates and piping, and will invariably result in distortion, with possible vibration or breaking of pump casing or piping.

Business Notes

THE LITTLE RED WAGON CO., Omaha, Neb., announces that it has purchased the business of Stroud & Co. and will continue the manufacture of the Stroud line of road-making machinery, including elevating and blade graders, scrapers, dump wagons, plows and road drags.

SMITH ENGINEERING WORKS, Milwaukee, has opened a branch office at 50 Church St., New York in charge of Donald D. Barnes, formerly district manager in Chicago. Mr. Barnes is an engineer with wide experience in design of quarry and gravel plants. The Chicago office will be continued in the Old Colony Building under management of Victor H. Jones, formerly associated with American Blower Co.

C. B. ADAMS and S. P. HOLMES have incorporated under the name C. B. Adams & Co., Chicago, to represent the Union Iron Works of Erie, Pa., manufacturers of steel water-tube and fire-tube boilers; the Erie Engine Works, of Erie, Pa., manufacturer of slide-valve engines; and the Sims Co. of Erie, Pa., manufacturer of water-heating apparatus.

BARBER ASPHALT CO. has installed a new power plant at its works in Maurer, N. J., to supply steam, electricity and compressed air to its three manufacturing units, the roofing plant, oil refinery and asphalt plant. The new building is 115 ft. long with boiler room 75 ft. wide and engine room 41 ft. wide. There are five 520 hp. boilers, and a 300 and a 500 kw. turbine. While the boilers are stoker equipped all but one unit are fitted for burning fuel oil, one of the company's products. Lockwood, Greene & Co. were engineers for the plant.

SEATTLE MACHINE WORKS announce that experiments on the Johnson airless injection Diesel engine have been completed. The company is now preparing to manufacture these machines for marine service, electric generating sets and contractors' equipment.

Equipment and Materials

New Heavy Duty Hoists

A new heavy-duty hoist, adaptable to cableways, tail rope systems and general haulage, has been added to the line of the Treadwell Engineering Co., Easton, Pa. The equipment is operated by electric motor and special attention has been given to the elimination of cast iron in the brake mechanism.

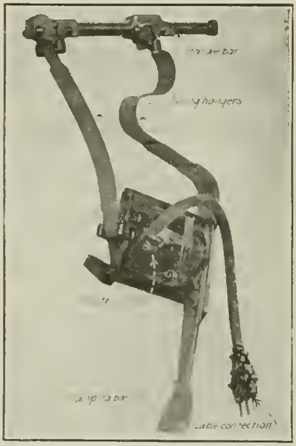
The frame is a gray-iron box type casting with motor and intermediate shaft bearings mounted on it, thus insuring perfect alignment. Bearings are of cast iron, of the pedestal type, and bearing caps are machined at the joints. All bolts are provided with lock-nuts. To insure absolute rigidity the bearings and pedestals are provided with machined tongues which fit into grooves in the frame. Gears are either of semi-steel or cast steel, with cut teeth.

The friction clutches are of the single-face cone type operated by a screw thrust. The drum consists of two heads or flanges bolted to and supporting a cylindrical shell of cast iron. Each drum is provided with one or two brakes, as ordered, of the differential type. For ordinary service hardwood blocks are used as the brake lining, but for heavy duty asbestos-treated blocks are substituted.

These hoists are built in four sizes equipped with electric motors of 100, 150, 225 and 300 hp. respectively, these ratings being based on a rope speed of 400 ft. per minute.

Electric Tie Tamper

The latest form of the Jackson electric tie-tamping machine, made by the Electric Tamper & Equipment Co., Chicago, delivers about 60 strokes per second, each stroke having a force estimated at 600 lb. This tamper is said to work well in stone, gravel, sand and cinder ballast. The revolving element of the motor is mounted on a nickel-steel shaft running in ball bearings and having at one end an unbalanced weight which revolves at 3,600 r.p.m. and sets up powerful vibrations in that end of the motor casing to which the tamping bar is bolted. The handle is attached to the motor casing by spring plates.



In moving, the tamper is not lifted but is dragged, its weight being carried on the curved spring. Current is furnished by a portable plant having a 5-hp. gasoline engine belted to a 1¼-kw. 110-volt motor. This power unit, weighing about 500 lb., will operate four tampers and such other track tools as bond drills and rail saws. With a 250-ft. electric cable work can be done for a distance of 500 ft. with one set-up of the power unit, but longer cables may be used.

Publications from the Construction Industry

Revolving Car-Dumper — WELLMAN-SEAVER-MORGAN Co., Cleveland, has issued an illustrated 8-p. bulletin on its revolving dumper for unloading railway freight cars of all sizes and capacities. The equipment consists of a cradle which, after the car has been clamped within it, revolves, dumping the contents in only a fraction of the time that would be required by other means of hand or mechanical unloading. The car-dumpers are designed for a normal capacity of 20 cars per hour.

Track Drainage—W. S. DICKEY CLAY MFG. Co., Kansas City, Mo., has issued a 60-p. booklet on the use of vitrified pipe for ordinary drainage of railway track, roadbed and yards, and also for the elimination of wet spots which make maintenance expensive. Numerous installations are illustrated. Incidentally the pamphlet deals with the use of this pipe for culverts, pile protection, well casing and small septic tanks at shops and stations.

Railway Station Heating—AMERICAN RADIATOR Co., Chicago, has issued a 16-p. illustrated pamphlet on the Ideal-Arcola boiler, radiator and hot-water circulating system specially designed for small railway stations which have no basement for a heating plant and where the agent is the only attendant. This system is applicable also for signal and interlocking towers and other small structures.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Construction Possibilities During the Coming Year

Probable Extent of 1924 Building Shown—Also Value of Plumbing, Heating, Lighting and Painting Jobs

With a $6,000,000,000 building year drawing to a close, some idea of the 1924 construction prospect may be gained from the figures shown herewith.

Commercial buildings formed 30 per cent of the estimated 1923 total; industrial buildings 9 per cent; residential buildings, 28 per cent and other engineering construction exclusive of buildings, 33 per cent.

Based upon the above percentages, the probable extent of 1924 construction in the classes mentioned, will be as follows:

Streets and Roads	$1,250,000,000
Industrial building	350,000,000
Commercial building	1,350,000,000
Residential building	550,000,000
Other construction	1,500,000,000

The money values of possible jobs in the estimated 1924 program will be as follows:

	Industrial Building	Commercial Building
Plumbing	$1,750,000	$27,000,000
Heating	12,600,000	67,500,000
Lighting	9,695,000	47,250,000
Painting	11,060,000	27,000,000

Present New York Building Wage Scale To Hold During 1924

The Building Trades Employers Association of New York City has decided to maintain during 1924 the same wage scale and bonus paid throughout 1923. A higher wage scale would perhaps hinder and in many cases block construction that is now needed. Present indications point toward intensive operations for the coming year. With increased activities in the construction lines ahead, there does not seem to be any likelihood of non-employment.

The United States Bureau of Labor reported in September that the cost of living this year was 75.4 per cent higher than 1914.

A table of wage increase over a period of nine years will show how this cost of living has been met and also how it has affected construction costs. The per cent increase in each trade since 1914, is shown as follows:

Kind of Labor	Daily Wage 1914	Daily Wage 1923	Per Cent Increase
Cement masons' laborers	$2 62	$7 50	186 2
Cement masons	5 00	10 00	100
Bricklayers' laborers	3 00	8 00	166 6
Bricklayers	6 00	12 00	100 •
Engineers, hoisting	6 00	12 00	100
Carpenters (Bronx, Brooklyn, Queens)	4 50	10 00	122 2
Plasterers' laborers	3 25	8 50	161 5
Plasterers	5 50	12 00	118.1
Stone masons	4 80	12 00	150.
Derrickmen and riggers	4 00	9 50	137 5
Sheet metal workers	5 00	10 00	100
Plumbers	5 50	10 00	81 8
Steamfitters	5 50	10 00	81 8
Tile layers	5 50	10 00	81 8

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 347 to 356, are the following:

Power Station, Sumner, Wash., to Stone and Webster, Inc., $1,060,000.

High School, Brooklyn, N. Y., to Turner Constr. Co., $2,045,000.

Current Freight Rates Compared With 1921-22

Due almost entirely to reductions in freight rates, made both voluntarily and by order of the Interstate Commerce Commission, the freight bill of the people of this country was approximately $431,000,000 less during the first eight months this year than it would have been if the rates existing during the corresponding period of 1921 had remained in effect.

Compared with the rates in effect during the first eight months of 1922, the freight bill this year represents to the shippers of this country a reduction of approximately $282,750,000 due to the voluntary reduction on agricultural products that became effective on Jan. 1, 1922, to the general rate reduction of 10 per cent effective on July 1, 1922, and to a number of individual readjustments in freight rates.

These estimates, which are made by the Bureau of Railway Economics from reports filed by the carriers with the Interstate Commerce Commission, are based on the freight traffic transported by the carriers from Jan. 1 this year to Sept. 1, which has been the heaviest in history.

Business Briefs

Call money steady at 4¾ per cent as of Dec. 21.

Time money market dull with rate at 5 per cent.

Commercial paper rate 5 per cent with very little in the market.

Foreign exchange declines. Sterling, $4.34⅜; last week, $4.36⅞; year ago, $4.64⅜. Franc, $0.0510½; last week, $0.0530½; year ago, $0.0743¾. Lira, $0.0431½; last week, $0.0435; year ago, $0.0512½.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 347 to 356, are the following:

Hotel, Minneapolis, Minn., Calhoun Beach Holding Co., $1,300,000.

Apartment, New York, N. Y., I. Kraft, $1,500,000.

Recent Unit Bids Throughout the Country

The accompanying table gives the accepted prices of materials and operations in various parts of the country taken from contracts awarded during the last month.

The unit bids form an index of construction costs in outlying districts. A thorough knowledge of cost conditions may be had by reviewing the bid prices published weekly in the Construction News section of *Engineering News-Record.*

UNIT BID PRICES ON MATERIALS AND OPERATIONS FROM RECENT CONTRACTS AWARDED

Where Located	E.N.R. Issue	Nature and Extent of Job	Unit Bid Price
Ala., Fayette	Nov. 22	Digging 2 mi. ditch 10 ft. wide	$147,000.00
Ark., Walnut Ridge	Nov. 29	236,000 cu.yd. excav. drain. ditches, per cu.yd.	0.115
Ark., Russellville	Nov. 29	1 mi. grading and conc. surfacing	25,000 00
Ark., Little Rock	Dec. 6	3 in. asphalt top, per sq.yd.	1 44
		6 in. conc. base, per sq.yd.	1 35
Ark., Mena	Dec. 6	16 mi. grading and gravel surfacing	90,000.00
California	Dec. 20	460 tons, 70 lb. rails, per ton	52.50
		325 tons high T rails, per ton	59.43
		Joint plates, per cwt	4 42
Calif., Stockton	Nov. 22	2,900 cu.yd. grading, per cu.yd.	.50
		5,390 tons gravel, per ton	2.25
Calif., Oakland	Dec. 6	52,500 sq.ft. grading, per sq.ft.	0 05
		50,400 sq.ft. 2 in. Warrenite bitulithic on 6 in. conc. per sq.ft.	0 30
		15,982 sq.ft. oil macadam pave., per sq.ft.	0 11
		7,022 sq.ft. cement walks, per sq.ft.	0 16
Calif., Oakland	Dec. 20	15,088 lin.ft. 8 in. vitr. sewer	34,500.00
Colo., Denver	Nov. 22	Excavation and grading, per cu.yd.	1.60
		Removing old soil and replacing with new, per cu.yd.	2 50
La., Bastrop	Nov. 29	25 mi. 8 in. gas pipe line	25,000.00
Michigan	Nov. 22	34,946 cu.yd. excav., per cu.yd.	0.55
		74,760 sq.yd. 8 in. rein.conc. pave., per sq.yd.	1 60
		29,242 cu.yd. excav., per cu.yd.	0 38
		54,393 sq.yd. gravel surface, per sq.yd.	0.625
Minn., St. Paul	Nov. 22	22 tons asphalt, per ton	22.66
		5,000 lb. solder, per cwt.	22.20
Nev., Lovelock	Dec. 6	336,495 cu.yd. excav., per cu.yd.	0.1375
O., Akron	Dec. 6	26,000 cu.yd. grading, per cu.yd.	0 60
		3,400 sq.yd. brick gutter, asphalt filler, per sq.yd.	2.35
		16,800 sq.yd. asphalt willite pave., plan B, Trinidad, per sq.yd.	1 85
Oregon	Dec. 13	75,000 cu.yd. com. excav., per cu.yd.	0 32
		35,000 cu.yd. solid rock excav., per cu.yd.	1 15
		2,170 lin.ft. 12 in. corrugated galv. i. pipe, per lin.ft.	1 25
Tex., Center	Nov. 22	22,290 sq.yd. conc. pave., per sq.yd.	2 65
Tex., Ft. Worth	Dec. 13	2,500 cu.yd. gravel, per cu.yd.	1 60
		2,900 gal. Texaco macadam binder, per gal	0.06

Foreign Projects of Interest to Americans

A number of foreign construction projects which should be of interest to American engineers, contractors and manufacturers has been reported by the United States Department of Commerce. They are noted here, further information being available at the Bureau of Foreign and Domestic Commerce or its district co-operative offices, when a reference number in given.

Pipe Line company's official now in New York relative to the purchasing of supplies. American firms interested may secure this official's New York address and other information concerning the Colombian Concession. Reference No. Colombia 35XA.

Bids for railway construction is desired by South American country. The line is to connect two important cities. Bids close Jan. 20, 1924. Reference No. 113,170.

American contractor's service desired in Japan by the owner of a large building property. Contractors already at work in Japan may be interested. Reference No. 113,181.

Sugar mill to be constructed in a Brazilian State. The project will involve an expenditure of about $200,000.

Canning factory for South American country. The machinery to be installed is to come from America, about $60,000 worth. This may be a forerunner to an extensive outlay.

Wire nail factory for American branch house in Mexico. The president of the firm in question is desirous of receiving quotations on nail machinery of 2-ton per day capacity and information concerning nail-polishing machine. Reference No. 113,166

Enlargement of waterworks and public building in Rumania. The municipal engineer of a city in Rumania is quoted in part as follows: At present the city would grant to an American contractor not only the constructing of the waterworks and canalization (sewage), but the building of the public market hall, the development of the electric plant and of the management of all this works. Reference No. 111,822.

Cold-storage plant for Brazil. The name of the company and the city where this plant is to be erected is available for interested American firms.

Public works planned by city in China as follows: street building, waterworks system, electric light and power plant. Finances of the municipality reported sound. Reference No. 815X.

Paving Brick Shipments Remain High

Considering seasonal influences, shipments of vitrified paving brick for November ran considerably above normal,—64 per cent of the industry's tonnage reporting total shipments of 21,689,000 according to a report just made to the U. S. Department of Commerce by the National Paving Brick Manufacturers Association. In October 66 per cent of the industry's tonnage reported shipments of 34,287,000.

Unfilled orders on hand declined from 64,531,000 for October to 54,535,000 for November. For the first time since last spring the total number of brick manufactured for the month ran greatly in excess of shipments indicating that companies are manufacturing for stock in anticipation of late winter and early spring shipments.

Future Transportation Needs

That the future transportation needs of the country have been thoroughly studied, is shown by recent reports of the Transportation Conference's Committee on Governmental Relations to Transportation. The committee reports that in the next ten years the freight volume will be one-third more than at present; passenger traffic one-fourth more. In order to meet this demand, there must be 38,350 additional miles of track; 13,200 more locomotives; 725,000 freight cars; 12,300 passenger cars. These additions will cost approximately $5,339,874,000.

(*Continued on p.* 1080)

Recent Unit Bids on Large Bridge Contract

Bids were opened by State Highway Comm. at Trenton, N. J., Nov. 27, for a bridge over the Raritan River between Perth Amboy and South Amboy, N. J. (a) Stillman, Delehanty, Ferris Co., 1 Exchange Pl., Jersey City, (awarded contract); (b) F. Snare Corp., 114 Liberty St., New York; (c) P. McGovern, 50 East 42nd St., New York. This is Federal Aid Project No. 20, the main bridge consisting of 1,536 lin.ft. steel plate girder spans carried on concrete piers, supported on pile and faced with granite, and 360 ft. span. The unit bids are as follows:

	A	B	C
Necessary clearing of right-of-way, etc., complete (lump sum)	$4,973.00	$14,000.00	$28,000.00
3,418 cu.yd. excavation, roadway cut, north approach, including grading	3.50	2.00	6.25
62,119 cu.yd. earth fill, north approach, including grading	3.00	1.60	5.00
72,950 cu.yd. earth fill, south approach, including grading	3.50	1.60	5.00
5,310 cu.yd. excavation, piers 1 to 9 and ret. wall, north approach	5.00	7.00	5.45
14,495 cu.yd. excavation, piers 10 to 12 and 16 to 28 inclusive	8.00	15 00	12.40
12,593 cu.yd. pneumatic excavation, piers 13, 14 and 15	23.00	17.00	32.50
556 cu.yd. pneumatic rock excavation, piers 13, 14 and 15	120.00	40 00	56.25
8,287 cu.yd. excavation, piers 29 to 55 incl., drainage ditches, etc.	5 00	9.00	8.65
2,040 lin.ft. piles 30 ft. length	2.85	.75	.50
9,270 lin.ft. piles 40 to 49 ft. length	2.24	.90	.50
23,777 lin.ft. piles 50 to 59 ft. length	1.74	.80	.55
61,072 lin.ft. piles 60 to 69 ft. length	1.77	.90	.70
58,204 lin.ft. piles 70 to 79 ft. length	1.61	1.00	.70
44,940 lin.ft. piles 76 to 78 ft. length (creosoted)	1.32	1 50	1.65
98,998 lin.ft. piles 80 to 89 ft. length	1.59	1.10	.85
34,567 lin.ft. piles 90 to 95 ft. length	1.45	1.20	.90
3,491 cu.yd. 1:2½:5 plain concrete, piers 1 to 9 and 29 to 55, inclusive, and retaining walls	12.00	18.00	15.50
6,509 cu.yd. 1:2½:5 plain concrete, piers 10 to 12 and 16 to 28, inclusive	15.00	33.00	15.25
9,024 cu.yd. 1:2½:5 plain concrete, piers 13, 14 and 15	20.00	40.00	12 50
888 cu.yd. 1:2:4 plain concrete, piers 2 to 9 and 29 to 54, inclusive	20 00	20 00	17.00
3,750 cu.yd. 1:2:4 plain concrete, piers 10 to 12 and 16 to 28, inclusive	25 52	34.00	17.00
4,608 cu.yd. 1:2:4 plain concrete, piers 13, 14 and 15	18.70	40.00	14.25
1,250 cu.yd. 1:2:4 concrete, retaining wall, north approach, including straps	21.61	20.00	25.00
1,990 cu.yd. 1:2:4 reinforced concrete, cols. beams and piers	28.40	24 00	34.00
1,569 cu.yd. 1:2:4 reinforced concrete, piers 10 to 13 and 15 to 28	15.00	24.00	34.00
3,853 cu.yd. 1:2:4 reinforced concrete, girders, slabs, etc.	30 00	32.00	29.00
2,450 cu.yd. 1:2:4 reinforced concrete, roadway and sidewalk slabs, etc.	25 00	30.00	22.00
1,520 cu.yd. 1:2:4 reinforced concrete, sidewalks, earth fill	30 00	20.00	18.25
272 cu.yd. 1:2:4 reinforced concrete, railings and posts	93 00	60.00	79.00
826 cu.yd. 1:2:4 plain concrete around conduits	15 00	12.00	19.00
2,019 cu.yd 1:3:5 plain concrete roadway pavement, etc.	10 00	12.00	19.00
5,205 cu.yd. 1:1½:3 reinforced concrete roadway pavement, south approach	15.60	15.00	24.00
56 cu.yd. 1:3 cement mortar protection coat	82.81	40.00	23.40
390 cu.yd. 1:3 cement mortar waterproofing protection coat	71.26	10.00	19.40
90 cu.yd. 1:3 grout for ballast	11.70	15 00	13.00
115 cu.yd. 1:2 cement mortar for fascia girders, etc.	51.18	80.00	61 00
1,843 cu.yd. rock faced granite, piers 10 to 12 and 16 to 28	76.00	93.00	62.90
399 cu yd rock faced granite, piers 13, 14 and 15	73.50	93.00	62.90
16,850 cu.yd. back fill around piers, abutments and retaining walls	.77	.50	.50
370 cu.yd. ballast on concrete viaduct	4.16	3.00	5.00
251 cu.yd. broken stone for drains	4.16	3 00	5.60
6,501 gal bituminous cement	.44	.50	.30
14,685 sq.yd. waterproofing	1.05	1 00	1.30
17,140 sq.yd. 2½-in. asphalt block	2.50	2.80	2 55
1,520 sq.yd. 2 in. asphalt block	2.50	2.60	2.30
40,725 lin.ft. 4 in. fiber conduit	.18	.20	.25
106,089 lin.ft. 3 in. fiber conduit	.17	.15	.22
1,350 lin.ft. 2 in. fiber conduit	.17	.15	.20
658 lin.ft. 4 in. v.t. pipe	.96	1.50	.50
690 lin.ft 12 in. v.t. pipe	2 12	4 00	4.20
895 lin.ft 15 in. v.t pipe	2 69	5 00	4.60
611 lin.ft. 18 in. v t pipe	2 16	7 00	5.30
446 lin.ft. 8 in. c.i pipe	2 25	6 00	5.10
52 lin.ft. 10 in. c.i pipe	2 82	12 00	6 70
62 lin.ft. 16 in. c.i pipe	5.36	18 00	12 00
36 lin.ft 18 in. c.i pipe	6.56	25.00	14 00
2,000 sq.ft. cobble gutter	13	.50	50
211,000 sq.ft. grassing and top soil	.06	.05	30
11,000 lin.ft. wooden railing	2.48	.60	2 50
415,225 M.B.M. lumber for fenders, etc.	162.00	120 00	120 00
11,513 lb. copper flashing	.37	.80	.60
1,540 lb. sheet lead	19	.30	.10
1,322,500 lb. steel reinforcement	.075	.06	.05
52,980 lb. clinton wire cloth	.075	.10	.07
214,000 lb. galvanized steel fabric	055	.10	.08
4,935,000 lb. structural steel for girder spans	.0528	.0567	.055
2,163,000 lb. structural steel for draw span	.0728	.077	.0775
132,720 lb. ornamental steel for hand railing	.1483	.17	.12
234,406 lb. curb angle guard including bolts	.0433	.07	.045
79,754 lb. miscellaneous steel	.0988	.10	.06
84,950 lb. cast steel for girder bearing	.1446	.14	.12
84,830 lb. cast iron for scuppers	.07	.10	.08
31,340 lb. miscellaneous cast iron	.16	.10	.10
283,000 lb. machinery for draw span	.24	.216	.215
145 pull boxes	28 00	60 00	25.00
63 draw boxes and manhole covers	64 00	80.00	50.00
Operator's and gatemen's houses (lump sum)	4,200 00	7,000.00	7,500.00
Bronze name plates and brackets	4,300 00	4,000.00	1,500.00
84 wood lighting poles	125 00	50.00	58.00
Lighting system complete (lump sum)	36,000 00	24,000.00	50,000.00
Electrical equipment for draw span (lump sum)	19,850 00	20,000.00	25,000.00
Extended totals	$3,702,922	$3,778,645	$3,862,847

Future Transportation Needs

(*Concluded from p. 1079*)

Motor trucks and buses have been recognized as legitimate supplements to railroad facilities and as such have been figured in the program to meet the country's future transportation needs. This will permit the railroads to discontinue a service which is not profitable and which can be more easily handled by motors.

Water transportation was also studied and is a part of the problem to be worked out.

Some figures which are of general interest has come from the work of this conference.

In 1921, the railroads paid $277,000,000 in taxes and during this same period expended $756,000,000 on maintenance. Electric railways paid $92,000,000 in taxes and expended $101,000,000 on maintenance for the same year.

If the motor trucks are to meet the requirements of the future, the states must see that highways are suitable for such traffic. The sources of the money used for the 1921 highway program was studied and the committee summarized the situation as follows:

Bonds	$417,817,208
General state and local taxation	381,091,542
Miscellaneous	88,919,158
Gasoline tax and registration	109,154,226
Federal and forest road aid	76,679,897
Total	$1,071,662,031

The work of this conference has pointed the way to improvements in the present transportation system but back of it all—the idea—the country's good and need.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Dec. 6; the next, on Jan. 3.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.40	$3.30	$3.55	$4.20	$3.60	—$3.85	$4.25
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	·4.25	5.30	5.00	—4.05	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.38	3.20	3.45	3.85	3.65	+4.25	4.00
Steel pipe, black, 2½ to 6 in. lap, discount	44%	40%	43%	47%	53–5%	36%	33.2@42.2%	35%	47.43
Cast-iron pipe, 6 in. and over, ton	61.60@63.60	54.75	61.00	57.20@60.20	60.50	66.00	—57.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.50@2.60	2.35	2.05	2.10	2.42	2.84	2.61	2.90	2.25
Gravel, ¾ in., cu.yd.	2.00	1.75	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.20	2.00	2.00	1.25@1.50	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	—58.00	37.00	54.75	55.50	44.75@46.00	41.75	38.00	+30.00	42.00
Lime, finishing, hydrated, ton	18.20	23.00	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	1.85	1.50	1.50	2.70	2.10	+2.80	9.50
Common brick, delivered, 1,000	23.65	11.00	11.60	11.00	16@18	12.00	15.50	15.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.10	.11	.0724	.075	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1179	.10	.11	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.95	+.97	+1.07	.94	1.01	1.10	1.03	1.15	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	—.40@.45	.35@.50	.50	.62½	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on white pine lumber, free on cars at mill. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.50). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in., $119.

Weekly Review of the Market

Except for the usual holiday activity, a somewhat slower pace is noticeable in business, generally. A slight decrease in employment is reported among basic industries and a decline in freight loadings indicates the lessened volume of merchandise being handled. The slowness of pig-iron buying is just an instance of the attitude of buyers, who show a tendency to defer important commitments until the new year.

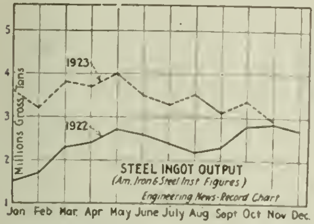
Favorable indications, however, are apparent in a 12 per cent increase in the estimated value of the years' agricultural output. This means increased buying power in that direction. Increased issuance of building permits indicates a continuation of the winter construction movement. Firmness of steel prices and maintenance of buying among railroads and automobile makers, are indicative of the trend of business expected at the beginning of the new year. November export figures were higher than any other month this year.

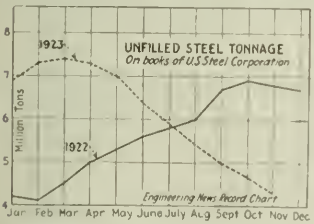
A brief outline of the iron and steel situation follows: Pig-iron market very quiet. No. 2 foundry iron quoted as low as $20@$21 per ton at Birmingham. Iron and steel scrap buying active; prices tending upward. Tin plate demand fairly good; mills operating at 96 per cent of capacity. Fabricated structural steel prices still firm at $2.50 for plates and shapes and $2.40 per 100 lb. for bars, f.o.b. Pittsburgh.

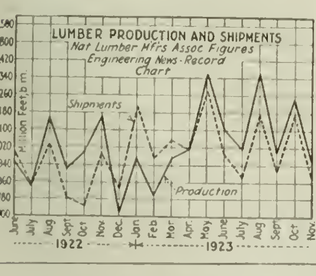
The Construction Barometer

Slower Pace in Industrial Activity—Production Conditions Exactly Opposite One Year Ago

THE reported slower pace in industrial activity is confirmed by the charted trends in iron, steel, lumber and cement production, as shown below. Pig-iron, steel ingot and lumber output declined considerably during November of this year, against an exactly opposite condition existing in November, 1922. From March to October, 1922, the unfilled steel tonnage steadily rose; during the same period this year it gradually dropped. Although unfilled tonnage declined during the last quarter of 1922, the drop from October to November of this year was unusually abrupt. Cement output, though lessened, conforms closely to the regular seasonal trend. November debits to individual accounts (Federal Reserve) showed only a slight drop from the preceding month, against a sharper decline last year. Payments of debts are normally heavier in the last three months of the year than during the preceding quarter.







Engineering News-Record Statistics

VALUE OF LARGE CONTRACTS LET IN THE UNITED STATES

Week Ended	Public Work	Private Work	Total Contracts
Dec. 6	$9,806,000	$20,846,000	$30,652,000
Dec. 13	10,775,000	16,335,000	27,110,000
Dec. 20	22,207,000	20,068,000	42,275,000
3 weeks	$42,788,000	$57,249,000	$100,037,000

LARGE BUILDING CONTRACTS NUMBER AND VALUE

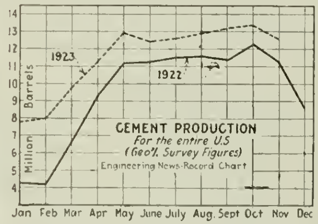
Week Ended	No.	Public Work	No.	Private Work
Dec. 6	20	$5,034,000	49	$14,770,000
Dec. 13	16	3,567,000	26	9,576,000
Dec. 20	17	7,988,000	28	16,008,000
3 Weeks	53	$16,589,000	105	$40,354,000

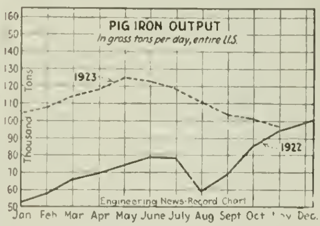
NUMBER OF LARGE JOBS NOW OUT FOR BIDS

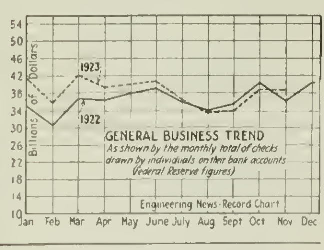
Week Ended	Private	Public: All	Public: Streets and Roads	Public: Waterworks and Sewers	Public: All Buildings
Dec. 6	40	183	58	27	61
Dec. 13	38	177	50	33	56
Dec. 20	29	137	30	22	40

LUMBER LOWER—OTHER BASIC PRICES FIRM

	Quoted on Dec. 27, at	Price was	On
Structurals, Pittsburgh, 100 lb.	$2 50	$2 50 @ 2 60	June 21
Cement, Chi., net bbl.	2 10	2 20	Nov. 22
Pine, N. Y., M.ft.	58 00	59 00	Dec. 20
Fir, San Fran., M.ft.	38 00	41 00	Dec. 13
Common labor, hr	54	.53	June 28







PROPOSALS

For proposals Advertised see the pages immediately following the "Construction News" Section.

Bids Close — See Eng. News-Record

WATERWORKS

Jan. 3 Erie, Pa. ....Dec. 8
Jan. 3 Sacramento, Calif. ....Dec. 27
Jan. 7 Ames, Ia. ....Dec. 20
Jan. 8 Burbank, Calif. ....Dec. 27
Jan. 10 Belzoni, Miss. ....Dec. 20
Jan. 10 St. James, Mo. ....Dec. 20
Jan. 14 North East, Pa. ....Dec. 27
Adv. Dec. 27.
Jan. 15 Oklahoma City, Okla. ....Dec. 20
Adv. Dec. 20 and 27.

Bids Close — See Eng. News-Record

Jan. 16 South Bend, Ind. ....Dec. 20
Jan. 19 Charlottesville, Va. ......Dec. 27
Adv. Dec. 27.

SEWERS

Dec. 31 Granite City, Ill. ....Dec. 27
Jan. 2 Long Branch, N. J. ......Dec. 20
Jan. 2 Johnson City, N. Y. ......Dec. 27
Jan. 3 Carrollton, Mo. ....Dec. 27
Jan. 3 McKenzie, Tenn. ....Dec. 27
Adv. Dec. 27.

BRIDGES

Jan. 3 Robert Lee, Tex. ....Dec. 27
Jan. 3 New Smyrna, Fla. ....Dec. 27
Jan. 11 Seattle, Wash. ....Dec. 20
Adv. Dec. 20 and 27.
Jan. 22 St. Louis, Mo. ....Dec. 27
May 1 Tientsen, North China ....Oct. 11

Bids Close — See Eng. News-Record

DAMS

Jan. 7 Los Angeles, Calif. ......Nov. 29
Feb. 7 Kingston, N. C. ....Dec. 27

RAILWAYS

Mar. 18 New Zealand ....Sept. 20

EXCAVATION, DRAINAGE IRRIGATION

Dec. 28 New York, N. Y. ....Dec. 20
Dec. 29 Brooklyn, N. Y. ....Dec. 20
Jan. 3 Senatobia, Miss. ....Dec. 27
Jan. 17 Rochester, N. Y. ....Dec. 20
Adv. Dec. 20 and 27.
Jan. 18 Lake Charles, La. ....Dec. 27
Adv. Dec. 27.

Bids Close		See Eng. News-Record

STREETS AND ROADS

Bids Close		See Eng. News-Record
Jan. 2	Indiana	Dec. 20
Jan. 2	Nevada	Dec. 20
Jan. 2	Richmond Heights (St. Louis P. O.), Mo.	Dec. 27
Jan. 3	Albany, Ga.	Dec. 27
Jan. 3	Robert Lee, Tex.	Dec. 27
Jan. 3	Louisiana	Dec. 20
Jan. 3	North Kansas City, Mo. Adv. Dec. 20 and 27.	Dec. 20
Jan. 3	Buffalo, N. Y.	Dec. 27
Jan. 4	Alabama	Dec. 13
Jan. 7	Vicksburg, Miss.	Dec. 13
Jan. 7	California	Dec. 20
Jan. 7	Stockton, Calif.	Dec. 27
Jan. 7	California	Dec. 27
Jan. 7	Oroville, Calif.	Dec. 27
Jan. 8	Monticello, Ind.	Dec. 20
Jan. 9	Del Rio, Tex.	Dec. 27
Jan. 10	San Angelo, Tex.	Dec. 20
Jan. 11	Seattle, Wash.	Dec. 27
Jan. 11	Franklin, Tex.	Dec. 27
Jan. 14	Ollton, Okla.	Dec. 13
Jan. 15	Michigan	Dec. 6
Jan. 15	Michigan	Dec. 13
Jan. 15	Rock Springs, Tex.	Dec. 27
Jan. 15	Louisiana	Dec. 27
Jan. 22	St. Louis, Mo.	Dec. 27

INDUSTRIAL WORK

Bids Close		See Eng. News-Record
Jan. 8	Canton, N. Y.	Dec. 27
Feb. 1	Peoria, Ill.	Dec. 27
Apr. 30	Wellington, New Zealand	Dec. 6

BUILDINGS

Bids Close		See Eng. News-Record
Dec. 31	Bryn Mawr, Pa.	Dec. 13
Dec. 31	Phila., Pa.	Dec. 13
Jan. 1	Williamson, W. Va.	Nov. 22
Jan. 1	Ft. Worth, Tex.	Dec. 20
Jan. 1	Wilkes Barre, Pa.	Dec. 20
Jan. 2	Bloomington, Ind.	Nov. 15
Jan. 3	New York, N. Y.	Dec. 20
Jan. 3	Tucson, Ariz.	Dec. 20
Jan. 3	Baltimore, Md.	Dec. 20
Jan. 3	Texarkana, Tex.	Dec. 20
Jan. 3	Columbia, Mo.	Dec. 13
Jan. 8	Wilson, N. C.	Dec. 20
Jan. 8	Brooklyn, N. Y.	Dec. 27
Jan. 8	New York, N. Y.	Dec. 27
Jan. 8	Bellaire (Jamaica P. O.), N. Y.	Dec. 27
Jan. 9	Baltimore, Md.	Dec. 27
Jan. 9	Denver, Colo.	Dec. 13
Jan. 10	Birmingham, Ala.	Dec. 13
Jan. 12	Boston, Mass.	Nov. 29
Jan. 14	Galveston, Tex.	Nov. 29
Jan. 14	Schuylerville, N. Y.	Dec. 13
Jan. 14	Galveston, Tex.	Dec. 27
Feb. 1	Dorchester, Mass.	Nov. 29
Feb. 4	Urbana, Ill. Adv. Dec. 13 to 27.	Dec. 13
Feb. 4	Columbus, O.	Dec. 27

FEDERAL GOVERNMENT WORK

Bids Close		See Eng. News-Record
Dec. 29	Metal Work—Louisville, Ky. Adv. Dec. 6 to 27.	Dec. 6
Jan. 2	Post Office—Liberty, Mo.	Dec. 6
Jan. 2	Extension to Building—Keyport, Wash.	Dec. 20
Jan. 3	Gates—Washington	Dec. 6
Jan. 3	Lock Gates—Addison, Ky. Adv. Dec. 6 to 27.	Dec. 6
Jan. 3	Post Office and Custom House—Mineral Point, Wis.	Dec. 13
Jan. 9	Scow—Phila., Pa.	Dec. 20
Jan. 9	Storage and Recreation—Cape Hatteras, N. C.	Dec. 20
Jan. 9	Quarters and Boathouse—Poyners Hill, N. C.	Dec. 20
Jan. 9	Underpinning Foundations — Wash., D. C.	Dec. 20
Jan. 9	Remodeling—Norfolk, Va.	Dec. 27
Jan. 10	Steel Hulls — Vicksburg, Miss.	Dec. 6
Jan. 15	Filtration Plant, etc.—Wash., D. C. Adv. Dec. 20 and 27.	Dec. 20
Jan. 16	Scow and Barge—Milwaukee, Wis. Adv. Dec. 20 and 27.	Dec. 20
Jan. 16	Fuel Oil Storage—Mare Island, Calif.	Dec. 6
Jan. 19	Gates—Cincinnati, O. Adv. Dec. 27.	Dec. 27
Jan. 21	Post Office—State College, Pa. Adv. Dec. 27.	Dec. 27
Jan. 30	Ward—Great Lakes, Ill.	Nov. 15
Feb. 6	Storehouse—Pearl Harbor, H. T.	Dec. 20

UNCLASSIFIED

Bids Close		See Eng. News-Record
Dec. 28	Bulkhead—Long Island City, N. Y.	Dec. 20
Dec. 28	Heating and Ventilating Apparatus—Brooklyn, N. Y.	Dec. 20
Jan. 3	Aluminum Steel Cored Cable, etc.—Melbourne, Australia	Nov. 1
Jan. 3	Ferry Boats—New Orleans, La.	Dec. 13
Jan. 7	Swimming Pool — Taylor, Tex.	Dec. 20
Jan. 9	Transmission Towers — San Francisco, Calif.	Dec. 20
Jan. 9	Wharf—Pembroke, Ont.	Dec. 27
Jan. 19	Transformers, etc.—Melbourne, Australia	Oct. 18
Mar. 31	Hopper Dredge — Brisbane, Queensland, Australia	Nov. 1
Apr. 30	Headworks—Wellington, New Zealand	Dec. 13

MATERIALS AND EQUIPMENT

Bids Close		See Eng. News-Record
Dec. 31	Tractor, etc.—Pass Christian, Miss.	Dec. 27
Dec. 31	Pipe, etc.—Phila., Pa.	Dec. 27
Jan. 2	Gravel—Abbeville, La.	Dec. 27
Jan. 3	Cement—Wisconsin	Dec. 27
Jan. 7	Crushed Stone, etc.—Houston, Tex.	Dec. 27
Jan. 9	San Francisco, Calif.	Dec. 20

Where name of official is not given inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Waterworks

PROPOSED WORK

N. Y., Clinton—Plans 20 m.g. reservoir at White Creek. $106,775. W. G. Stone, Whitesboro, engr.

N. Y., Herkimer—Takes bids within week pumping equipment and motors for new well and water supply. $10,000. Engineer's name withheld. Address Municipal Comn. Noted Nov. 22.

W. Va., Martinsburg—Water Comn. plans additional reservoir. $30,000.

Fla., Cocoa — Plans waterworks system. $95,000. J. E. Craig, 427 King St., Jacksonville, engr.

Fla., Longwood — Had plans prepared waterworks system. $20,000. J. E. Craig, 427 King St., Jacksonville, engr.

Fla., St. Augustine—Making plans for obtaining supply of soft water, improving distribution system, and new pumping engines, etc. $300,000-$400,000. Bond election soon. J. E. Craig, 427 King St., Jacksonville, engr.

Fla., Sanford—Had plans prepared waterworks system, incl. 31 mi. mains, two-three m.g. pumping engines, soft water collecting system $375,000; will vote on $845,000 bonds Jan. 11, for waterworks, electric and gas plants. J. E. Craig, 427 King St., Jacksonville, engr.

O., Cincinnati—Plans reservoir 400 ft. square, 30 ft. deep, 30 m.g. capacity, on Winton and North Bend Rds. $110,000. J. A. Hiller, City Hall, engr.

O., Youngstown — Mahoning Water Co. plans new mains and dams creating lakes for reserve supply. $200,000. W. F. Hopkins, supt.

Mich., Otsego—See "Streets and Roads."

Ill., Addison—Will probably take bids about Mar. 1, 4- to 10-in. mains. $25,000. E. Hancock, 2047 Ogden Ave., Chicago, engr.

Ill., Lebanon — Plans water supply and distribution system. Address W. C. Lang.

Kan., Russell—Voted $95,000 bonds for waterworks system. J. W. Murphy, city clk.

Mo., Miller—Alexander Bros., engrs., 535 West Commercial St., Springfield, takes bids about Jan. 1, improving waterworks here, for city. $16,250. Noted Sept. 13.

Mo., Thayer—Jan. 8, to vote on $65,000 bonds waterworks and distribution system. Alexander Eng. Co., Springfield, engrs. Noted Oct. 18.

Tex., Austin—Voted $300,000 bonds rapid sand filtration plant. J. B. Hawley, Cotton Exch. Bldg., Ft. Worth, consult. engr.

Tex., Mart—Jan. 15, to vote on $150,000 bonds water works system. Koch & Fowler, Central Bank Bldg., Dallas, engrs. Noted Aug. 23.

Okla., Chickasha — Election Dec. 28, to vote on $60,000 bonds for 10,000 ft. of 16 in. c.i. pipe line and motor driven pumping units. J. C. Milliken, Chickasha, engr.

Wash., Anacortes—Having surveys and estimates made for waterworks extensions, making Lake Campbell source of water supply for city. $100,000. A. Short, city engr.

Calif., Coronado (San Diego P. O.)—Coronado Water Co., Union Bldg., San Diego, plans to extend water system to outlying districts, will install electrically driven pumps for 7 wells. Project includes storage dam 55 ft. high, 650 ft. long on top. $100,000 or more. A. Ervast, Union Bldg., San Diego, engr.

BIDS DESIRED

Pa., North East—Jan. 14, by Boro. Council, 600,000 gal. per day filtration plant; adv. E. N.-R. Dec. 27.

Va., Charlottesville — Jan. 19, by B. A. Bennett, city mgr., 12 mi. 18 in. c.i. pipe line, tunnel, diversion dam, etc. Fuller & McClintock, 170 Bway., New York City, and L. H. Williamson, Natl. Bank Bldg., Charlottesville, engrs.; adv. E. N.-R. Dec. 27.

Ia., Dubuque—Taking bids 20 and 24 in. Class D and 8 and 12 in. Class B c.i. pipe and valves. $5,000. Mead & Seastone, Journal Bldg., Madison, Wis., engrs.

Tex., Hillsboro — Taking bids two 750 g.p.m. motor driven centrifugal pumps for fire use, 241 ft. head, 2 deep well pumps, 80 g.p.m., 250 ft. lift, 1 well pump 400 ft. lift, 60 g.p.m. T. A. Bullock, city engr.

Calif., Sacramento—Jan. 3, by H. G. Denton, clk., 67,000 ft. 6 in. c.i. mains.

BIDS RECEIVED

R. I., Providence — Water Supply Bd., City Hall, Dec. 19, clearing, grubbing, earth and rock excav. in preparation for Scituate Reservoir, in Scituate, from W. D. Winchell, 315 Stillman Bldg., Columbus, O., $251,265. Noted Nov. 22.

N. Y., New York — N. J. Hayes, comr. Water Supply, Gas & Electricity, Municipal Bldg., mains in Oak Point and Viele Aves., etc., from Beaver Eng. & Contg. Co., 51 Chambers St., $9,993; Brinsmade and Calhoun Aves., etc., from C. De Blasio, 339 7th Ave., Mt. Vernon, $10,600. Noted Dec. 13.

Calif., Montecito — Montecito County Water Dist., Dec. 11, ditching, backfilling and laying water pipe for waterworks system, from J. Currie, 3120 Balboa St., San Francisco, $94,143.

CONTRACTS AWARDED

Md., Baltimore—Bd. Awards, piping for pumping station, for Fire Dept., Lexington and Gay Sts., to H. A. Kries, 6 West Lombard St., $4,418. Noted Dec. 6.

O., Youngstown—Mahoning Water Co., 1 m.g. filtration plant at Burgess Lake, to Burnip Constr. Co., 223 East Broad St., Columbus, $100,000.

Ia., Grinnell—New well to C. B. Brant, Indianapolis, Ind., $23,850.

Ill., Forest Park—Artesian wells to S. B. Geiger, Old Colony Bldg., Chicago, $22,000.

Mich., Menominee—H. W. Blunder, city clk., installing one 2,500 gal. centrifugal pump, two 1,000 gal. centrifugal pumps, one 60 cycle generator, etc., to Commonwealth Electric Co., 417 Bway., St. Paul, Minn., $20,150. Noted Dec. 6.

Ont., Fort Erie—Constructing pumping station to F. F. Fry & Co., Ltd., 43 Scott St., Toronto. $18,596.

Sewers

PROPOSED WORK

Conn., Hartford—Street Dept. plans 2,000 ft. 10- to 20-in. vitr. clay sewers in Norwich and Wyllys Sts. $28,000. R. N. Clark, city engr.

Conn., West Hartford (Branch of Hartford)—Plans trunk line sewer, probably segmental block or concrete, Steele Rd. $45,000. G. H. Barton, chn. Bd. Sewer & Water Dept.

N. Y., Ilion—Plans disposal plant. $50,000-$60,000. Engineers name withheld.

N. Y., Rochester—Plans sewers in Longacre and Falleson Rds., Clinton and Edgemont Aves., Harding and Nye Sts. $34,200. Will mature in spring. C. A. Poole, City Bldg., engr.

N. C., Sanford—Making plans and soon takes bids 2 mi. extension to sewer system. $30,000. W. H. Fitts, mayor.

Fla., Cocoa — Plans sewerage system. $65,000. J. E. Craig, 427 King St., Jacksonville, engr.

O., Cincinnati—Plans election to vote on $200,000 bonds Millcreek sewer. F. Krug, City Hall, engr.

Mich., Detroit—Plans vitr. crock sewers, 2,310 ft. 12-18 in. in Laterals 4066 and 4056, 8,252 ft. 12-20 in. in Laterals 4057 and 4060, 7,928 ft. 12-24 in. in Laterals 4058 and 6125, 1,333 ft. 10-24 in. in Lateral 4059. G. Jerome, city engr.

Sewers (Continued)

Mich., Otsego—See "Streets and Roads."

Ill., Bensenville — Making preliminary plans 20,000 ft. 8- to 18-in. sanitary sewer and disposal plant, $200,000; 10- to 36-in. storm water sewer, $110,000. E. Hancock, 2047 Ogden Ave., Chicago, engr. Noted June 27.

Ill., Posen—Making preliminary surveys complete sewerage system and disposal plant. $200,000. E. Hancock, 2047 Ogden Ave., Chicago, engr.

Ark., Helena—Having preliminary plans prepared storm and sanitary sewers in downtown district. $60,000.

Tex., Ft. Worth—See "Streets and Roads."

Tex., Kerrville — Voted $78,000 bonds, sewerage disposal plant and sewer extensions. Municipal Eng. Co., 715 Praetorian Bldg., Dallas, engrs. Noted Nov. 29.

Okla., Chickasha — Election Dec. 28, to vote on $70,000 bonds for 10,000 ft. 24 in. vitr. clay outfall sewers and disposal plant. J. C. Milliken, Chickasha, engr.

Calif., Santa Monica — City plans joint outlet sewer from Topango to Hyperion for cities of Santa Monica, Los Angeles, Venice and Pacific Palisades Assn. To exceed $25,000.

Calif., Pasadena — Jan. 10, to vote on $125,000 bonds for sewer drain from municipal sewer farm to Rio Hondo Wash.

Que., Montreal—Plans 2 x 3 brick sewers, 1,369 ft. in Belanger St. $13,030, 3,309 ft. in 14th Ave. $25,300, 3,354 ft. in 12th Ave. $26,430, 930 ft. in 15th Ave. $15,100, 7,137 ft. in. 11th Ave. $62,760, 1,135 ft. in. Dandurand St. $11,900, 3,486 ft. in 13th Ave. $26,970, 3,392 ft. in Lafond St. $25,480, 4,975 ft. in Tolhurst St. $35,534, 1,798 ft. in Henry Julien Ave. $10,907, 100 ft. in Clay St. $1,872. E. Gauthier, asst. city clk.

BIDS DESIRED

N. Y., Johnson City—Jan. 2, by Bd. Village Trustees 8,952 ft. 8- to 42-in. rein.-con. and vitr. clay sewers from Riverside Dr. along tracks of Delaware, Lackawanna & Western R.R. to Willow and Division Sts., Grand, Burbank, Farr and Lincoln Aves., $65,000. F. A. Tillman, Municipal Bldg., engr. Noted Dec. 13.

Tenn., McKenzie—Jan. 3, by Mayor and City Council, construction vitr. sewerage system and settling tanks. B. H. Klyce, 506 4th and 1st Natl. Bank Bldg., Nashville, engr.; adv. E. N.-R. Dec. 27.

Ill., Granite City—Dec. 31 approximately 5,000 lin.ft. sewers in Dists. 5 and 6. $54,000. W. W. Kerch, 1st Natl. Bank Bldg., engr.

Mo., Carrollton — Jan. 3, by City Clerk, City Hall. 6 mi. 6- to 21-in. sewers. $50,000. D. W. Frush, Carrollton, engr. Noted Aug. 9.

BIDS RECEIVED

N. Y., Brooklyn — E. Riegelmann, boro pres., Boro Hall, Dec. 19, temporary sewers in Clarendon Rd., from Tomasetti & Co., Inc., 1133 60th St., 78.5% engrs. est. ($32,785). Noted Dec. 13.

N. Y., New York — H. Bruckner, pres. Bronx Boro, Dec. 19, sewers in Zulette Ave., from MacDonald & Wilson Co., $17,937; Findlay Ave., from J. V. Timoney Constr. Co., 220 East 201st St., $11,502; Melville St., from F. Gasparine, $41,108; Rhinelander and Wilson Aves., from A. Gregorio & Co., $59,942 and $28,252 respectively. Noted Dec. 13.

Pa., Phila.—Sewers in (1) Bridge St. (2) 18th St. (3) Mifflin St (4) Luzerne St. (5) Broad St. (6) Emily St. (7) Mitchell St. (8) Wagner St. (9) Madison St., from C. DiPasquali, 1215 South 17th St., (1) $6,218 (4) $2,133; A. DiSandro & Son, 39067 5th Ave., (2) $2,897 (8) $3,619; J. Lombardi, 601 Lincoln Bldg., (5) $2,284 (7) $3,914 (9) $3,608; McCoul Constr. Co., 5033 Duffield St., (3) $2,364; A. DiVito, Phila., (6) $3,766.

O., Toledo—W. T. Jackson, dir. Pub. Serv., Dec. 18, Relief Sewer 1432, incl. concrete bulkhead and 10,527 lin.ft. 30- to 96- in. (a) concrete segmental block (b) vitr. segmental block (c) monolithic concrete pipe, from Anderson & Campbell, 81 Petersboro St., Detroit, Mich., (a) $264,396: R. Mercier, Griswold St., Detroit, Mich., (b) $266,013; Graham & Henderson, Cleveland, (c) $288,656. Noted Dec. 6.

Calif., Morgan Hill—Sewerage system and disposal plant from Schultz Constr. Co., 46 Kearny St., San Francisco, $51,191. Noted Dec. 13.

CONTRACTS AWARDED

R. I., Providence—Reconstructing 250 ft. 48 in. brick sewer, etc., to W. V. Polleys & Co., 217 Turks Head Bldg. Noted Nov. 15.

N. Y., Brooklyn — E. Riegelmann, boro pres., Boro Hall, sewers in Fort Hamilton Parkway, engrs. est. $17,100, 80th St. $3,398, and East 28th St. $1,867, to C. F. Vacharias, 645 40th St., 78%, 90% and 98.7% of engineers est. respectively; Ferris St. $4,217, to Tomassetti & Co., 1133 60th St., 98%; Fort Hamilton Parkway between 83rd and 84th Sts. $1,813, Fort Hamilton Parkway between Bay Ridge Ave. and 68th St. $1,625, and Fort Hamilton Parkway between 72nd and 73rd Sts. $1,542, to Nazzarro & Querriero, 101.99%, 98% and 97.9% respectively; Douglass St. $1,200, and Ave. N $800, to R. Iovino, 84% each. Noted Dec. 13.

W. Va., Bluefield—C. E. Ridley, city mgr., 16 mi. sanitary sewers, ditching to Pace Constr. Co., Roanoke, Va.; concrete box culverts to C. A. Haggerty, 18 Negus St., Webster, Mass.; constructing sanitary and storm sewers, to J. R. Vaughan & Co., Roanoke, Va., total $349,775. Noted Nov. 22.

N. C., Raleigh—See "Streets and Roads."

La., Baton Rouge—Comm. Council, sewerage system to J. B. McCrary Co., Citizens and Savings Bank Bldg., Atlanta, Ga., $126,855.

Mich., Holland—Common Council at office R. Overweg, city clk., 1,900 ft. 60 in. and 350 ft. 3 ft. x 7 ft. concrete storm sewer, to Hammen & Co., 4612 Woodward Ave., Detroit. $38,200. Noted Nov. 15.

Waste Disposal

PROPOSED WORK

Tex., Austin—Voted $50,000 bonds for incinerator. C. E. Leonard, city engr. Noted Nov. 15.

CONTRACTS AWARDED

O., Willow (Brooklyn, P. O.)—F. Kohler, mayor, and Bd. Control of Cleveland, 500 ton garbage disposal plant, here, to C. O. Bartlett & Snow Co., French and Winter Aves., Cleveland, $930,000. Noted June 14, under "Cleveland."

Bridges

PROPOSED WORK

N. Y., Leroy—Plans 150 ft. 1 or 2 span bridge, 30 ft. wide, two 6 ft. walks on each side over Oatka Creek. $50,000. Engineers name withheld.

Ga., Macon—Comrs. Bili Co plan bridge over Stone Creek. $50,000.

Wis., Kaukauna—City plans 2 rein.-con. bridges over Fox River. $80,000 for both. Harrington, Howard & Ash, 1012 Baltimore St., Kansas City, Mo., engrs.

Missouri—State Hy. Dept., Jefferson City, rejected bids Nov. 27, one 37½ ft. rein.-con. deck girder, two 20 ft. and three 18 ft. rein.-con. slab spans, etc., over tracks of Chicago & Alton R.R., State Project Route 2, Sect. 6A, Jackson Co. Noted Dec. 6.

Wash., Arlington—Snohomish Co. (Everett), takes bids about Jan. 1, bridge over Stillaguawamish River, here, steel and concrete, one 210 ft. and one 100 ft. span, piling approach, 5 ft. sidewalks. $70,000. M. M. Caldwell, Central Bldg., Seattle, engr. Noted June 7 under "Everett."

California—State Hy. Dept., Sacramento, making plans 400 ft. concrete bridge, six 60 ft. spans, 21 ft. roadway, over Cottonwood Creek, Shasta and Tehama Counties. R. M. Norton, state highway engr.

California—State Hy. Dept., Sacramento, plans bridge over Chowchilla River, Madera Co. To exceed $25,000. County will appropriate $13,000 toward cost. R. M. Morton, state highway engr.

Que., St. Anne de Bellevue—Provincial Government, Quebec, plans 1,382 ft. steel bridge from here to Isle Perrot, rein.-con. floor, asphalt roadway, 4 ft. concrete sidewalks, concrete or stone wall approaches, also space for Canadian Pacific and Canadian Natl. Ry. tracks. $450,000. C. Denis, Shaughnessy Bldg., Montreal, engr.

B. C., Vancouver — Plans to reconstruct portion of Connaugh Bridge, 350 ft. steel deck plate girder, 60 ft. wide. $120,000. F. L. Fellowes, city engr.

BIDS DESIRED

Fla., New Smyrna—Jan 3, by Comrs. Volusia Co., (DeLand), steel draw bridge over Indian River, concrete pivot pier, creosoted pile trestles, 45,000 cu.yd. earth embankment, 400 cu.yd. concrete, also creosoted timber trestle bridge across Callalera Creek, 9,500 cu.yd. excav. $100,000. N. A. Hobard, Lutz Bldg., engr.

Mo., St. Louis — Jan. 22, by Bd. Pub. Serv., 208 City Hall, rein.-con. bridge to carry Gravois Ave. over River Des Peres, removing 5,130 cu.ft. old masonry, 4,630 cu.yd. grading, 33,270 cu.yd. excav., 90,100 cu.ft. concrete, 398,200 lb. reinforcing, 18,550 sq.ft. brick paving, 5,965 sq.ft. walks, etc. $106,000. L. R. Bowen, 301 City Hall, engr.

Tex., Robert Lee—Jan. 3, by E. J. Stockton, Judge Coke Co., 237 ft. bridge over Oak Creek, one 70 ft. steel span, concrete piers and approaches. $26,000. J. E. Beavers, Bronte, co. engr.

BIDS RECEIVED

Tex., McKinney—Collin Co., 6 bridges on State Highway 6, rein.-con. pile trestles, concrete girders and steel spans, forty-three 20 ft., one 80 ft., four 31 ft. and one 43 ft. spans, from Brown-Abbott Co., Wilson Bldg., Dallas, $81,447. Noted Dec. 6.

CONTRACTS AWARDED

North Carolina — State Hy. Comn., Raleigh, bridging (**S. P. means State Project**) rein.-con. bridges and culverts on **S. P. 791 A**, Yadkin Co, to Luten Bridge Co., 405 East 4th Ave., Knoxville, Tenn., $40,046; **S. P. 237 A**, Johnston Co., to T. Dameron & Sparling, Nashville, $56,885; **S. P. 513**, Caswell Co., to R. W. Curtis, Lynchburg, Va., $66,643; **S. P. 148**, Hertford and Gates Counties, to Roanoke Iron & Bridge Co., Roanoke, Va., $134,648; **S. P. 912**, Cherokee Co., to W. T. Moore, Andrews, $100,270. Noted Dec. 13.

Ga., Savannah—State and Chatham Co., draw span of bridge over Savannah River, here, to Virginia Bridge & Iron Co., Roanoke, Va., $28,000.

Fla., Orlando—Orange Co. bridge over west fork of St. Johns River, 700 ft. superstructure, one 100 ft. steel span, concrete abutments, to Austin Bros. Bridge Co., 1813 Clarence St., Dallas, Tex., $39,515.

Ohio—See "Streets and Roads."

Wis., Hubbleton—State Hy. Dept., Madison, bridge, here, Project 316, Jefferson Co., to Widell Co., First Natl. Bank Bldg., Mankato, Minn., 1,905 cu.yd. Class A concrete $23.25, etc., total $50,909.

Missouri—State Hy. Dept., Jefferson City, constructing bridges over stream, De Kalb Co., over stream, Buchanan Co., over Castor River, Madison Co., and over Morgan Branch, De Kalb Co., to M. E. Gillioz, Monett, $6,051, $9,946, $25,947 and $7,792 respectively, over Little River Diversion Channel, and over Drainage Ditch, Cape Girardeau Co., to List & Weatherly Constr. Co., $416 Ry. Exch. Bldg., Kansas City, $135,633 and $7,450 respectively, over stream, Pettis Co., to Bertman & Menefee, Sedalia, $2,582, over Coon Creek, Taney Co., to Easley Bros., Aurora, $8,644, over Robins Draft, Howell Co., to Muskogee Contg. Co., Tulsa, Okla., $12,624, over Cow Branch, Atchison Co., to G. W. Condon, 510 Farnum Bldg., Omaha, Neb., $11,786. Noted Dec. 6.

Ore., Seaside—Rein.-con. bridge, three 50 ft. spans, 50 ft. wide, on Bway. over Necanicum River, to J. H. Tilman Co., Portland, $27,437.

Ont., Niagara Falls—See "Unclassified"

Dams

PROPOSED WORK

Mich., Marquette — See "Industrial Works."

Calif., Coronado (San Diego P. O.)—See "Waterworks."

BIDS DESIRED

N. Y., Kingston—Feb. 7, by Bd. Water Comrs., City Hall, addition to Coopers Lake Dam, 2,500 cu.yd. earth fill, 410 cu.yd. rein.-con., etc. $40,000. H. Barker, 36 State St., Albany, engr.

Railways

PROPOSED WORK

Connecticut—Connecticut Co., State St., Hartford, plans double tracking Park Rd. from Prospect Ave. to Main St. in West Hartford (Hartford P. O.) $50,000, and Blue Hills Ave., Hartford, $25,000.

Virginia—Atlantic Coast Line R.R., Wilmington, N. C., plans to expend $1,415,000 for various improvements between Richmond, Va., and Jacksonville, Fla., incl. buildings, signal appliances, tracks and other structures. J. E. Willoughby, Wilmington, N. C., ch. engr.

Kentucky—Chesapeake & Ohio R.R. Co., 82 3East Main St., Richmond, Va., plans 4 mi. third track from Ashland to Russell. $125,000. H. Frazier, ch. engr.

CONTRACTS AWARDED

Texas—North Texas Traction Co., 3rd and Main Sts., Ft. Worth, extension to

Railways (Continued)

Riverside carline, to Stone & Webster, 147 Milk St., Boston, Mass. $25,000.

California—Municipal Railway System of Eureka, 460 tons 70 lb. rails to Rolph-Mills Co., 149 California St., San Francisco, $52.50 per ton; 325 tons high T rails and joint plates, to U. S. Steel Products Co., Rialto Bldg., San Francisco, $59.43 per ton and $4.42 per cwt. Noted Dec. 20.

California—Southern Pacific R.R. Co., 65 Market St., double tracking 3 units of railroad between Truckee and Summit, in Sierra Nevada mountains, to Utah Constr. Co., Phelan Bldg., San Francisco.

Excavation, Drainage, Irrigation

PROPOSED WORK

Fla., Ft. Lauderdale—Broward Co. election Jan. 5, to vote on $50,000 bonds to complete New River Inlet.

Minn., Caledonia—Houston Co. preparing plans 1,292,644 cu.yd. excav., 63,500 cu.yd. excav. for pumping station installation of 80,000 gal. per minute capacity, in County Drain and Conservancy Dist. 1. $428,000. Central States Eng. Co., Muscatine, Iowa, engrs.

Texas—Gulf, Colorado & Santa Fe R.R., Galveston, having plans prepared 145 mi. heavy steel railway from Sweetwater to Lometa. $1,000,000. F. Merritt, Union Sta., Galveston, ch. engr.

Wash., Grand Dalles—North Dalles Irrigation Dist. had preliminary plans prepared and will probably take bids about Feb. 1, for system to irrigate 5,000 acres land, near here. Water to be taken from Klickitat River, main supply line 12 mi. canal, 8 mi. flume and several short inverted siphons and tunnels. $425,000. Election in January to vote on bonds. W. J. Roberts, 616 Puget Sound Bank Bldg., Tacoma, engr.

Calif., San Diego—Vista Irrigation Dist. plans to vote bonds for distribution system from Henshaw Dam and distributed to every 40 acre tract within Vista Irrigation Dist., incl. 16 mi. main canal, concrete lined, and concrete and steel pipes. J. B. Lippincott, Central Bldg., Los Angeles, consult. engr.

Calif., Ventura—Ventura Co. D. D. 2, plans election to vote on $300,000 bonds for drainage and irrigation system for approximately 20,000 acres, incl. levees, canals and pumping plants. C. Petit, Ventura, engr. Noted Dec. 6.

BIDS DESIRED

Miss., Senatobia—Jan. 3, by Bd. Drainage Comrs. Tate-Panola D. D. 1, Tate and Panola Counties, at Court House, 309,400 cu.yd. excav. in main canal, 90,000 cu.yd. excav. Partee Canal, 22,000 cu.yd. excav. enlarging old ditch in Panola Co. Southern Eng. Co., Clarksdale, engrs. Noted Nov. 15.

La., Lake Charles — Jan. 18, by Police Jury Calcasieu Parish, Court House, constructing Sects. 3 and 5 of navigation channel. F. Shutts, parish engr.; adv. E. N.-R. Dec. 27.

O., Cleveland — Winterbottom-Connelly Co., 17316 Madison Ave., taking bids 40,000 cu.yd. trench excav. on drainage system.

CONTRACTS AWARDED

N. Y., Brooklyn—E. Riegelmann, boro pres., Boro Hall, dredging 15,000 cu.yd. scow measurement in Gowanus Canal, and 20,000 cu.yd. in Wallabout Canal, to W. E. Potter, $14,635 and $15,980 respectively; 40,000 cu.yd. in Newtown Creek, to J. McSpirit, $25,600; 40,000 cu.yd. foot of 64th St., to Columbia Dredging Corp., 30 Church St., New York, $11,160. Noted Dec. 20.

Tex., Dallas—Levee Impvt. Dist. 9, ditching, etc., to M. H. Edmonson, Greenville, $64,000.

Calif., Manteca—South San Joaquin Irrigation Dist., 542,000 sq.ft. concrete canal gunite lining, to J. S. Greaves, Oroville, $0.084 per yd.; 50,000 sq.ft. asphalt lining, to Hewitt-Davenport, San Francisco, $0.093 per sq.ft. Owner to furnish materials. Noted Nov. 29.

B. C., Vancouver—Canadian Pacific Ry., Windsor Sta., Montreal, Que., dredging mud from bottom of inlet and filling in with rock and gravel for foundation of new pier, 75,000 cu.yd. floating dredgework and 400,000 yd. rock and gravel, to Northwestern Dredging Co., 510 Hastings St. W., $60,000.

Streets and Roads

PROPOSED WORK

Conn., Hartford—Plans paving Sigourney St., Asylum and Franklin Aves., asphalt on concrete; Capitol Ave., asphalt or concrete on concrete; Westbourne Parkway, Commerce, Ridgefield and Vine Sts., concrete; also macadamizing 15 streets. Total $387,000. R. N. Clark, city engr.

Conn., New Britain—Plans paving Wells St., bituminous macadam. $25,000. J. D. Williams, city engr.

N. Y., Rochester—Plans paving Farragut St., willite, $31,000, about $\frac{3}{8}$ mi. Middlesex Rd., 20 ft., asphalt, $33,600; curbing, grading and paving $\frac{1}{2}$ mi. Haloid, Dana, Boxart, Castleman and Scheib Sts., $25,000; 6 ft. widening, setting back curb to conform and repaving Monroe Ave., brick, $50,000. Will mature in spring. C. A. Poole, City Bldg., engr.

Pa., Wilkes-Barre—Plans to pave, grade and curb 1 mi. Northampton, Priestly, Reese, Berlin, Sylvanus, Dana, Moyallen, New Empire, Meade and Sheridan Aves. $40,000. B. K. Finch, city engr.

North Carolina—State Hy. Comn., Raleigh, rejected bids Nov. 27, grading and topsoiling 16.9 mi. State Project 912, Cherokee Co., $150,000; grading and bridging 7.02 mi. State Project 952-B, Jackson Co., $60,000; concrete or asphaltic paving 8.2 mi. State Project 318, Brunswick Co., $246,000. Will readvertise shortly. C. M. Upham, comr. Noted Dec. 13.

N. C., Burlington—Soon lets contract additional street and sidewalk paving. $25,000. E. B. Horner, mayor.

Fla., Arcadia—De Soto Co. election soon to vote on $45,000 bonds for road from Arcadia-Manitee Co. line; $35,000 No. 2, North Arcadia-Nocatee Rd.; $30,000 for road from end of brick to Highlands Co. line; $30,000 to complete Carlston Field Rd.

Fla., Ft. Lauderdale—Broward Co. election Jan. 2, to vote on $250,000 bonds for roads. H. C. Davis, Ft. Lauderdale, engr.

Ala., Birmingham—Plans chirt and asphalt paving and some grading on 10 blocks 21st, 22nd, 23rd Sts., North Ave., 13th Ave. N., and 15th St. S. $105,315.

Ala., Selma—Sold $50,000 bonds paving Church St.

La., Vernon — Jackson Parish election Jan. 9, to vote on $250,000 bonds to build 2 additional improved highways under supervision of State Hy. Comn., Reymond Bldg., Baton Rouge, one highway from Ruston to Columbia, and other Jackson-Enos Monroe Highway.

Tennessee — Dept. Hys. & Pub. Wks., Nashville, plans to construct 509 mi. road, 16 and 18 ft., mostly gravel, concrete and bituminous macadam, $8,000,000. J. G. Creveling, highway comr.

O., Cleveland—Cuyahoga Co. plans brick paving Northfield Akron Rd. $168,200. F. Lander, Court House, engr.

Ind., Shelbyville—Shelby Co. plans concrete paving 29,532 sq.yd. Lydia Jones Rd. $74,000. G. C. Oltman, Shelbyville, engr.

Mich., Otsego—Voted $80,000 bonds for paving work, $10,000 bonds for watermains and $5,000 for sewers.

Ill., Cairo — Making preliminary plans grading, concrete paving, concrete curbing etc., various streets. $45,000. G. F. Dewey, 610 Ohio St., engr.

Ill., Elmhurst—Making preliminary plans grading, curbing, guttering and bituminous macadam paving about 11,000 ft. in Cunnings Addition, $120,000; 2nd St., 49,000 sq.yd. bituminous macadam on concrete, 39,000 lin.ft. concrete curbing. E. Hancock, 2047 Ogden Ave., Chicago, engr.

Ill., La Grange—Making preliminary plans grading, curbing, guttering and surfacing 7,000 ft. in northwest section, 14,000 lin.ft. concrete curb, 14,000 sq.yd. concrete, etc., $75,000; 3,000 ft. Maple, Benton and 9th Sts., 6,000 lin.ft. concrete curb, 10,000 sq.yd. concrete base, 10,000 sq.yd. either hot mix, Kentucky rock or asphalt surfacing. $35,000. E. Hancock, 2047 Ogden Ave., Chicago, engr.

Wisconsin—Following are county appropriations for roadwork during 1924. Sawyer Co. $46,419, E. J. Collett, Hayward comr.; Outagamie Co. $207,987, A. G. Bruscwitz, Appleton, comr.; Waukesha Co. $104,898, C. J. Hahn, Waukesha, comr.

Wis., Hudson—St. Croix Co. appropriated $69,092 for road work during 1924. J. Caffrey, Hammond, comr.

Wis., Shorewood (Milwaukee P. O.) — Making plans concrete paving $\frac{3}{8}$ mi. Riverside Dr., 24 ft. $25,000. H. A. Schmitt, Village Hall, engr.

Ia., Cedar Falls — Will probably take bids in January, paving 10 blocks or more of Lincoln and North Franklin Sts. To exceed $30,000. C. H. Streeter, city engr.

Kan., Leavenworth — Leavenworth Co. having plans prepared paving 3.8 mi. roads. $30,000. L. C. Clark, Leavenworth, engr.

Wyo., Cheyenne—Will probably take bids in January 7,600 ft. grading, curbing, guttering, paving, etc., 24 blocks in Pershing Heights Dist., incl. Warren, House, 1st, 2nd, 3rd, 4th and 5th Sts., 40 ft. $100,000. J. A. Bruce, Cheyenne, engr.

Mo., Hannibal—Soon takes bids grading, concrete curbing, guttering, 6 in. rein.-con. surfacing 6,015 sq.yd. Hill St. from Main to 3rd Sts., 4th to 3rd Sts., 5th to 7th Sts., and Front to Main Sts., also alley in Block 41. $22,500-$25,000. W. R. Gettler, City Hall, engr. Noted Nov. 15.

Mo., St. Louis—Soon takes bids grading 2,365 cu.yd. Nashville St., $3,500; grading and surfacing 3,090 sq.yd. Pennsylvania St. and Indiana Ave., warrenite on concrete, $17,750; grading, surfacing, concrete curbing, guttering 6,615 sq.yd. Ivanhoe St., willite or bitulithic on concrete, $37,500; resurfacing 14,200 sq.yd. 9th and Penrose Sts., bitulithic on concrete, $39,600. W. W. Horner, 300 City Hall, engr.

Mo., Springfield — Making preliminary plans widening about 6 blocks Traffic St. from 18 to 50 ft. $75,000.

Tex., Austin—Travis Co. voted $1,500,000 for bituminous macadam paving, gravel surfacing and bridging state highways and county roads, 16 ft. and 18 ft. surfacing. O. Leonard, co. engr. Noted Nov. 15.

Tex., Batesville — Zavalla Co. election soon to vote on approximately $100,000 bonds roads in La Pryor Dist.

Tex., Denton—Denton Co. making plans grading and gravel surfacing 8 mi. State Highway 39 from Justin Rd. to Wise Co. line, 16 ft., $76,000; soon takes bids grading and gravel surfacing 6 mi. State Highway 39 from Little Elm to Collin Co. line, 16 ft., $45,000. H. T. Brewster, co. engr.

Tex., Ft. Worth—Baker & Von Zuben, engrs., Ellison Bldg., making plans walks and sewers, etc., for Riverside Park, 300 acre addition to Ft. Worth. $75,000-$100,000. Owners name withheld.

Tex., Hillsboro — Voted $15,000 bonds paving 2nd St., brick or bituminous. Total cost approximately $40,000. Property owners to pay $\frac{2}{3}$ of cost. T. A. Bullock, city engr.

Tex., Karnes—Karnes Co. voted $126,000 bonds grading and surfacing roads. O. N. Powell, Kenedy, engr.

Tex., Sinton—San Patricio Co. voted $25,000 bonds highway improvement. F. M. Percival, Rockport, co. engr. Noted Nov. 29.

Okla., Lexington—Plans grading and paving 5 blocks Main St. and McLean Ave., 7,000 sq.yd. concrete, 3,600 lin.ft. curbing, etc. $30,000. Engineer not selected.

Okla., Stillwater—Plans grading and paving 11 blocks Main and 14th Sts., 7,950 sq. yd. concrete, 6,800 lin.ft. curbing, 3,000 cu. yd. excav. $38,000. C. A. Wood, Stillwater, engr.

Ore., Portland—Plans widening 9 blocks in business district. $2,348,193. O. Laurgaard, city engr.

California—State Hy. Dept., Sacramento, making plans paving 9 mi. Stockton Rd., San Joaquin Co., concrete; from Manteca to south boundary, concrete, and from Manteca to French Camp, concrete or asphalt, both San Joaquin Co.; reconstructing and paving Rincon Grade, Santa Barbara Co., concrete; resurfacing 12 mi. Redwood Highway between Santa Rosa and Willowbrook, Sonoma Co.; constructing 6 mi. Tahoe-Ukiah Rd. west of Sutter City, Sutter Co. R. M. Morton, state highway engr.

California—State Hy. Comn., Sacramento, making plans paving approximately 12 mi. in Calabassas Dist., Los Angeles Co. R. M. Morton, state highway engr.

California—State Hy. Dept., Sacramento, making plans gravel surfacing 38 mi. Pollock-Dunsmuir Rd., Siskiyou Co. R. M. Norton, state highway engr.

Calif., Chico—Will take new bids paving various streets. $160,000. Former contract rescinded. F. A. Lammiman, city engr.

Calif., Colton—Had plans prepared improving 9th St., 235,054 sq.ft. 5 in. concrete pavement with $\frac{3}{4}$ in. surface, 1,328 sq.ft. walks, etc.

Calif., Fresno—Fresno Co. (Fresno) and Monterey Co. (Salinas) plan to improve 29 mi. San Lucas-Coalinga Highway. To exceed $800,000. C. P. Jensen, Fresno, and H. Cozzens, Salinas, county road surveyors.

Calif., Lodi—Had plans prepared improving portions Garfield Ave., Harold St., etc., 217,031 sq.ft. grading, 206,690 sq.ft. $2\frac{1}{2}$ in. asphaltic concrete base with $1\frac{1}{2}$ in. warrenite bituminous surface, 10,060 sq.ft. concrete gutters and 12,048 lin.ft. concrete curb. To exceed $48,000. L. F. Barzellotti, city engr.

Calif., Los Angeles—Los Angeles Co. soon takes bids improving 4.06 mi. Las Flores Canyon Rd., Rd. Dist. Impvt. 181, grading, rolling and oiling 16 ft. roadway, etc. To exceed $63,000.

Calif., Mill Valley—Had plans prepared improving Old Mill St., Lovell Ave., etc., 4,624 cu.yd. grading, 121,007 sq.ft. 6 in. concrete pavement, 19,044 sq.ft. macadam pavement, 2,730 lin.ft. concrete curb and gutter, 2,768 sq.ft. concrete gutter, etc. J. C. Oglesby, Cheeda Blk., San Rafael, engr.

Streets and Roads (Continued)

Calif., Oakland — Alameda Co. plans rock surfacing and oiling Redwood extension of Skyline Blvd. $25,000. G. A. Posey, co. surv.

Calif., San Fernando—Plans 85,000 sq.ft. 6 in. asphaltic concrete paving, laying concrete curbs, walks and gutters, and installing ornamental lighting system on various streets. To exceed $25,000. G. H. Schwabland, city engr.

Calif., Santa Ana—Orange Co. plans to improve Yorba Bridge Rd., 48,600 sq.ft. 5 in. asphaltic concrete pavement, 1,500 cu. yd. gravel shoulders, etc. J. L. McBride, co. road comr.

P. C., Vancouver—Voted $500,000 bonds for permanent surfacing various streets. F. L. Fellowes, city engr. Noted Nov. 1.

BIDS DESIRED

N. Y., Buffalo—Jan. 3, by Commissioner Pub. Wks., Municipal Bldg., paving and repaving Highgate and Copsewood Aves., Freeman and Rhode Island Sts., vitr. brick or asphalt on 6 in. concrete. To exceed $40,000. C. E. P. Babcock, Municipal Bldg., engr.

Ga., Albany—Jan. 7, paving 7 blocks Jefferson St., 15,430 sq.yd. 1½ in. sheet asphalt surfacing, 1,200 tons black binder. P. F. Whittier, dir. pub. wks.

Louisiana—Jan. 15, by State Hy. Dept., Baton Rouge, 5.43 mi. State Project 336-A, Opelousas-Ville Platte Highway, St. Landry Parish, also furnishing 7,650 cu.yd. washed gravel or alternate 10,200 cu.yd. sand clay gravel. J. M. Fourmy, ch. engr.

Ill., Elmhurst—Taking bids and opens same about Jan. 15, grading curbing and paving 27,000 ft. Spring Rd., 22 ft., 54,000 lin. ft. concrete curb, 67,000 sq.yd. cement concrete, vibrolithic concrete, warrenite or asphaltic concrete. E. Hancock, 2047 Ogden Ave., Chicago, engr.

Mo., Richmond Heights (St. Louis, P. O.) —Jan. 2, by G. H. Skilliman, city clk., 7409 La Veta Ave., grading, concrete curbing, guttering and paving 17,600 sq.yd. Bellvue Ave., 3 in. trap rock asphalt penetration on 6 in. macadam. $60,000. F. Pitzman, 615 Chestnut St., St. Louis, engrs.

Mo., St. Louis—Jan. 22, by Bd. Pub. Serv., 208 City Hall, rein.-con. paving 130,000 sq. yd. roads for St. Louis Training School for Feeble Minded. $43,000. L. R. Bowen, 301 City Hall, engr. Noted Dec. 13.

Tex., Del Rio—Jan. 9, by W. F. Littleton, judge Val Verde Co., grading and gravel surfacing 12.74 mi. State Highway 12, Federal Aid Project 392, 16 ft. Noted Nov. 8.

Tex., Franklin—Jan. 11, by J. Reid, judge Robertson Co., grading and gravel surfacing 9.74 mi. State Highway 43 A. 16 ft. $77,261. L. A. Peterman, Hearne, engr.

Tex., Robert Lee—Jan. 3, by E. J. Stockton, judge Coke Co., grading, etc., 14.47 mi. State Highway 70, 16 ft., $10,000; 11.477 mi. State Highway 70, 16 ft., $42,000. J. E. Beavers, Bronte, co. engr.

Tex., Rock Springs—Jan. 16, by W. E. Simpson Co., engrs., 414 N. B. C. Bldg., San Antonio, highway improvement, 17.13 mi. macadam road, 16 ft., for Edwards Co. $154,000. Noted Dec. 6.

Wash., Seattle — Jan. 11, by Bd. Pub. Wks., paving, curbing, etc., Jackson St. et al., 20,000 sq.yd. vitr. brick block on 9 in. concrete, 10,000 sq.yd. (street railway portion) vitr. brick block on 7 in. concrete. $475,000. J. D. Blackwell, city engr.

California—Jan. 7, by State Hy. Comn., Sacramento, improving 13.1 mi. Shoup Ave. to west city limits of Los Angeles, Los Angeles Co. 52,000 cu.yd. unclassified excav., 21,080 cu.yd. Class A concrete pavement, 385 cu.yd. Class A concrete in structures, 37,970 sq.yd. reinforcing steel in pavement, etc. R. M. Morton, state highway engr.

Calif., Hanford—Regrading and repaving with asphaltic concrete portions 6th, 7th, 8th, Douty and Irwin Sts., from California Constr. Co., Hanford, $18,867.

Calif., Oroville—Jan. 7, by Supervs. Butte Co., extending 6.1 mi. Oroville-Quincy Rd. Will be graveled at later date. H. H. Hume, co. engr.

Calif., Stockton—Jan. 7, by A. L. Banks, clk., grading, curbing and paving portions East Worth, Worth, East Anderson Sts., etc., 7,116 lin.ft. concrete curb and gutter, 77,878 sq.ft. 4 in. crushed rock base with 2 in. asphaltic concrete surface. W. B. Hogan, city engr.

BIDS RECEIVED

N. Y., New York—J. Miller, pres. Manhattan Boro, Municipal Bldg., Dec. 18, granite block repaving 1st Ave. and West Bway., from J. Meehan & Son, 74 Cortlandt St., $47,070 and $88,801 respectively. Noted Dec. 13.

N. Y., New York—H. Bruckner, pres. Bronx Boro, 3rd and Tremont Aves., Dec. 19, grading, curbing and laying sidewalks, etc. on Reservoir Pl., from L. Di Minna, $5,176; grading, etc. Tyndall Ave., from I. F. Cavaluzzo, 1538 Walton Ave., $16,040; sheet asphalt repaving East 188th St., from Interboro Asphalt Co., 2306 Creston Ave., $8,295. Noted Dec. 13.

Pa., Ebensburg—Comrs. Cambria Co., 12,244 ft. Ligonier Pike, rein.-con., from E. R. Vipond, 604 Penn St., Hollidaysburg, $124,631; 15,000 ft. Reade Twp., vitr. brick on concrete, from Burnside Constr. Co., Burnside, $156,943.

Pa., Nanty-Glo—Boro. Council, concrete paving 2,477 lin.ft. 2nd St. from J. L. Elder, Ebensburg, $49,799.

Md., Baltimore—Bd. Park Comrs., Lexington and Gay Sts., 50,000 cu.yd. grading and filling at Mt. Royal Reservoir, Mt. Royal and North Aves., from H. O. Firor & Co., 1707 West Pratt St., $0.59.

N. Y., New York—G. A. Whalen, comr. Plant & Structures, Municipal Bldg., reconstructing pavement, curbs and headers on south clearance roadway alongside approach of Williamsburg bridge, from Sicilian Asphalt Paving Co., 41 Park Row, $31,143. Noted Dec. 13.

Tex., Henderson—Rusk Co. grading and gravel surfacing 7.63 mi. State Highway 15-A, State Aid Project 419, 16 ft., from Rusk Co., c/o J. T. Watson, co. judge, Henderson, $45,501.

Tex., Houston — Harris Co., bituminous topping Katy Rd., from Uvalde Rock Asphalt Co., Bankers Mort. Bldg., Uvalde rock asphalt 1½ in. $1.15, 1 in. $0.85; Hayden & Austin, Santa Fe and Runnels Sts., inverted penetration 2 course $0.60, one course $0.30. Engrs. est. to exceed $25,000. Noted Nov. 29.

Tex., McKinney—Collin Co. grading and surfacing with rein.-con., 6.19 mi. State Highway 6, Federal Aid Project 402, 18 ft., from Tibbetts Constr. Co., 209½ West 8th St., Ft. Worth, $220,119. Noted Nov. 29.

Ariz., Tucson—Grading, curbing and paving Speedway between Stone and Campbell Aves. and between Campbell Ave. and Tucson Blvd., 87,150 sq.yd. sub grade, 55,920 sq.yd. paving, 16,504 lin.ft. 14 in. concrete curb, 63,370 sq.ft. concrete sidewalk, etc., from Borderland Constr. Co., Tucson, 3½ in. asphaltic concrete base, 1½ in. asphaltic or Warrenite surface, $158,725; Tucson Co., Tucson, 5 in. concrete $182,087, 4 in. Willite $162,137.

Calif., Los Angeles — Improving Vernon Ave. from Van Ness to Mesa Dr., from W. Liddington, 420 East 60th St., grading lump sum $4,990, 166,477 sq.ft. concrete pavement $0.2325, bituminous base pavement $0.12, 125 ft. curb $0.70, 2,452 ft. house sewers $1.50, etc., rein.-con. culvert $340.

Calif., San Bruno—Grading, paving and building sewers in Elm, Cypress, Acacia, Sts., etc., in Huntington Park, 120,000 sq. ft. asphaltic concrete base with Warrenite surface, from Municipal Impvt. Co., 306 12th St., Oakland $90,221. Noted Dec. 13.

Calif., Santa Rosa—Sonoma Co. grading 38.53 mi. Jenner-Mendocino Co. Highway 240,000 cu.yd. excav., etc., from J. M. DeLucca, 6500 Kales Ave., Oakland, $181,526 Noted Dec. 6.

CONTRACTS AWARDED

N. Y., Brooklyn—E. Riegelmann, boro pres., Boro Hall, asphalt paving Carroll and Crown Sts., to Borough Asphalt Paving Co., 1301 Metropolitan Ave., $7,107 and $21,415 respectively. Ave. D, also paving and repaving Glenwood Rd. and 87th St., asphalt, to Brooklyn Alcatraz Asphalt Paving Co., 1301 Metropolitan Ave., $26,765, $34,051 and $9,608 respectively; asphalt paving 14th St., to Uvalde Asphalt Paving Co., 1 Bway., New York, $71,430, Wilson Ave., to Sicilian Asphalt Paving Co., 41 Park Row, New York, $32,813; grading, curbing and flagging Ave. D, to C. Bennett Contg. Co., 414 Rutland Rd., $18,621. Noted Nov. 29 and Dec. 13.

Pa., Waynesburg — Comrs. Greene Co. concrete paving 3,044 ft. road from Sycamore towards Ninervah, to Reed & Moore, Waynesburg, $41,640. Noted Dec. 20.

W. Va., Buckhannon—Upshur Co., grading and concrete paving 7.04 mi. Clarksburg Pike to Barbour County line, to Marshall & Gillooly, Elkins, $354,675. Noted Nov. 22.

North Carolina—State Hy. Comn., Raleigh, improving roads (**S. P. means State Project**) grading and concrete paving 7.32 mi. **S. P. 457-H**, Orange Co., to L. L. Tindall, Waterford, Wis., $230,338, 6.85 mi. **S. P. 852**, McDowell Co., to A. J. Wardrep, Holsten Bank Bldg., Knoxville, Tenn., $216,325; grading and sand asphalt paving 4.94 mi. **S. P. 571**, Moore Co., to Wesco Co., Chattanooga, Tenn., $81,679; grading, concrete paving and bridging 4.65 mi. **S. P. 666**, Richmond Co., to G. R. Martin & Co., Salisbury, $159,138; grading and asphaltic paving 13.12 mi. **S. P. 275**, Sampson Co., to Highway Eng. & Contg. Co., Selbyville, Del., $266,038, 2.01 mi. **S. P. 557**, Montgomery Co., to W. F. Bowe, Jr., 541 Broad St., Augusta, Ga., $63,187; grading 13.4 mi. **S. P. 791-A**, Yadkin Co., to W. E. Graham, Mt. Ulla, $76,288, 5.03 mi. **S. P. 648-A**, Lincoln Co., to G. Ginn, Inc., Gastonia, $27,580; grading and topsoiling 16.34 mi. **S. P. 513**, Caswell Co., to N. L. Teer, Durham, $115,618; grading 9.88 mi. **S. P. 646-A**, Lincoln Co. and grading and topsoiling 6.83 mi. **S. P. 750-B**, Stokes Co., to J. F. Mulligan Constr. Co., North Wilkesboro, $32,416 and $111,141 respectively. Noted Dec. 13.

N. C., Raleigh — Paving various streets asphalt on concrete base, curbing, guttering, storm sewers, etc., to R. G. Lassiter & Co., Citizens Bank Bldg., $425,000. Noted Nov. 15.

Georgia—State Hy. Dept., East Point, surfacing sheet asphalt 2 mi. Albany-Americus Rd., Federal Aid Project 298, Daugherty Co., to Sam Finley Co., 212 West North Ave., Atlanta, Ga., $35,224; with macadam 2.66 mi. Blue Ridge-Copperhill Rd., Federal Aid Project 358, Fannin Co., to Nicholas Constr. Co., 1 La France, Atlanta, $64,572.

Ohio — Dept. Highways and Pub. Wks., Columbus, grading, bridging and paving 3 mi. Sects. "C and I" Chardon-Madison Rd., Geauga Co., concrete, to G. A. Stein, Niles, $49,309; 0.979 mi. Sect. "Caledonia" Marion-Galion Rd., Marion Co., bituminous macadam, asphalt and brick, also 0.0625 mi. Sect. "Caledonia" Marion-Galion Rd., Marion Co., brick, to W. K. Drake, Marion, $51,017 and $3,655 respectively; 4.095 mi. Sect. "W-Englewood" Part of "X" National Rd., Montgomery Co., Kentucky rock asphalt, to Losey Rd. Constr. Co., Kenton, $122,414; 0.457 mi. Sect. "D" Canton-Steubenville Rd., Stark Co., brick, to P. Christensen, 1355 Yale Ave., N. W., Canton, $23,085; 1.493 mi. Sects. "B-1 and B-2" Alliance-Minerva Rd., Stark Co., brick (use 80% old brick) to G. W. Hadley, Goldberg Bldg., Canton, $49,547; 0.984 mi. Sect. "I-1" Bucyrus-Upper Sandusky Rd., Wyandot Co., brick, to G. B. Walther, 425 Amer. Bank Bldg., Lima, $37,693. Noted Dec. 20.

Ohio—Dept. Highways and Pub. Wks., Columbus, grading, bridging and paving 2.554 mi. Sect. "B" Marietta-Athens Rd., Athens Co., rein.-con., to Mariner & Co., Athens, $85,738. Noted Dec. 20.

Indiana—State Hy. Comn., Indianapolis, improving roads (**F. A. means Federal Aid**) concrete paving 7.511 mi. Dixie Bee Rd., F. A. 36, Sect. A, and F. A. 64, Sullivan Co., to W. D. Hutchinson, Indianapolis, $150,665; 8.309 mi. Lafayette Pike, F. A. 40, Sect. B, to G. T. Miller, Lebanon, $162,245; 8.788 mi. Sect. A, Michigan Rd., Marion and Shelby Counties, and 8.705 mi. Sect. B, Shelby Co., F. A. 45, to Davis Constr. Co., Tipton, $171,008 and $187,981 respectively, engrs. est. $195,427 and $229,198 respectively; 6.128 mi. Bluff Rd., Sect. A, F. A. 63, Marion Co., to F. Cunningham, 2161 North Meridian St., Indianapolis, $135,536, engrs. est. $147,082; 6.678 mi. Bluff Rd., Sect. B, F. A. 63, to Morgan and Johnston Counties, to F. J. Tillman, 565 Cramer St., Milwaukee, Wis., $154,670, engrs. est. $180,479; 10.39 mi. Bluff Rd., Sect. C, Morgan Co., F. A. 63, to Dill Bros., Arcanum, O., $281,794, engrs. est. $319,706; 6.208 mi. Dixie Bee Line Rd., Sect. A, F. A. 65, Gibson Co., to Kerr & Murphy, Bloomington, $131,710, engrs. est. $137,297; 6.969 mi. Range Line Rd., Sect. A, F. A. 70, Miami Co., to Gluss Bros. & Co., Hamler, O., $135,205, engrs. est. $156,717; 7.847 mi. Range Line Rd., Sect. B, F. A. 70, Miami Co., to C. T. Cain, Bluffton, $169,631, engrs. est. $193,551; 6.299 mi. French-Lick Rd., Sect. G, F. A. 16, Dubois Co., to Foulks Constr. Co., 706 Ohio St., Terre Haute, $128,497, engrs. est. $147,770, gravel base course on 5.596 mi. Tell City-English Rd., Sect. D, F. A. 19, Perry Co., to Harshman & Jarrell, Frankfort, $54,383, engrs. est. $59,043; grading 3.484 mi. Sect. A, Salem-Palmyra Rd., F. A. 23, Washington Co., and 4.204 mi. Sect. D, Salem-Palmyra Rd., F. A. 23, Washington Co., to Maggard & Maggard, Austin, $19,636 and $36,722 respectively, engrs. est. $25,045 and $46,226 respectively. Noted Dec. 6.

Ind., Wabash—Wabash Co., paving Lee A. Carr Rd., 17,828 sq.yd. asphalt on concrete, to Citizens Paving Co., Kokomo, $65,435. Engrs. est. $62,000. Noted Dec. 20.

Michigan — State Hy. Dept., Lansing, grading and surfacing 6.012 mi. Assess-

Streets and Roads (Continued)

ment Dist. Rd. 280, Tuscola and Huron Counties, 41,879 cu.yd. excav., 42,311 sq. yd. gravel, to J. Bright, Pigeon, $45,158. Noted Nov. 22.

Kan., Kansas City—Paving ½ mi. Federal Aid Project 174, concrete, to Somers-Hall Constr. Co., Newton, $32,000.

Ark., Little Rock—Grading and surfacing 25,750 sq.yd. State St. from West 10th to West 20th Sts., warrenite on concrete, to M. D. L. Cook, Southern Trust Bldg., $85,528. Noted Nov. 22.

Tex., Austin—Travis Co. grading 5.57 mi. State Highway 2, 24 ft., to Evans & Greathouse, c/o J. A. Greathouse, 1706 West 6th St., $11,112; drainage structures on same, to R. G. Buckner & Sons, Gonzales, $13,255. Engrs. est. $26,804. Noted Dec. 20.

Tex., Ennis—Paving 57 blocks Dallas and various other streets, Warrenite bitulithic, to Central Bituminous Co., Praetorian Bldg., Dallas, $3 per sq.yd.

Tex., Vernon—Wilbarger Co. rein.-con. surfacing 38,255 sq.yd. State Highway 5, etc., to J. P. Soty, Vernon, $105,508. Noted Dec. 13.

Tex., Wichita Falls—Wichita Co. grading and surfacing with conglomerate gravel and asphalt topping 5 mi. Electra-North Rd., 16 ft., to J. E. Ward & Co., 714 Linz Bldg., Dallas, $74,000. Engrs. est. $75,000.

Okla., Marlow—Grading and paving 14 blocks Bway. and Main Sts., 13,900 sq.yd. concrete, 11,260 lin.ft. curbing, 5,000 cu.yd. earth, excav., etc., to Stephens Constr. Co., Marlow $60,001. Noted Dec. 13.

Idaho—Dept. Pub. Wks., Div. Highways, Boise, grading and surfacing 8.56 mi. Coeur d'Alene-Yellowstone Trail between Kellogg and Wallace, Shoshone Co., Federal Aid Project 73-A, to Shoshone Co., Wallace, 24,739 cu.yd. solid rock excav. $1.60, 29,494 cu.yd. earth excav. $0.37, 15,897 cu.yd. surfacing $1.50, etc., total $81,260; to H. H. Beomer, Ziegler Bldg., Spokane, Wash., 31,014 cu.yd. channel change $0.40, 143,003 station yards overhaul $0.04, etc., total $20,746.

Calif., Colton—Improving C and South 8th Sts., to Hall-Johnson Co., P. O. Box 51, Lynwood, 191,000 sq.ft. 2 in. course Willite pavement $0.224, 1,752 ft. curb $0.66, 1,450 sq.ft. walks $0.18; and 84,500 sq.ft. 4 in. Willite pavement $0.222, 3,630 ft. 5 in. Willite pavement $0.253, 1,500 sq.ft. walks $0.18, 1,398 lin.ft. curb $0.56. Noted Dec. 13.

Calif., Oroville — Butte Co. improving Route 17, Sect. A, Humboldt Rd., to M. C. Pelk, Chico, $26,150 using commercial stone.

Industrial Works

PROPOSED WORK

Mass., Somerset—Montaup Electric Co. organized by officials of Fall River Electric Co., 85 North Main St., Fall River, Blackstone Valley Gas & Electric Co., 231 Main St., Pawtucket, R. I., and Edison Electric Illuminating Co., 42 Main St., Brockton, plans electric generating plant and transmission system, here. $7,500,000.

Mass., Worcester—Machine Shops—H. Mandell, 33 Derby St., having plans prepared by H. L. Meacham, 571 Main St., two 2 story, 60 x 125 ft., Foster St. $60,000.

N. Y., Binghamton—Warehouse—W. H. Yager Co., Water and Henry Sts., plans 5 story, 100 x 100 ft., Lewis St. Will mature in spring.

N. Y., Buffalo—Factory—Morrison Sheet Metal Wks., 26 East North St., having plans prepared by G. M. Wolfe, 1377 Main St., 2 story, 150 x 250 ft., rein.-con., brick and steel, St. Paul St. $190,000.

N. Y., Buffalo — Foundry — Kensington-Davis Corp., 144 Kensington Ave., having plans prepared 1 story, 140 x 300 ft., rein.-con., brick and steel, Kensington Ave. $140,000. Austin Co., 16112 Euclid Ave., Cleveland, O., engrs.

N. Y., Utica—Plant—Utica Gas & Electric Co., 222 Genesee St., having plans prepared by T. E. Murray Co., engrs., 55 Duane St., New York City, 250,000 hp. steam plant, to include two 33,000 hp. units, etc. Will mature in spring.

N. Y., Penn Yan—Factories—Finger Lakes Canning Co., Monell St., plans 2 story, 40 x 144 ft. and 2 story, 50 x 60 ft. factories, $60,000. Will mature in spring.

Pa., Phila.—Mill—Concordia Silk Mills, Allegheny and Bourdenot Sts., having plans prepared by E. A. Stopper, Fuller Bldg., 2 story and basement, 66 x 105 ft. rein.-con. and brick, plain foundation, Allegheny and Boudenot Aves. $100,000.

Virginia—Railway Buildings—See "Railways."

W. Va., Fairmont — Plant — Owens Bottling Co. plans addition. $40,000.

N. C., Asheville — Garage — Asheville Overland-Knight Co., Inc., having plans prepared by Smith & Carner Asheville, 4 story garage containing 100,000 sq.ft. floor space. $300,000.

N. C., Asheville—Plants—Sayles Finishing Plant, Inc., plans to construct cotton, silk finishing and bleaching plants, along Swannanoa River, near here. $2,000,000. H. Parker, secy.

N. C., Greenville—Gas Plant—City plans large gas plant. $100,000. Address E. E. Williams, c/o Municipal Water & Light Comn.

Fla., Sanford—Electric and Gas Plants—See "Waterworks."

La., New Orleans—Warehouse—Louisville & Nashville R.R., 229 St. Charles St., plans storage warehouse $750,000.

Tenn., Colombia—Factory—Crissey Tire and Rubber Co., plans 2 story, 100 x 350 ft. factory. $160,000. R. W. Crissey, c/o owner, archt.

Tenn., Copperhill—Plant—Tennessee Electric Power Co., Chattanooga, having preliminary surveys made plant on Ocoee River, near here, to develop 16,000 hp.

Tenn., Knoxville — Foundry — Day-Evans Iron Wks., Inc., plans 1 story, 75 x 160 ft. $55,000.

Tenn., Martin—Warehouse—Stafford Milling Co. plans to rebuild cotton gin and warehouse recently destroyed by fire. $60,000.

Tenn., Nashville—Packing Plant—Nenhoff Packing Co., 1308 Adams St., plans 5 story, rein.-con. addition. $150,000.

Ky., Paducah—Foundry—Shelton Brothers Fdry. Co. plans 1 story foundry. $40,000.

O., Cleveland — Assembly — Ford Motor Co., c/o A. L. Schmitt, Highland Park, Detroit, Mich., plans 1 story, 300 x 1,000 ft., brick and steel, here. A. Kahn, Marquette Bldg., Detroit, Mich., archt.

O., Cleveland — Factory and Garage — Curtiss-Ambler Realty Co., The Arcade, having plans prepared by G. K. Ferrington Co., 4900 Euclid Ave., 1 story (ultimately 2 story 60 x 160 ft., brick and steel, ? Prospect Ave. $50,000. Auto Electrical Maintenance Co., 943 Chester Ave., lessee.

O., Cleveland—Garage—L. Duchon, 3045 Essex Rd., Cleveland Heights, having plans prepared by A. F. Janowitz, 811 Prospect Ave., 1 story, 60 x 170 ft., brick, Perkins Ave., here. $50,000.

O., Cleveland—Garage—I. Margolin, 2496 Derbyshire Rd., Cleveland Heights, plans 2 story, concrete, brick and steel, Chester Ave., here. $60,000. M. Weis, 617 Union Bldg., archt.

O., Cleveland—Garage and Commercial—C. F. Neuberger, c/o Statler Hotel, plans 1 and 4 story, brick, steel and concrete, on lot 60 x 190 ft., 1905 Prospect Ave. $100,000. A. F. Janowitz, 811 Prospect Ave., archt. and engr.

O., Cleveland—Plant and Office—E. H. Ferguson, c/o H. Laronge, 319 Williamson Bldg., plans 2 or 3 story, brick, steel and concrete, East 49th St. and Superior Ave. $100,000. Engineer and architect's name withheld.

O., Conneaut — Factory — Graham Clay Products Co., c/o B. J. Graham, pres., 627 Guardian Bldg., Cleveland, having preliminary plans prepared by H. K. Ferguson Co., 14900 Euclid Ave., Cleveland, 1 and 2 story, brick and steel, here. $100,000. Noted Oct. 18.

O., Dayton—Factory—Duro Pump & Mfg. Co., East Monument Ave., having plans prepared by Schenck & Williams, Mutual Home Bldg., 4 story and basement, 80 x 200 ft., rein.-con. and brick, plain foundation, Amelia St. $175,000.

Ind., Angola—Plant—Standard Body Co. plans addition to plant. $200,000.

Ind., Bedford—Mill—Interstate Cut Stone Co. plans 1 story, 125 x 450 ft., brick and steel. $600,000. Private plans.

Ind., Bloomington—Garage—N. Hill plans 2 story and basement, 70 x 132 ft., rein.-con. and brick. $50,000. J. L. Nichols, Bloomington, archt.

Ind., Hartford City—Factory—Overhead Door Co. plans 1 story factory. $40,000.

Mich., Marquette—Power Plant—Voted $275,000 bonds for 2 story, brick and steel power plant, plain foundation, also dam in Dead River. Orbison & Orbison, 812 College Ave., Appleton, Wis., engrs. Noted Sept. 20. Noted under "Dams" Oct. 26.

Wis., Clintonville—Garage—A. O. Haase having plans prepared 2 story, 30 x 50 ft., garage and repair shop, brick, rein.-con. and steel, plain foundation. $45,000. Private plans.

Wis., Kenosha — Garage — City having plans prepared by J. M. Albers, City Hall, 2 story, 50 x 90 ft. rein.-con., brick and steel garage and repair shop, plain foundation. $40,000.

Wis., Madison—Power House—Madison Gas & Electric Co., c/o J. St. John, mgr., 100 North Fairchild St., plans brick and steel addition to power house, will install 2 new boilers each 1,000 hp. and one 5,000 kw. turbine. Engineer not selected.

Wis., Milwaukee—Factory—Koehring Co., 31st and Concordia Sts., rejected bids 1 story, 122 x 360 ft., brick and steel factory, plain foundation. Will readvertise later. Van Ryn & De Gelleke, 114 Grand Ave., archts.

Wis., Shullsburg—Factory—Farmers Cooperative Co., R. F. D., plans 2 story, brick and tile factory, plain foundation. $40,000. Private plans.

Wis., Wausau—Factory—Wausau Parts Mfg. Co., c/o W. A. Schoefield, mgr., plans 2 story, 60 x 90 ft., brick and rein.-con. factory, plain foundation. $50,000. Engineer and architect not selected.

Minn., St. Paul—Warehouse and Storage—Central Supply Co., 1514 11th Ave. S., Minneapolis, had plans prepared by Toltz, King & Day, 1410 Pioneer Bldg., 3 story and basement, 100 x 100 ft., rein.-con. and brick, University Ave. and Griggs St. $125,000.

Mo., Nevada—Plant—Vernon Asphalt Co. plans plant. $75,000. Engineer and architect not selected.

Mo., St. Louis — Warehouse — Westinghouse Electric Mfg. Co., 717 South 12th St., plans 3 story, rein.-con and brick addition. $150,000.

Mo., Taskee Station—Plant, etc.—I. W. Rodgers and H. E. Springer, Poplar Bluff, having preliminary plans prepared concentrate mill and washer, power plant, etc., with trams to carry ore from building to building, here. $200,000. Private plans.

Ark., Dumas—Saw Mill—J. V. Stimson Hardwood Lumber Co., New South Memphis, having preliminary plans prepared concrete and timber mill, 50,000 ft. daily capacity. $50,000. Private plans.

Tex., Dallas—Wholesale—Crowdus Drug Co., Commerce St., having plans prepared by Whitson & Dale, Medical Arts Bldg., 6 story and basement, 125 x 213 ft., concrete and brick, Orange and McKinney Sts. $200,000.

Tex., Dallas—Warehouse and Office—Merton Investment Co., Jefferson Hotel, having plans prepared by Finn & Dunne, Magnolia Bldg., 2 story and basement, (with foundation to carry 6 story) brick and concrete, Jackson St. $85,000.

Tex., Ft. Worth—Factory—Parker Brown Co., 1302 Pacific Ave., plans addition to factory, Pacific Ave. $80,000.

Tex., Ft. Worth—Warehouse—Bergman Produce Co., 239 West 16th St., plans 200 x 200 ft. concrete and brick warehouse, Railroad Ave. $60,000. Engineer and architect not announced.

Okla., Tulsa—Laundry—Clipson Cleaning & Dyeing Co., 915 South Main St., plans 2 story and basement, 96 x 115 ft., rein.-con. and brick. $200,000. Private plans.

Ore., Portland—Warehouse—J. I. Case Threshing Machine Co., Miller Bldg., Racine, Wis., having plans prepared 4 story, 100 x 186 ft., rein.-con., plain foundation, East Clay, 1st and 2nd Sts., here. $150,000. Will take bids in spring. Private plans. Address W. G. Davis, pres.

Wash., Cle Elum—Sub Station—Puget Sound Power & Light Co., Stuart Bldg., Seattle, plans concrete substation, to cover area 200 ft. sq., 5,000 kw. capacity, here. $160,000.

California—Cold Storage—Natl. Ice & Cold Storage Co., Postal Telegraph Bldg., San Francisco, having plans prepared by Davis-Heller-Pearce Co., Delta Bldg., Stockton, six 2 story plants, rein.-con., in Vallejo, Hayward, Hollywood, Riverside, Tropico and another location to be determined. $30,000-$50,000 each.

Calif., Alhambra—Factory—Amer. Liquid Meter Co., 406 West Rose Rd., San Gabriel, interested in company recently organized which plans factory, first unit to exceed $75,000.

Calif., Emeryville—Garage—Cozzens-Ball, Inc., 48th St. and San Pablo Ave., Oakland, having plans prepared by F. Soderberg, 276

Industrial Works (Continued)

Perkins St., Oakland, 1 story, rein.-con.. San Pablo Ave., here. $85,000.

Calif., Pasadena—Light and Power Plant—Plans election to vote on $250,000 bonds for extensions to municipal electric light and power plant, incl. new substation, power equipment, transmission lines, pumping plants, etc.

Calif., San Diego — Warehouse, etc. — Dohrmann Commercial Co., Geary and Stockton Sts., having preliminary plans prepared 4 story, fireproof, 7th and C Sts. To exceed $100,000.

Calif., San Francisco—Factory—J. D. and A. B. Spreckels Securities Co. (Western Sugar Refining Co.) 2 Pine St., had plans prepared concrete and steel factory, 23rd St. $200,000. Foundation work will be done by day labor. Steel to Pacific Rolling Mill Co., 17th and Mississippi Sts., $99.79 per ton.

Calif., San Francisco—Plumbing and Heating Shop—Lawson & Drucker, 450 Hayes St., plans 2 story, rein.-con., Tehama St. $40,000. Private plans.

Calif., San Francisco—Warehouse—L. R. Lurie, 315 Montgomery St., having plans prepared by O'Brien Bros., Inc., 315 Montgomery St., 1½ story, brick, south of Market Dist. $42,000.

Ont., Wiarton—Garage and Repair Shop—McCrabbs Garage plans to rebuild garage and repair shop recently destroyed by fire. $40,000.

N. B., St. Stephen—Paper Plant—Hollingsworth & Whitney Co., 185 Devonshire St., Boston, Mass., plans paper plant, machine shop, power unit etc., brick, along St. Croix River, here. $300,000. Private plans

B. C., Vancouver—J. Hanbury and associates, 4th Ave. and Granville St., plans central heating plant to utilize waste material from lumber mills in False Creek area and piping steam to city business area. $1,000,000. Engineer not selected.

BIDS DESIRED

N. Y., Canton—Poultry—Jan. 8, by R. C Ellsworth, secy. St. Lawrence University, poultry buildings for New York State School of Agriculture. $55,000.

N. J., Camden—Machine Shop—Dec. 26, by E. F. McClintock, master carpenter, Pennsylvania Offices, Camden, 1 story, 86 x 150 ft., brick and steel, plain foundation, Clinton, here, for Pennsylvania R.R., Broad St. Station, Phila. $75,000. W. H. Cookman, Broad St. Station, Phila., archt.

Md., Baltimore—Substation—Dec. 27, by United Realty Co., Continental Trust Bldg., 1 story, 27 x 66 ft., concrete and brick, plain foundation, 313-15-17 North Payson St. $40,000. Private plans. G. Wannegal, asst. supt. power.

O., Cleveland—Garage—See "Buildings."

O., Lorain—Factory—J. Spang Baking Co., c/o J. Spang, 2701 Barber Ave, Cleveland, taking bids 2 story and basement, brick and steel, here. $50,000. E. Huberty, 8017 Whitethorn Ave., Cleveland, archt.

Ill., Chicago—Auto Service and Garage—D. S. Klafter, archt., 64 West Randolph St., receiving bids 1 story, 150 x 150 ft., fireproof, Lawrence and Ridgeway Aves., for A. Natlin, c/o architect. $75,000.

Ill., Chicago—Dye House—J. H. Klafter, archts., 127 North Dearborn St., receiving bids 1 and 2 story, 50 x 125 ft., fireproof, Wentworth and 4th Pl., for Almore Dye House Co., c/o archt. $40,000.

Ill., Chicago—Factory—L. E. Russell, archt., 25 North Dearborn St., receiving bids 4 story, 60 x 150 ft., fireproof, addition, for Chicago Pottery Co., 1924 Clybourn St., $150,000.

Ill., Peoria—Packing Plant—Feb. 1, by B. H. Stephens, archt., 87 West Van Buren St., Chicago, 3 story, 112 x 250 ft., brick and concrete, Water St., here, for McDonough Packing Co., Sawyer St. $200,000.

Wis., Kenosha—Factory—P. Pirsch & Co., Fairfield Ave., taking bids 1 story, 100 x 200 ft. concrete factory, plain foundation. $60,000. Private plans.

Calif., Los Angeles—See "Unclassified."

CONTRACTS AWARDED

Mass., Brockton—Substation, etc.—Edison Electric Illuminating Co., 42 Main St., 2 story substation, transformers and equipment at Dupont Circle; 4½ transmission line from here to East Bridgewater; also equipment, extensions and rearrangement of switching equipment at East Bridgewater Station, to Stone & Webster, Inc., 147 Milk St., Boston. Total $785,000

R. I., Phillipsdale (Branch of Providence)—Factory—Amer. Electrical Wks., 1 story, 80 x 280 ft., steel, in Phillipsdale Dist., to Stone & Webster Inc., 147 Milk St., Boston. Engrs. est. $100,000.

R. I., Providence — Warehouse — Orrin Jones Co., 59 Central St., 6 story, 45 x 76 ft., brick and steel, Central St., to Central Eng. & Constr. Co., Main St., Pawtucket, $100,000.

N. Y., Cranesville—Power House—Adirondack Power & Light Co., 511 State St., Schenectady, 1 story, 145 x 200 ft., brick and steel addition, plain foundation, here, to J. T. Turner & Sons, Schenectady, $275,000.

N. Y., Long Island City—Factory—Nedwell Building Corp., c/o Baker & Ludwig, archts. and engrs., 9 Jackson Ave., 6 story, 60 x 100 ft., rein.-con., brick and steel, plain foundation, Hoffman Blvd., to Pritz & Stone, Grand Central Terminal, New York. Archts. est. $180,000.

N. Y., Palmyra—Power Station—R. K. Fuller, comr. Canals & Waterways, Albany, power station at Lock 29, here, Contr. 193, to T. H. Ryan, Inc., 184 Cleveland Ave., Buffalo, $63,600. Noted Nov. 15.

Pa., Phila.—Factory—V. H. Smith & Co., 2nd and Green Sts., 5 story, 30 x 85 ft. rein.-con. and brick, plain foundation, Spring Garden and Phillip Sts., to E. Atkins, 249 South 24th St., $55,000.

Pa., Phila.—Garage—W. Golder, c/o L. B. Rothchfld, 215 South Broad St., 1 story, 75 x 167 ft. brick and steel garage, plain foundation, 1019 Arch St., to Golder Constr. Co., 274 South 20th St., $40,000.

Pa., Phila.—Sales and Garage—R. J. Seltzer, 1423 Locust St., will build 1 story, 50 x 265 ft. brick and steel, plain foundation, 3427-3429 North Broad St., by day labor. $50,000.

Pa., Phila.—Tank Shop—General Electric Co., River Rd., Schenectady, N. Y., 1 story, 125 x 250 ft. brick and steel, plain foundation, 69th and Elmwood Aves., to White Constr. Co., 95 Madison Ave., New York City, $200,000.

Tenn., Nashville—Packing Plant—Neuhoff Packing Co., 1308 Adams St., 4 story and basement, 45 x 100 ft., brick and concrete addition, to Foster-Creighton Co., 4th and 1st Natl. Bank Bldg., approximately $150,000.

O., Cleveland—Garage and Commercial—Auto Electrical Maintenance Co., c/o H. E. Page, 943 Chester Ave., 1 story, 62 x 278 ft. brick and steel, 2332 Prospect Ave., to H. K. Ferguson Co., 4900 Euclid Ave. Archts. est. $75,000.

O., Dayton—Auto Repair Shop—See "Buildings."

O., Dayton—Sales, etc.—E. F. Kimmel, Ludlow Bldg., 3 story and basement, 66 x 130 ft., sales and auto repair shop, rein.-con. and brick, plain foundation, North Jefferson St., to I. F. Weber & Co., 809 Commercial Bldg., $100,000.

Mich., Detroit—Plant—Natl. Ice Co., 245 Congress St., 1 story, brick and steel plant, plain foundation, Sterritt Ave., to Pine & Munnecke, 103 Marquette Bldg., $40,000.

Ill., Chicago—Auto Service and Garage—J. J. Wright Motor Co., 853 East 55th St., 1 story, 105 x 180 ft., fireproof, near Princeton Ave. and 55th St., to R. S. Woods, 12 West 55th St., archts. est. $70,000.

Ill., Chicago—Auto Sales and Service—L. Bromberg, 1252 North Oakley Blvd., 1 story, 103 x 250 ft., fireproof, 3250-56 Milwaukee Ave., by day labor. $100,000. A. M. Ittuttenberg, 64 West Randolph St., archt. Noted Sept. 18.

Ill., Chicago—Garage—W. E. Garage Co. c/o Halperin & Braun, archts., 19 South La Salle St., 2 story, 96 x 125 ft., fireproof, 1830-38 West Madison St., to H. Janisch & Co., 1813 Winona Ave. Archts. est. $90,000.

Wis., Madison — Garage, etc. — Madison Medical Assn., c/o R. S. Ingersoll, Lakeside St., will build 2 story, 45 x 100 ft. rein.-con., brick and steel garage, laundry and boiler house, plain foundation, by day labor. $50,000. F. Riley, Conklin Bldg., archt.

Wis., Madison—Mill—L. J. Schultz Co., 1326 West Washington Ave., 2 story, 41 x 72 ft., factory and mill, brick, plain foundation, Regent St., to G. Nelson, 1118 West Jackson St. Archts. est. $40,000.

Wis., Milwaukee—Warehouse—Meredith Bros. Co., 1043 Kinnickinnic Ave., will build 1 story, 40 x 142 ft., brick and timber, plain foundation, Washington St., by day labor. $45,000.

Kan., Topeka — Plant — Southwestern Serum Co., 21st and Mosley Sts., 1 story, 100 x 125 ft. and 2 story, 50 x 80 ft., rein.-con. and brick, East 21st St., to Clickmer Constr. Co., Hutchinson. Archts. est. $50,000.

Neb., Omaha—Laundry—Kimball Laundry Co., 3 story and basement, 15th and Jones Sts., to P. Kiewits Sons, 908 Omaha Natl. Bank Bldg., $150,000.

Mo., Moberly—Plant—Polar Wave Ice & Fuel Co., 3626 Olive St., 83 x 250 ft., rein.-con. and brick, 50 ft. high, to Bell Bros. Constr. Co., Moberly. Archts. est. $125,000. Noted Dec. 13.

Mo., St. Louis—Foundry—Warren Steel Casting Co., 3400 Maury Ave., 1 story, 60 x 200 ft. foundry, to E. Lund Constr. Co., Merchants-Laclede Bldg. Archts. est. $50,000. Noted Nov. 22.

Mo., St. Louis—Laundry—Cascade Wet Wash Co., Texas and Victor Sts., 1 and 2 story, 125 x 247 ft., rein.-con. and brick, Ohio Ave., to Fruin-Colnon Constr. Co., Merchants-Laclede Bldg. Archts. est. $75,000. Noted Mar. 1.

Mo., St. Louis—Plant—St. Louis Terra Cotta Co., 5811 Manchester Ave., will build 1 story, 63 x 145 ft., 80 x 160 ft., and 95 x 450 ft. plants, and 5 kilns, brick and sheet iron, Oleatha St., by day labor. $75,000. Private plans.

Ark., Forrest City—Hardware—Vaccaro-Drobmyer Co., will build 2 story and basement, 109 x 150 ft., by day labor under supervision of J. L. Gatling, archt., Madison Ave. Bldg., Memphis, Tenn. Noted Nov. 22.

Ark., Hot Springs—Garage—M. J. Henderson, c/o Arkansas Trust Co., 621 Central St., will build 3 story, 110 x 159 ft., brick, rein.-con. and steel garage, by day labor under supervision S. M. Frank, archt., Hot Springs. $50,000.

Tex., Ft. Worth—Factory—Parker Brown Mfg. Co., East Front and Oak Sts., brick and concrete factory, East Front St., to C. F. Hodge, Keene Bldg., $79,000.

Wash., Sumner—Power Station—Puget Sound Power & Light Co., 4th unit in White River hydro-electric plant, incl. 20,000 kva. generator, transformers, circuit breakers, 1,800 ft. steel penstock and addition to building, to Stone & Webster, Inc., 147 Milk St., Boston. $1,060,000.

Calif., Los Angeles—Garage—California Co., 626 South Spring St., 1 story, 110 x 135 ft., brick, Temple St. near Alvarado St., to Benet & Co., 416 Beverly Dr., Beverly Hills, percentage basis. Checker Taxi Cab Co., 846 Bway., lessee.

Calif., San Francisco—Warehouse—J. W. Bender Roofing Co., Monadnock Bldg., 1 story, rein.-con., Alabama and 19th Sts., to Lindgren-Swinerton Co., Standard Oil Bldg., $42,000.

Buildings

PROPOSED WORK

N. Y., Buffalo—Church—Bley & Lyman, archts., 250 Delaware Ave., take bids about Feb. 1, rein.-con., brick and stone, Main St., for St. Joseph Roman Catholic Church, 1238 Main St.

N. Y., Long Island City—Church—Church of St. Patrick, c/o R. J. Reilly, archt. and engr., 50 East 41st St., New York, having plans prepared brick, steel and stone, plain foundation, Academy St., here. $150,000.

N. Y., New York—Apartment—C. Kreymborg, archt. and engr., 2534 Marion Ave., making sketches brick, steel and stone, plain foundation, Grand Concourse. $350,000. Owner's name withheld.

N. Y., New York—Apartment—S. Liberman, c/o Springsteen & Goldhammer, archts. and engrs., 32 Union Sq., having plans prepared brick, steel and stone, plain foundation, 189th St. and Audubon Ave. $275,000.

N. Y., New York — Church and Hall — Roman Catholic Church of St. John Nepomak, c/o J. C. Van Pelt, archt. and engr., 126 East 59th St., having plans prepared, brick, steel and stone, plain foundation, 1st Ave. and 68th St. $400,000.

N. Y., New York—Turkish Bath—P. D. R. Constr. Corp., c/o Gronenberg & Leuchtag, archts. and engrs., 32 Union Sq., having plans prepared 8 story, 75 x 98 ft., brick, steel and stone, plain foundation, 121-127 West 46th St. $350,000.

N. Y., Webster—School—Voted $370,000 bonds school, South Ave. Will mature in spring. Noted Dec. 6.

N. J., Glen Ridge—School—Bd. Educ. had plans prepared by F. Goodwille, 56 West 45th St., New York City, brick, High St. $190,000.

Pa., Chestnut Hill (Phila. P. O.)—Dormitory—G. D. Weisener having plans prepared by H. Trumbauer, Land Title Bldg., Phila., 2 story, 40 x 75 ft. stone dormitory, and 1½ story, 60 x 420 ft. stable, at Erdenheim. $150,000.

Pa., Lancaster—School—School Bd. having plans prepared by C. E. Urban, Woolworth Bldg., 3 story and basement, 169 x

Buildings (Continued)

211 ft. brick, steel and stone, plain foundation. $400,000.

Pa., Merion (Phila. P. O.)—Apartment—Merion Apartment Co., c/o Smullen & Berry, 217 South Broad St., Phila., having plans prepared by T. B. Lippincott, 11 South 16th St., Phila., 3 story and basement, 40 x 290 ft. with 2 wings 40 x 75 ft. and 40 x 100 ft. brick, plain foundations, Idris Rd. $500,000.

Pa., Phila. — Wynnefield-Taylor, Pelham Court, Germantown, (Phila. P. O.), having plans prepared by T. B. Lippincott, 11 South 16th St., 7 story and basement, 48 x 128 ft., rein.-con., brick and steel, plain foundation, Lincoln Dr. and Emlen St. $450,000.

Pa., Wilkes-Barre—Bank—Heights Deposit Bank, East Market and Hancock Sts., having plans prepared 4 story, 40 x 100 ft. rein.-con. and steel, East Market St. $150,000. Architect not selected.

W. Va., Huntington—Court House—Cabell Co. rejected bids Nov. 26, 3 story, 65 x 107 ft. addition, rein.-con. $150,000. Will readvertise.

W. Va., Morgantown—High School—Jan. 22 to vote on $600,000 bonds for high school. W. S. John, secy. Bd. Educ. Noted Dec. 6.

W. Va., Welch—School—Big Creek Dist. Bd. Educ., plans 3 school buildings. $150,000.

N. C., Greensboro — Municipal — Sold $200,500 bonds new municipal building. P. C. Painter, city mgr.

N. C., Hickory—School—Sold $340,000 bonds new school.

Ala., Birmingham—Office—E. M. Elliott, 1214 Virginia Ave., plans 8 or 10 story, 100 x 150 ft., 5th Ave. and 23rd St. $500,000. Architect and engineer not selected.

Miss., Biloxi—School—Voted $100,000 additional bonds for 3 ward buildings. $100,000 previously available.

Tenn., Knoxville — Temple — Kerbela Shrine Temple plans to construct temple. $350,000. Engineer and architect not selected.

Tenn., Morristown—School—Bd. Educ. for Negroes, Methodist Episcopal Church, plans 3 industrial school buildings. $150,000.

Ky., Dawson Springs — Hospital — National Hospital of Church of Christ, plans 3 story hospital. $500,000. Engineer and architect not selected.

Ky., Louisville — Temple — Union Labor Temple Co., Inc., having plans prepared by Weakley & Hawes, C & S Bldg., 5 story, 75 x 200 ft., steel frame, Main St. $350,000.

O., Carey—Church—A. M. Fish, pastor, having plans prepared by Ogden & Gander, archts. and engrs., 17 Steuben St., Albany, N. Y., 1 story, 80 x 200 ft., stone and timber, plain foundation. $250,000.

O., Cleveland — Apartment Hotel — M. Goodman, c/o S. H. Kleiman Co., Natl. City Bldg., having plans prepared by N. Petti, Williamson Bldg., 4 story and basement, 88 x 150 ft., brick, East 20th St. $150,000.

O., Cleveland — Apartment — S. Koslen, 1077 East 97th St., having plans prepared by M. Weis, 617 Union Bldg., 3 story, brick, East 93rd St. $200,000.

O., Cleveland — Apartment — S. Koslen, 1077 East 97th St., having plans prepared by M. Weis, 617 Union Bldg., 4 story, brick, East 82nd St. $300,000.

O., Cleveland — Apartment — M. Morris, 1829 Grasmere Ave., having plans prepared by A. F. Janowitz, 811 Prospect Ave., 3 story and basement, 39 x 145 ft., brick and timber, East 77th St. south of Euclid Ave. $150,000.

O., Cleveland — Apartment — T and R Constr. Co., c/o J. Shafran, 12109 Union Ave., having plans prepared by M. Altschuld, 5116 Woodland Ave., 3 story, 37 x 157 ft., brick and timber, East 88th and East 90th Sts. $150,000.

O., Columbus — Medical Science — Bd. Trustees Ohio State University having plans prepared by J. N. Bradford, Ohio State University, 4 story and basement, 50 x 125 ft., rein.-con. and brick addition, campus. $200,000.

O., Garfield Heights (Bedford P. O.)—School—Bd. Educ., Turney Rd., having plans prepared by W. H. Nicklas, 1900 Euclid Ave., Cleveland, 2 story, brick, metal lumber and concrete addition. $190,000.

O., Wooster—Community—Wooster College plans college community building. $200,000.

Ind., Ft. Wayne—Temple—Mizpah Temple, A. A. O. N. M. S., having revised plans prepared by G. Mahurin, Lincoln Life Bldg., 5 story and basement, 146 x 165 ft. $600,000. Noted Sept. 7.

Ind., Indianapolis — Bank and Office — Guardian Realty Co., Meyer-Kiser Bank, plans 4 story and basement, rein.-con. and brick, Indiana Ave. $150,000. Vonnegut, Bohn & Mueller, Indiana Trust Bldg., archts.

Ind., Indianapolis—Schools—Bd. School Trustees plans 2 story and basement, West Washington St., $500,000, Vonnegut, Bohn & Mueller, Indiana Trust Bldg., archts.; 2 story and basement high school, North Meridian St., $1,500,000, Kopf & Woolling, Indiana Pythian Bldg., archts.; 2 story and basement, colored high school, North West St., $500,000, Harrison & Turnock, Bd. of Trade Bldg., archts. All brick, steel and rein.-con. Noted Jan. 11.

Ind., South Bend—College—St. Marys College plans 3 story and basement, rein.-con. and brick. $150,000. M. Carroll, 614 Ridge Arcade, Kansas City, Mo., archt.

Mich., Highland Park (Detroit P. O.)—School—Bd. Educ. having plans prepared by Burrowes & Eurich, 2631 Woodward Ave., Detroit, 2 story and basement, 64 x 200 ft. rein.-con., brick, steel and stone addition to Ford School, 2nd and Midland Aves. $160,000.

Mich., Jackson—Hotel—General Organization Co. plans hotel, $1,000,000. Engineer and architect not selected.

Ill., Chicago—Apartment—C. J. Carey, 227 East Superior St., plans 6 story, 48 x 148 ft., fireproof, 117 East Walton St. $250,000. Fugard & Knapp, 219 East Superior St., archts.

Ill., Chicago—Apartment—S. & J. Handelsman, c/o Loewenberg & Loewenberg, archts., 111 West Monroe St., plans 3 story, 125 x 150 ft., fireproof, 1332-42 South Harding St. $200,000.

Ill., Chicago—Apartment—C. F. Henry, c/o R. F. France, archts., 155 North Clark St., plans 3 story and basement, 140 x 200 ft., fireproof, Malden and Sunnyside Aves. $600,000.

Ill., Chicago — Apartment — N. Kaplan, c/o Rawson & Eisenberg, archts., 5 North La Salle St., plans 3 story and basement, fireproof, Cottage Grove Ave. near 42nd St. $150,000.

Wis., Appleton — Hotel — Conway Hotel Co., Oneida St., having plans prepared by M. Tullgren & Sons, 425 East Water St., Milwaukee, 6 story and basement, 60 x 75 ft., brick and concrete addition, plain foundation. $150,000.

Wis., Bloomington—School—Joint Dist. 3 having plans prepared by E. Tough, East Mifflin St., Madison, 2 story and basement, 68 x 100 ft., brick, tile and concrete, plain foundation. $150,000.

Wis., Cross Plains—School—St. Francis Catholic Congregation, c/o E. J. Kersteny, pastor, having plans prepared by F. L. Kronenberg, Carroll Bldg., Madison, 2 story and basement, 73 x 110 ft., brick, rein.-con. and stone, plain foundation. $150,000.

Wis., Eau Claire—Exchange—Wisconsin Telephone Co., 418 Bway., Milwaukee, plans 3 story, brick and concrete, plain foundation, East Grand Ave., here $150,000. Engineer and architect not selected.

Wis., Eau Claire — High School — Bd. Educ., c/o J. E. Barron, secy., plans 4 story, rein.-con., brick and steel, plain foundation. Election soon to vote on $200,000 bonds. Architect not selected.

Wis., Kenosha—Bank and Office—Merchants & Savings Bank, 262 Main St., having preliminary plans prepared by Lindl, Lesser & Schutte, 82 Wisconsin St., Milwaukee, 4 story and basement, 50 x 85 ft., brick and concrete, plain foundation. $200,000.

Wis., Madison—City Hall and Court House—City and Dane Co., c/o W. G. Woodward, chn., 17 West Main St., having plans prepared by Claude & Starck, Badger Annex, 4 story, rein.-con., brick and steel, plain foundation. $175,000.

Wis., Madison—School—Bd. Educ., 22 West Dayton St., having plans prepared by E. Tough, Washington Bldg., 2 story, 50 x 95 ft. rein.-con., brick and steel addition to Randolph School, plain foundation, Spooner Ave. $200,000.

Wis., Menasha—Church—First Congregational Society, c/o W. H. Miner, chn. building com., 330 Park St., plans 2 story, brick and tile, plain foundation. $160,000. Engineer and architect not selected.

Wis., Milwaukee—Apartments—J. Hunholz, 2310 Vliet St., plans three 8 story and basement, brick and concrete, plain foundations, Martin St. $350,000 each. Engineer and architect not selected.

Wis., Milwaukee — High School — Our Lady of Mercy Academy, 705 Natl. Ave., having plans prepared by Brust & Philipp, 405 Bway., 3 story and basement, concrete, brick and tile, plain foundation, 22nd and Mitchell Aves. $400,000.

Wis., Rhinelander—High School—School Bd. soon takes bids 3 story and basement, brick, tile and concrete, plain foundation. $445,000. Smith, Reynolds & Brandt, Dempsey Bldg., Manitowoc, archts.

Wis., Shorewood (Milwaukee P. O.) — School Dist. 4, c/o W. Siekert, clk., having plans prepared by Herbst & Kuenzli, 114 Grand Ave., 3 story and basement, brick, tile and concrete, plain foundation, Oakland Ave. $280,000.

Wis., Wausau—Hotel—Hotel Wisconsin Realty Co., 86 Michigan St., Milwaukee, having preliminary plans prepared by M. Tullgren & Sons, 425 East Water St., Milwaukee, 8 story and basement, brick and concrete, plain foundation, 3rd and Scott Sts. $800,000.

Wis., Wauwatosa—High School—Township and city election Jan. 4, to vote on $400,000 bonds 2 story and basement Union High School. Engineer and architect not selected.

Wis., West Bend—High School—School Dist. 1, having revised plans prepared by Foeller, Schober & Stephenson, Nicollet Bldg., Green Bay, 2 story and basement, brick, tile and concrete, plain foundation. $200,000.

Wis., Wyocena—Asylum—Columbia Co. c/o S. C. Cushman, supt., having plans prepared by Claude & Starck, Badger Annex, 2 story and basement, 50 x 166 ft., brick, rein.-con. and steel, plain foundation. $150,000.

Ia., Ames—School—State Bd. Educ., Des Moines, having plans prepared by Proudfoot, Bird & Rawson, archts., 810 Hubbell Bldg., Des Moines, 3 story and basement, rein.-con., brick and stone, at Iowa State College, here. $200,000. W. H. Gemmill, secy.

Minn., Minneapolis — Hotel — Calhoun Beach Holding Co., c/o H. S. Goldie, treas., 929 Plymouth Bldg., soon takes bids and opens same after Jan. 1, 6 story superstructure, 120 x 250 ft., with 3 wings, rein.-con., brick and tile, West Lake St. and Dean Blvd. $1,300,000. Former bids rejected. A. Rose, 1007 Builders Exchange, archt. Noted Aug. 2 under "Unclassified."

Minn., Wells—School—Bd. Educ. plans 2 story and basement, rein.-con., brick and tile. $150,000. L. M. Buscho, clk. Engineer and architect not announced.

Kan., Lawrence—Hotel—W. E. Simons, c/o Eldridge Hotel, having preliminary plans prepared by W. E. Hulse & Co., Stamey Hotel Bldg., Hutchison, 6 story and basement, 42 x 117 ft., rein.-con., brick and stone. $200,000.

S. D., Watertown—Court House—Codington Co. plans 3 story and basement, rein.-con., brick and stone. $300,000. Engineer and architect not announced.

Mo., St. Louis—Administration—Southwestern Bell Telephone Co., Bway. and Locust Sts., having preliminary plans prepared 20 story and basement, 109 x 229 ft., rein.-con., brick, steel and stone, Pine St. $3,500,000. Private plans.

Mo., St. Louis—Exchange—Southwestern Bell Telephone Co., Bway. and Locust St., having preliminary plans prepared 7 story and basement (equal in height to 11 story), 110 x 130 ft., rein.-con., brick, steel and stone, Chestnut St. $750,000. Private plans.

Tex., Austin—Schools—Voted $600,000 bonds for erection of new junior high school, ward school and additions to present schools. Engineer and architect not selected. Noted Nov. 15.

Tex., Cleburne—Hotel—R. A. Johnson, Jacksonville, plans 4 story, brick and concrete, James St. $150,000. Engineer and architect not announced.

Tex., Ft. Worth — Library — Texas Christian University takes bids early in 1924, for 2 or 3 story, concrete and brick, on campus. $150,000 E. M. Waite, pres. Engineer and architect not announced.

Tex., San Antonio—Auditorium—City receiving competitive sketches auditorium, rein.-con., brick, stone and marble, Romana and North St. Marys Sts. Additional $200,000 bonds voted, total cost $700,000. Noted Oct. 11.

Okla., Blackwell — Hall and Store — Masonic Lodge making preliminary plans 3 story, 100 x 140 ft., Main St., $175,000. Architect not selected.

Okla., Guthrie — High School — Voted $280,000 bonds 3 story, 165 x 180 ft., rein.-con. and brick, plain foundation, Noble St. Hawk & Parr, Magnolia Bldg., Oklahoma City, engrs.

Okla., Oklahoma City—Medical Arts and Bank—Medical Assn. & Security Natl. Bank, 109 North Bway., having plans prepared by Layton, Smith & Forsyth, 906 Baniff Bldg., 12 story and basement, 76 x 140 ft., rein.-con., brick and stone. $800,000.

Wash., Tacoma—Temple—Masonic Corp., c/o B. W. Coiner, 516 Bankers Trust Bldg., had sketches prepared and takes bids early in spring, 10 story, 125 x 175 ft., rein.-con., Bway. and St. Helens St. $400,000. Engineer and architect not selected. Noted June 22.

Ore., Salem—High School—W. C. Knighton, archt., United States Bank Bldg., Portland, takes bids about March 21, 2 story.

Buildings (Continued)

90 x 120 ft., rein.-con., here, for Bd. Educ. $190,000.

Calif., Long Beach—Lodge and Commercial—Masonic Lodge having plans prepared by Davies & Baume, Long Beach, 4 story, 50 x 150 ft., brick, Pine Ave. $170,000.

Calif., Los Angeles—Apartment—R. V. New, c/o L. A. Smith, archt., Lily-Fletcher Bldg., having plans prepared 4 story and basement, brick, 11th St. near Lake St. $150,000.

Calif., Los Angeles — Apartment — R. Roland, having plans prepared by Walker & Eisen, Pacific Finance Bldg., 13 story and basement, 100 x 150 ft., rein.-con. and brick, Wilshire Blvd. and Ardmore Ave. $1,500,000.

Calif., Los Angeles—Memorial Hall—Los Angeles Co. plans approximately 5 story, steel and rein.-con. To exceed $300,000. Will be occupied by Amer. Legion.

Calif., Pacioma—Bank and Store—Suburban Estate Co., c/o B. Bloser, archt., Consolidated Realty Bldg., Los Angeles, having preliminary plans prepared 1 story, 160 x 163 ft., brick, Sherman Way.

Calif., San Diego—Schools—Election Jan. 15 to vote on $400,000 bonds for elementary schools and $850,000 for junior high school. W. Angier, secy. City Bd. Educ. Noted Aug. 23.

Calif., San Francisco—Apartment—S. L. Pelser, 130 Palm Ave., having prepared by Macdonald & Couchot, 234 Pine St., 5 story and basement, rein.-con., Jackson St. near Buchanan St. $150,000.

Calif., San Francisco—High Schools—City and San Francisco Co. having plans prepared by J. Reid, Jr., city archt., 1st Natl. Bank Bldg., for Durant High School, $150,000 or more, Park-Presidio High School, $150,000 or more, South End High School, $150,000 or more, Lowell High School, $150,000 or more.

Que., Montreal—Office—Chamber of Commerce, St. Gabriel St., plans 4 story, office, St. James and St. Gabriel Sts. $300,000.

Ont., Ottawa—School—Pub. School Bd. having plans prepared by W. C. Beattie, c/o Elgin St. School, for 2 story and basement, rein.-con. and brick, plain foundation, Warren Ave. $200,000.

BIDS DESIRED

N. Y., Bellaire (Jamaica P. O.)—School—Jan. 8, by Superintendent Bd. Educ, 500 Park Ave., New York, P. S. 109, brick, steel and stone, plain foundation, 92nd Ave. and 213th St., here. W. H. Gompert, Flatbush Ave. extension and Concord St., Brooklyn, archt. and engr.

N. Y., Brooklyn—School—Jan. 8, by Superintendent Bd. Educ., 500 Park Ave., New York, P. S. 201, brick, steel and stone, plain foundation, 12th Ave. and 80th St., here. W. H. Gompert, Flatbush Ave. extension and Concord St., archt. and engr. Noted Dec. 21, 1922.

N. Y., New York—Church—J. Gregory, archt. and engr., 49 West 46th St. taking bids and opens same about Jan. 6, brick and stone, plain foundation, University Ave., for Calvary Methodist Episcopal Church. $400,000. Noted Oct. 11.

N. Y., New York—School—Jan. 8, by Superintendent Bd. Educ., 500 Park Ave., P. S. 80, brick, steel and stone, plain foundation, East Mosholu Parkway. W. H. Gompert, Flatbush Ave. extension and Concord St., Brooklyn, archt. and engr.

Md., Baltimore—School—Jan. 9, by Bd. Awards, 3 story and basement, 111 x 211 ft., concrete and brick, plain foundation, Jackson Sq., Fairmont Ave. and Fayette St. $700,000. T. W. Pietsch, American Bldg., archt. H. Massart, 328 North Charles St., engr. H. G. Perring, superv. engr.

O., Cleveland—Apartment and Garage—L. Cahn, 10615 Grantwood Ave., taking bids two 3 story and basements, 47 x 190 ft. apartments, and 40 x 120 ft. garage brick, 735 East 105th St. $225,000.

O., Columbus—Hall—Feb. 4, by Richards, McCarty & Bulford, archts., 584 East Broad St., 5 story, 120 x 130 ft., brick and terra cotta, East State St., for Knights of Columbus, 6th and State Sts. $500,000.

O., East Cleveland (Cleveland, P. O.)—Apartment—M. Stein, 511 Schofield Bldg., Cleveland, taking bids 2 story and basement, 102 x 126 ft., brick, Page Ave., here. $160,000. A. F. Janowitz, 811 Prospect Ave., Cleveland, archt.

Ind., Hammond—Hospital—D. X. Murphy & Bro., archts., Louisville Trust Bldg., Louisville, Ky., taking bids and open same about Feb. 1, 4 story, 46 x 288 ft., rein.-con., for Franciscan Sisters of the Poor. $300,000. Noted Nov. 29.

Mich., Detroit—Mercantile—Dec. 28, by Smith, Hinchman & Grylls, archts., 800 Marquette Bldg., 15 story and basement, 100 x 244 ft. rein.-con., brick and steel, plain foundation, Gratiot Ave., for J. L. Hudson Co., Gratiot Ave. and Farmer St.

Mich., Flint—School—Dec. 28, by A. J. Wildanger, secy. School Bd., 2 story and basement, rein.-con., brick and steel, plain foundation, Padasena Ave. $300,000. Malcomson, Higginbotham & Palmer, 1219 Griswold St., Detroit, archts.

Ill., Chicago — Apartment — Dubin & Eisenberg, archts., 14 West Washington St., receiving bids 3 story and basement, 60 x 178 ft., fireproof, Greenview and Lunt Aves., for Rosen & Coine, c/o architects. $150,000.

Ill., Chicago—Apartment—W. C. Presto, archt., 111 West Washington St., receiving bids 3 story and basement, 84 x 125 ft., fireproof, Albany and Lawrence Sts. $150,000. Owners name withheld.

Wis., Madison—Chapel—Balch & Lippert, archts., Gay Bldg., taking new bids 4 story, 65 x 88 ft. rein.-con., brick and steel, plain foundation, for German Methodist Church, 110 South Congress St. $150,000. Former bids rejected. Noted Nov. 29.

Wis., Milwaukee — Apartments — Beach Realty Co., 63 Patton Bldg., taking bids two 4 story and basement, 50 x 130 ft., brick, tile and concrete, plain foundations, Irving Pl. $165,000 for both. Private plans.

Wis., Milwaukee—Bank and Office—Dick & Bauer, archts., 811 State St., taking bids on foundation and excavation work for 2 story, 30 x 65 ft. and 67 x 70 ft., brick and concrete, North Ave., for Northwestern Bank Bldg., c/o J. G. Reutermann, 114 Grand Ave. $150,000.

Wis., Milwaukee—Hotel—Leiser & Holst, archts., 105 Wells St., taking bids and opens same about Jan. 1, 3 story and basement, 77 x 145 ft., brick, tile and concrete, plain foundation, 6th and Grand Sts. $200,000. Owners name withheld.

Tex., Galveston—Laboratory—Jan. 14, by State Bd. Regents, Bd. Educ. Bldg., Austin, 3 story and basement, 84 x 144 ft., rein.-con., brick and stone, Ave. B and 9th St., here. $350,000. Herbert M. Green Co., 619 North Texas Bldg., Dallas, archts.

Calif., Long Beach—Club—J. Morgan, archt., Merchants Exch. Bldg., San Francisco, receiving bids 5 story and basement, rein.-con. building for Y. W. C. A., here. $400,000.

BIDS RECEIVED

N. J., Asyla (Grenloch P. O.)—Hospital—Camden Co. (Camden) Dec. 17, group of buildings here, from T. M. Gibbs Constr. Co., 215 South Broad St., Phila., $1,149,018. Noted Nov. 29 under "Camden."

N. J., Camden—High School—C. Adams, archt., 2038 Spruce St., Phila., Pa., Dec. 17, Cramer Junior High School, 3 story and basement, 80 x 153 ft. rein.-con., brick and steel, plain foundation, 29th and Federal Sts., here, for Bd. Educ., from G. Bachmann, 19 North 30th St., $185,969. Noted Dec. 13.

Ind., Ft Wayne—School—Bd. School Trustees, 2 story and basement, 162 x 170 ft., rein.-con. steel and brick, from N. Frantz, Silver Lake, $150,000. Archts. est. $200,000. Noted Nov 29.

Wis., Racine — Memorial Auditorium — Memorial Hall Com., 1 and 2 story, 180 x 200 ft., brick and concrete, from A. Kappel, 526 Wisconsin St., $173,913.

CONTRACTS AWARDED

Mass., Boston—School—City, 2 story and basement, 50 x 120 ft. rein.-con. and brick, wood pile foundation, Bluehill Ave., to be known as "Roger Walcott School," to McDonald & Imhof, 164 Dudley St., $259,000. Noted Nov 8.

Mass., Hyde Park (Boston P.O.)—Police Station—Pub. Wks. Dept., Boston, 2 story and basement, 79 x 110 ft., brick, granite and limestone, wood pile foundation, Hyde Park Ave., to Alco Contg. Co., Inc., 43 Tremont St., Boston, $181,916. Noted Nov 22.

N. Y., Brooklyn — Apartment — Sayco Realty Co., c/o McCarthy & Kelly archts. and engrs., 159 Remsen St., will build brick, steel and stone, plain foundation, Lincoln Rd., here, by day labor. $600,000.

N. Y., Brooklyn—High School—Bd. Educ., 500 Park Ave., New York, James Madison High School, brick, steel and stone, plain foundation, Bedford Ave. from Ave. P to Quentin Rd., here, to Turner Constr. Co., 242 Madison Ave., New York, $2,045,000. Noted Dec. 13.

N. Y., New York—Apartment—E. Brandt, c/o Springsteen & Goldhammer, archts., and engrs., 32 Union Sq., will build brick, steel and stone, plain foundation, 188th St. and Wadsworth Ave., by day labor. $200,000.

N. Y., New York—Apartment—I. Kraft, c/o Springsteen & Goldhammer, archts. and engrs., 32 Union Sq., will build brick, steel and stone, plain foundation, 189th St. and Amsterdam Ave., by day labor. $1,500,000.

N. Y., New York—Apartment—S. Williams, c/o G. G. Miller, archt. and engr., 1482 Bway., will build brick, steel and stone, plain foundation, 109th St. and 5th Ave., by day labor. $300,000.

N. Y., New York—School—Bd. Educ., 500 Park Ave., addition to P. S. 36, brick, steel and stone, Black Rock and Castle Hill Aves., Bronx Boro, to G. Colon & Co., 81 East 125th St., $347,000. Noted Dec. 13.

Pa., Phila.—Store—Heyman Bros., 215 South Broad St., 2 story and basement, 116 x 120 ft., steel, limestone and terra cotta, plain foundation, 1721-1729 Chestnut St., to J. Schnabel, Denckla Bldg., $200,000.

Tenn., Lebanon—Schools—City Bd. Educ., 2 buildings, 2 story and basement, brick and concrete, to Dunnavant Constr. Co., Nashville. Est. cost $150,000. Noted Dec. 13.

Ind., South Bend—Office—Tuttle Corp., 119 West Washington St., 8 story and basement, 56 x 122 ft., rein.-con., steel and brick, Colfax St., to Bedford Stone & Construction Co., Fletcher Savings & Trust Bldg. Archts. est. $700,000.

Ill., Chicago—Apartment—A. D. Schuler, 4634 North Kedzie Ave., 3 story and basement, 84 x 125 ft., rein.-con., brick and steel, fireproof, Sacramento and Lawrence Sts., to A. Haack, 1427 North Sawyer St. Archts. est. $150,000.

Ill., Oak Park—Apartment—M. P. Morrissey, 140 South Dearborn St., Chicago, apartment on Oak Park and Erie Sts., here, to Anderson & Winblad, 6235 South Michigan Ave., Chicago. Archts. est. $750,000.

Ia., Cedar Falls—Dormitory—State Bd. Educ., Des Moines, general contract 3 story and basement, rein.-con., brick, tile and stone addition to Iowa State Teachers College, here, to Tapager Constr. Co., Albert Lea, Minn., $120,167. Noted Dec. 20.

Mo., Kansas City—Medical Arts—Jackson Co. Medical Society, general contract 14 story and basement, rein.-con. and steel, 34th St. and Bway., to Reyburn Eng. & Constr Co., 609 Waldheim Bldg.

Mo., St. Louis — Church — Washington-Compton Presbyterian Church, Washington and Compton Aves., 2 story, 128 x 128 ft., brick and stone, 5 North Skinker Rd., to Wimmer Constr. Co., Victoria Bldg. Archts. est. $160,000.

Ark., Ft. Worth—Convent—Scholostria Convent, 3 story and basement, 42 x 178 ft. and 43 x 52 ft., rein.-con., brick and stone, general contract to Majors & Scheer, Sapulpa, Okla. Est. cost $200,000.

Tex., Galveston—Schools—Bd. Educ. general contracts, Goliad School, to Standard Constr. Co., West Bldg., Houston, $182,000; Ball High School and additions to Sam Houston and David Crockett schools to Walsh & Burney, Calcasieu Bldg., San Antonio, total $327,612; plumbing, sewering and gas fitting combined jobs, to A. H. Schafer, 217 North St. Marys St., San Antonio, $37,454; heating and ventilating, combined jobs, to Kennison Bros., Dallas, $56,600. Noted Nov. 1.

Tex., Port Arthur — Temple — Masonic Lodge 3 story, rein.-con., brick and stone, to Hickey & Montgomery, 1402 Main St., Dallas, $168,900. Noted Nov. 1.

Wash., Tacoma — Hotel — Citizens Hotel Corp., 601 Tacoma Bldg., 10 Story, rein.-con., 9th and Bway., to Pratt & Watson, P. S. Bank Bldg., $1,195,559.

Calif., San Francisco—Exchange—Pacific Telephone and Telegraph Co., 333 Grant Ave., 3 story and basement, Class A construction, Bush and Larkin Sts., to Monson Bros., 251 Kearney St., $225,000. Noted Dec. 6.

Ore., Portland—School—School Dist. 1, general contract 2 story, 100 x 310 ft., rein.-con., plain foundation, East 51st and Belmont Sts., to Hanson, Hammond & Clist, Portland, $161,913. Noted Oct. 25.

Calif., Los Angeles — Market — Youngs Market Co., 3 story and basement, 140 x 150 ft., rein.-con., 7th St. and Union Ave., to Weymouth Crowell Co., 2026 West 9th St., $400,000.

Calif., Los Angeles—Market and Loft—Youngs Market Inc., 216 South Spring St., 3 story and basement, rein.-con. and brick 7th and Union Aves., to Weymouth-Crowell Co., 2026 West 9th St., $350,000.

Federal Government Work

PROPOSED WORK

W. Va., Huntington—Quarterboat—U. S. Engineer rejected bids one 5 x 26 x 80 ft. steel quarterboat. Noted Nov. 8.

Ala., Florence—Cranes—U. S. Engineer, Florence, plans to purchase two 159 ton cranes for Wilson Dam.

Ky., Owensboro—Castings—U. S. Engineer, P. O. Box 72, Louisville, plans to purchase 44 tons c.i. castings for lock valves at Dam 46, Ohio River, here.

Federal Government Work (Continued)

Ind., Leavenworth—Cement—U. S. Engineer, P. O. Box 72, Louisville, Ky., plans to purchase 10,000 bbls. cement for Dam 44, Ohio River, here.

BIDS DESIRED

Pa., State College—Post Office—Jan 21 by Treas. Dept., Wash., D. C., construction, complete incl. mechanical equipment, U. S. Post Office, here; adv. E. N.-R. Dec. 27.

Va., Norfolk—Remodeling—Spec. 4912—Jan. 9, by Bureau Yards & Docks, Navy Dept., Wash., D. C., remodeling officers quarters at Marine Corps Base, here. Noted Oct. 4.

O., Cincinnati—Gates—Jan. 19 at office U. S. Engineer, furnishing and erecting gates for Lock 34, Ohio River; adv. E. N.-R. Dec. 27.

BIDS RECEIVED

D. C., Wash.—Bungalows—Dept. of Interior, construction complete, 7 bungalows at St. Elizabeth's Hospital, (1) work complete, from G. G. Loehler Co., Franklin Bank Bldg., 10th and Pennsylvania Ave., (1) $71,600 (2) $60,800; C. Colonna, P. O. Box 154, Hampton, Va., (1) $72,050 (2) $58,664. Noted Nov. 22.

CONTRACTS AWARDED

Ala., Florence—Cement—U. S. Engineer, Florence, furnishing 115,000 bbls. cement for use at Wilson Dam as follows: to Atlas Portland Cement Co., B-M Bldg., Birmingham, 63,334 bbls. f.o.b. Leeds, $2.25; to Signal Mountain Portland Cement Co., James Bldg., Chattanooga, Tenn., 20,000 bbl. f.ob. Chattanooga, $2.11; to Lehigh Portland Cement Co., Birmingham, 31,666 bbl. f.o.b. Boyles, $2.25. Noted Nov. 29.

La., New Orleans—Steel Hull—U. S. Engineer, 1 steel hull for derrick-boat, to Jahncke Dry Dock, Inc., New Orleans, $18,690.

Ky., Owensboro—Lumber—U. S. Engineer, P. O. Box 72, Louisville, furnishing lumber for Dam 46, f.o.b. here, as follows: Lot (1) 125,000 ft. No. 1 yellow pine s i.s.-i.e., to Daly Lumber Co., 905 Andrews Bldg., Cincinnati, O., $34 per M; Lot (2) 24,000 ft. No. 1 yellow pine rough, to Great Southern Lumber Co., Todd Bldg., Louisville, $35; Lot (3) 52,000 ft. Deuse merchantable yellow pine s4s, to Nicola, Stone & Myers Co., Hattiesburg, Miss., $44.30.

Wash., Puget Sound—Dredging—Spec. 4708—Bureau Yards & Docks, Navy Dept., Wash., D. C., dredging approximately 68,000 cu.yd. place measurement, Navy Yard, here, to Puget Sound Bridge and Dredging Co., Central Bldg., Seattle, $48,750. Noted Nov. 1.

Unclassified

PROPOSED WORK

Trestle, etc.—East Boston (Boston P. O.), **Mass.**—Boston Sand & Gravel Co., 88 Broad St., Boston, plans timber trestle, 250 ft. long, supporting traveling crane and belt conveyor with coal hoist mounted at one end. Cost incl. equipment. $40,000-$50,000. Private plans.

Transmission System—Somerset, Mass.—See "Industrial Works."

Park and Fish Hatchery — Burlington, Conn.—State Dept. of Fish & Game, Hartford, plans large park and fish hatchery, here.

Lighting Standards, etc.—Louisville, Ky.—Bd. Park Comrs. plan 75 lighting standards, etc. on Western Parkway. $25,000. A. A. Kreiger, city engr.

"White Way"—Louisville, Ky.—Bd. Pub. Wks. plans "White Way" system on 6th and 7th Aves. $25,000. A. A. Krieger, city engr.

Coaling Station — Russell, Ky. — Chesapeake & Ohio R.R. Co., 823 East Main St., plans 800 ton rein.-con. coaling station, here. $40.000. H. Frazier, ch. engr.

Power Development—Logansport, Ind.—J. A. Shafer, 1008 Odd Fellows Bldg., plans power development, incl. dam, on Wabash River, 6 mi. below here. To exceed $25,000.

Retaining Wall — Chicago, Ill. — South Park Comrs., 57th St. and Cottage Grove Ave., retaining wall along approaches to 23rd St. viaduct, to B-W Constr. Co., 720 Cass St., $42,850. Noted Nov. 22.

Street Lighting—Cuba City, Wis.—Having plans prepared ornamental street lighting system, concrete posts, cable, etc., $25,000. J. A. Clark, 15 North 4th St., Minneapolis, Minn., engr. Noted Nov. 8.

Grain Elevator—Milwaukee, Wis.—I. C. Lyman, 93 Michigan St., plans to rebuild brick and concrete grain elevator, plain foundation, recently destroyed by fire. $100,000. Engineer and architect not selected.

Gas Distribution System — Coffeyville, Kan.—Plans election to vote on $500,000 bonds for gas production and distribution system. T. R. Marshall, city engr.

Lighting System—St. Joseph, Mo.—Election in January to vote on $500,000 bonds electric lighting system. W. K. Seitz, city engr. Noted Sept. 20.

Dock—South St. Louis (St. Louis P. O.) **Mo.**—Natl. Lead Co., International Life Bldg., St. Louis, plans terminal dock on Mississippi River, at Canary Plant, here. To exceed $25,000.

Rock Crushing Plant—Colusa, Calif.—Colusa Sand and Rock Co., having plans prepared gravel and rock crushing plant, incl. spur tracks. Will install rock crusher, compressors, storage bins, motors, transformers and will probably be in market for dragline excavator.

Golf Course — Pasadena, Calif. — City plans election to vote on $125,000 bonds for golf course.

Transmission Lines, etc.—Pasadena, Calif.—See "Industrial Works."

Ornamental Lighting System—San Fernando, Calif.—See "Streets and Roads."

Transmission Line — Quebec — Electric Service Corp., Power Bldg., Montreal, plans 4,400 volt transmission line in municipalities of St. Felix de Valois and St. Jean de Matha, distance of 7 miles.

BIDS DESIRED

Dike, etc.—Los Angeles, Calif.—Petroleum Export Co., 423 Pacific Electric Bldg., receiving bids 850 ft. rein.-con. dike, 8 ft. high; one 50 x 100 ft. and one 50 x 75 ft. steel and corrugated iron warehouses, etc.

Wharf — Pembroke, Ont. — Jan. 9, by Dept. Pub. Wks., Ottawa, reconstructing concrete bulkhead 689 ft. long, 100 ft. return wall, gravel fill, wharf slips, dredging basin and channel 70,000 cu.yd. sand, muck and clay, gravel road, moving existing warehouse, and old pilework wharf approach 1,120 ft. long. $100,000. K. M. Cameron, engr.

BIDS RECEIVED

Transmission Line, etc.—Brockton, Mass.—See "Industrial Works."

Heating and Ventilating Apparatus — Brooklyn, N. Y.—Bd. Educ., 500 Park Ave., New York, Dec 19, heating and ventilating apparatus, in P. S. 99, East 9th St. between Aves. K and L, here, from Gillis & Geoghegan, 537 West Bway., New York, $44,229; in P. S. 142, Rapelyea St., here, from D. J. Rice, 405 Lexington Ave., New York, $46,970. Noted Dec. 20.

Heating and Ventilating Apparatus — New York, N. Y.—Bd. Educ., 500 Park Ave., Dec. 19, heating and ventilating apparatus in P. S. 60, 12th St. and Ave. A, from Raisler Heating Co., 129 Amsterdam Ave., $98,765. Noted Dec. 20.

Pavilions—New York, N. Y.—Bellevue & Allied Hospital, 415 East 26th St., Dec. 20, general contract pavilions F and G of new Bellevue Hospital, from George A. Fuller Co., 949 Bway., $2,940,700; heating work, from T. F. Hall, Inc., 405 Lexington Ave., $260,716; plumbing, from T. E. O'Brien, Inc., 6311 5th Ave., Brooklyn, $448,000. Noted Nov. 29.

CONTRACTS AWARDED

Car Sheds—Wichita Falls, Tex.—Wichita Tract, concrete and brick car sheds, to C. M. Balkowski, Morgan Bldg., $40,000.

Tunnel — Niagara Falls, Ont. — Queen Victoria Park Comn., extending scenic tunnel under Horse Shoe Falls, here, to J. H. McKnight Co., 88 St. David St., Toronto, $36,000, also 2 concrete bridges at Dufferin Islands, to R. H. H. Blackwell, 86 Clinton Ave., Toronto, $21,000.

Materials and Equipment

PROPOSED WORK

Tractor—Utica, N. Y.—Park Bd. plans to purchase tractor caterpillar type. $5.000.

Road Machinery—Wisconsin—Following are county appropriations for road machinery during 1924. Sawyer Co., $4,000 incl. 3 light trucks, patrol graders, etc., E. J. Collett, Hayward, comr.; Outagamie Co. $20,000 incl. larger grader, small tools, etc., A. G. Brusewitz, Appleton, comr.; Waukesha Co. $27,500 incl. tractor and crushing outfit, C. J. Hahn, Waukesha, comr.; Ashland Co. $10,000, incl. 3 patrol graders, one 12 ft. blade with back sloper and ditcher.

Road Machinery—Arcadia, Fla.—De Sota Co. election Jan. 7, to vote on $10,000 bonds for road building machinery.

Structural Steel — Chicago, Ill. — Illinois Central R. R., 135 East 11th Pl., plans to purchase 350 tons structural steel for bridges. F. L. Thompson, ch. engr.

Road Machinery — Hudson, Wis. — St. Croix Co. appropriated $10,000 for road machinery, incl. patrol graders. J. Caffrey, Hammond, comr.

Road Machinery — Manitowoc, Wis. — Manitowoc Co. takes bids about Feb. 1, 2 motor trucks, 1 patrol tractor, 3 patrol graders, 1 heavy grader and 5 wheel scrapers. $25,000. J. Connell, highway comr.

Dragline Excavator—Colusa, Calif.—See "Unclassified."

BIDS DESIRED

Pipe, etc.—Phila. Pa.—Dec. 31, by T. F. Armstrong, purch. agt., 312 City Hall, furnishing lengths c.i. pipe, Class 112, 50,000 lbs. pig lead, Class 111, fire hydrants, Class 113, all foregoing for Water Bureau, 175,000 gal. fuel oil, Class 115, 6,500 cu.yd. asphalt, 2,500 tons crushed slag, 2,500 tons binder stone, Class 116, etc., for Bureau of Highways.

Dredge — Savannah, Ga. — Jan. 10, by Comrs. Chatham Co. and ex-officio judges, furnishing land dredge.

Tractor, etc.—Pass Christian, Miss.—Dec. 31, by Bd. Supervs. Harrison Co., Court House, one crawler type factor and one 7 ft. grader with needed attachments.

Gravel—Abbeville, La.—Jan. 2, by J. E. Broussard, pres. Police Jury Vermillion Parish, 13,000 cu.yd. washed gravel and 5,000 cu.yd. sand clay gravel, 40% metal retained on ¼ in. sieve.

Tractor and Shovel—Granite City, Ill.—F. J. Lewis Mfg. Co. in market for caterpillar tractor and shovel, complete outfit.

Cement—Wisconsin—Jan. 3, by State Hy. Comn., at Capitol Annex, Madison, 1,023,000 bbl. Portland cement for delivery during 1924. A. R. Hirst, state highway engr.

Clam Loader—Pittsburg, Kan.—Du Bois Constr. Co., in market for clam loader for handling cement, sand and crushed rock.

Crushed Stone—Houston, Tex.—Jan. 7, by Comrs. Court Harris Co., 10,000 tons crushed stone, 10,000 tons gravel, 5,000 cu. yd. shell for highway construction and repairs. $60,000. Howe & Wise, co. engrs.

Crushing plant, etc.—Salado, Tex.—L. Harrington & Co., engrs., Houston Bldg., San Antonio, receiving bids and opens same about Jan. 1, equipment for new crushing plant, incl. 75 hp. pumper, screens and bins, 300 yd. sand washer, 75-100 hp. boiler, bucket line probably 2 yd. size, hoisting engine and appurtenances, for Salado Gravel Co., Salado. Noted Dec. 20 under "Industrial Works."

Paving Mixer—Okmulgee, Okla.—J. E. Parks (contractor) receiving bids large steam concrete paving mixer.

BIDS RECEIVED

Pipe—Montreal, Que.—Furnishing 207 tons 20 in. and 71.5 tons 16 in. pipe for spring delivery and 535 tons 20 in., 266.1 tons 16 in. and 568.75 tons 30 in. pipe for winter delivery, from Kennedy & Co., 288 Beaver Hall Hill, $46.50 per ton.

CONTRACTS AWARDED

Inorganic Dust, etc.—Brooklyn, N. Y.—E. Riegelmann, boro pres., Boro Hall, 1,200 tons inorganic dust, to Limestone Products Corp. of America, 17 West 42nd St., New York, $6,420; 6,000 cu.yd. asphalt sand, to T. E. McCormick, 810 Lincoln Rd. Flatbush, $7,800; 2,500 cu.yd. gravel or broken stone, to Rosoff Sand & Gravel Corp., 162 West 42nd St., New York, $6,125. Noted Nov. 29.

Lumber—Atlantic, Ia.—Cass Co., furnishing 300,000 ft. bridge lumber and 17,000 ft. red cedar to Standard Bridge Co., City National Bank Bldg., Omaha, Neb., $27.22. Noted Nov. 22.

Lumber—Marengo, Ia.—Iowa Co., 240,000 ft. bridge lumber, to Wheeler Lumber St., Des Moines, $37. Noted Nov. 29.
Bridge and Supply Co., 200 Southwest 9th

Steel Bars, etc.—Mason City, Ia.—Cerro Gordo Co., 15 tons ⅝ in. round steel reinforcing bars and 3,024 ft. 12 in. corrugated metal culvert to Ft. Dodge Culvert and Steel Co., Ft. Dodge, $3.115 per cwt. Noted Nov. 29.

Plank and Piling—Onawa, Ia.—Monona Co., 5 cars full sawn fir bridge plank and 1 car cedar piling to Blencoe Farmers Elevator Co., Blencoe, plank $39.60, piling $41.60. Noted Nov. 29.

Bridge Material—Vinton, Ia.—Benton Co., 120,000 ft. No. 1 rough fir bridge lumber, to W. W. Saylor, Waverly, $39.

Crushed Rock, Gravel, etc. — Portland, Ore.—Furnishing crushed rock gravel, etc., (1) at contractors' bunkers (2) delivered at city paving plant to City Motor Trucking Co., 291 Hawthorne Ave., (1) 500 cu.yd. 3 in. and 600 cu.yd. 1 in. crushed rock $1.80, 100 cu.yd. 2 in. crushed gravel $1, 200 cu.yd. rock screenings $2, 200 cu.yd. concrete sand and 200 cu.yd. masons sand $1; (2) 500 cu.yd. 3 in. and 5,860 cu.yd. 1 in. crushed rock $1.75, 900 cu.yd. crushed gravel $1, 2,980 cu.yd. rock screenings $1.90, 800 cu.yd. concrete sand $0.90 and 7,780 cu.yd. masons sand $0.95.

Steel Pipe—San Bernardino, Calif.—Furnishing 6,000 lin.ft. 4 in. and 5,000 lin.ft. 3 in. wrought steel pipe to Mark-Lally Co., 2nd and Clementina Sts., San Francisco, $51 and $31.10 respectively.

SEARCHLIGHT SECTION

OFFICIAL PROPOSALS

Copy: Official Proposals reaching our New York Office by 10 A. M., Tuesday can usually be printed in the issue out Thursday.

Rate:
40 Cents a Line an Insertion

Plans and Specifications for inspection by distant bidders may be filed at any of the Engineering News-Record offices without charge.

THESE ARE OFFICIAL NOTICES THAT BIDS ARE WANTED FROM BIDDERS EVERYWHERE

E.N.-R.

OFFICIAL PROPOSALS

Bids: Jan. 15.

Municipal Water Supply Improvement

Oklahoma City, Okla.

Sealed bids will be received by M. Peshek, Jr., City Clerk of the City of Oklahoma City, Oklahoma, up to 12.00 o'clock noon, Tuesday, January 15th, 1924, and a duplicate of each bid must be filed with the City Auditor of the said city, and will be opened and considered by the Board of Commissioners at 2.00 o'clock p.m., Tuesday, January 15th, 1924, for the construction of the following work for the improvement to the municipal water supply for the City of Oklahoma City, Oklahoma:

Section A—1—Ambursen Const. Co. plan —Main Dam Extension.
Section A—2—Ambursen Const. Co. plan —Intake.
Section A—3—Ambursen Const. Co. plan —Gates and Operating Mechanism, Main Dam Extension.
Section A—4—Ambursen Const. Co. plan —Steel Flashboards and Operating Mechanism—Intake.
Section B—1—V. V. Long & Co. plan—Main Dam Extension.
Section B—2—V. V. Long & Co. plan—Intake.
Section B—3—V. V. Long & Co. plan—Structural Steel Crest, Intake.
Section C—1—Callahan Const. Co. plan—Main Dam Extension.
Section C—2—Callahan Const. Co. plan—Intake.
Section C—3—Callahan Const. Co. plan—Gates and Operating Mechanism—Main Dam Extension.
Section C—4—Callahan Const. Co. plan—Gates and Operating Mechanism, Intake.
Section D—1—Holway Engr. Co. plan—Main Dam Extension.
Section D—2—Holway Engr. Co. plan—Intake.
Setion D—3—Holway Engr. Co. plan—Gates and Operating Mechanism—Main Dam Extension.
Section D—4—Holway Engr. Co. plan—Gates and Operating Mechanism—Intake.

Bids will be considered on each Section separately, and contractors may bid on any or all sections. All of the necessary work and materials used shall be in strict accordance with the plans and specifications therefor, now on file in the office of the City Clerk.

Each bidder shall accompany his bid with a sworn statement in writing that the bidder had not directly nor indirectly made any agreement, express or implied, with any other bidder or bidders, having for its object the controlling of the price or amount of such bid or bids, the limiting of the bidder or bidders, the parceling or farming out to any bidder or bidders, or other persons, of any part of the contract, or any part of the subject matter of the bid or of the profits thereof, and has no knowledge of the amount, kind or character of any bid to be made by any other person, firm or corporation, except those submitted and filed by him.

The bid or bids filed with the City Clerk must be accompanied by a certified check on any national bank, in the sum of at least five (5%) per cent of the amount of the bid or bids.

It being further understood that the amount of damages which the City would suffer would be impracticable to determine and extremely difficult to fix in case the successful bidder should fail to enter into a contract and give the required bonds within the required time, it is therefore understood that by the filing of a bid or bids it will be considered as agreed that the amount of damages which the City would suffer by reason of such failure on the part of said successful bidder is the amount represented by the check or checks so filed by the successful bidder, and that the City shall have the authority to appropriate such checks for its own use and benefit in payment for such damages.

Each bidder shall agree to enter into a contract and furnish the required bonds within ten (10) days after the acceptance of his bid, and shall state in his bid when he will begin the work and when he will complete the same.

The contractor will be required to give bond in the sum of twenty-five (25%) per cent of the contract price for faithful performance of the work, and all other bonds that are required by the laws of the State of Oklahoma or the ordinances of said City, and to give bond to hold the City harmless from any and all damages for which the City might be liable under the law, and which might occur by reason of any act upon the part of the said contractor or of any of his employees.

A deposit of fifty ($50.00) dollars will be required for each set of plans and specifications. Such deposit will be refunded upon the return of the plans and specifications in good condition within 10 days after the bids are opened.

Each bidder is hereby notified that the Ambursen Co. plans, the V. V. Long & Co. plans, the Callahan Const. Co. plans and the Holway Engr. Co. plans are different plans for the same construction work and the City reserves the right to finally adopt for said work any one plan or any part of any plan.

The Board of Commissioners further reserves the right to reject any or all bids.

M. PESHEK, JR.,
City Clerk.

Bids, Jan. 8

Fire Escapes

Sonyea, N. Y.

Sealed proposals for Construction—Fire Escapes, at Craig Colony, Sonyea, N. Y., will be received by Mr. Percy L. Lang, President, Board of Managers, Craig Colony, Sonyea, N. Y., until 2 o'clock p.m. on Tuesday, January 8, 1924, when they will be publicly opened and read. Proposal shall be enclosed in an envelope furnished by the State Architect, sealed and addressed and shall be accompanied by a deposit consisting of a certified check drawn upon some legally incorporated bank in this State and made payable to the State of New York, or money, equal to five per cent (5%) of the amount of the proposal. The contractor to whom the award is made will be required to furnish surety company bond in the sum of fifty per cent (50%) of the amount of contract within thirty (30) days after official notice of award of contract and in accordance with the terms of Specification No. 4182. The right is reserved to reject any or all bids. Drawings and specifications may be examined at Craig Colony, Sonyea, N. Y., at the Department of Architecture, 18th Floor, Fuller Bldg., Broadway and 23rd Street, and at the Department of Architecture, Capitol, Albany, N. Y. Drawings, specifications and blank forms of proposal may be obtained at the Department of Architecture, Capitol, Albany, N. Y., upon reasonable notice to and in the discretion of the State Architect, Sullivan W. Jones, Capitol, Albany, N. Y.

Dated: December 13, 1923.

OFFICIAL PROPOSALS

Bids: Jan. 18.

Dredging

ENGINEERING DEPARTMENT
PARISH OF CALCASIEU, LOUISIANA

Lake Charles, La.

December 15th, 1923.

Sealed bids will be received by the Police Jury of the Parish of Calcasieu, Louisiana, until noon, Friday, January 18th, 1924, in the Police Jury Room, Court House, Lake Charles, Louisiana, and then and there publicly opened, for the construction of a Navigation Channel 30 feet deep by 125 feet wide at the bottom, from Lake Charles to the Sabine River.

SECTION 3

The construction of a channel 30 feet deep and 125 feet wide at the bottom, from Station 714, East along the Intracoastal Canal, to Station 580. A distance of 2.54 miles. Approximately 2,020,000 cubic yards of earth to be moved.

This work is along the present Intracoastal Canal, which on this section, is 6 feet deep and 40 feet wide on the bottom. The Atlantic, Gulf and Pacific Dredging Company have a contract with the War Department to deepen and widen this part of the Intracoastal Canal to 12 by 90 feet; their dredge "TEXAS" is working about Station 750 at present, and will pass Station 714 going East between January 1st and 10th. From Station 714, East to Station 680, the land is marsh, elevation +1.0 to +2.0. The Gum Cove Ridge lies between Station 680 and 580, elevation +2.0 to +12.0. Average stage of water +1.2. All depths and elevations refer to Mean Low Gulf Datum.

SECTION 5

The construction of a channel 30 feet deep and 125 feet wide at the bottom, from Station 58 on the Intracoastal Canal, West to Station 322. A distance of 5 miles. Approximately 3,480,000 cubic yards of earth to be moved.

This work is along the present Intracoastal Canal, which has been deepened and widened from Station 58 to 120, to 12 feet deep by 90 feet wide on the bottom. From Station 120 to 322 the Canal is 6 feet deep by 40 feet wide on the bottom, with a Pilot cut from Station 176 to 322, 12 feet deep by 40 feet wide on the bottom, along the South side of the old ditch: The Government Dredge "BLACKWATER" is at present at Station 120 working West completing the Canal to 12 feet depth and 90 feet width. The Blackwater will probably pass Station 176 about February 1st. From Station 58 to 90 is a low Ridge; Elevation +2.0 to +7.0; from Station 90 to Station 322 is a Black Grass Marsh, with knolls; Elevation +1.0 to +3.0. Average stage of water +1.2. All elevations and depths refer to Mean Low Gulf Datum.

Every bid shall be accompanied by a certified check in an amount equal to five per cent (5%) of the amount of the bid, payable to the Treasurer of Calcasieu Parish, which check shall be forfeited to the Parish should the bidder to whom such contract is awarded fail to enter into the contract required within ten (10) days after notice to do so from the Police Jury of Calcasieu Parish.

The Police Jury reserves the right to reject any or all bids.

V. R. REEVES,
President, Police Jury.
FRED SHUTTS,
Parish Engineer.

OFFICIAL PROPOSALS

Bids: Jan. 17.

Excavation and Rock Protection

STATE OF NEW YORK
DEPARTMENT OF PUBLIC WORKS
BUREAU OF CANALS

Albany, N. Y.,
December 13, 1923.

Sealed proposals will be received by the undersigned at his office in Albany, N. Y., until twelve o'clock noon of Thursday, January 17th, 1924, at which place and hour they will be publicly opened and read, for improving the New York State canals pursuant to the provisions of Chapter 147 of the Laws of 1903, and of the acts amendatory thereof and supplementary thereto, and Chapter 570 of the Laws of 1915, as follows:

CONTRACT NO. 214.

Erie Canal—Section 9.

For completing the excavation of the canal channel in the Genesee river at Rochester and placing rock spoil protection along the river banks.

Sheets 1 to 3, inclusive.

Plans may be seen, and detailed specifications, engineers' estimates of quantities, proposal blanks, form of contract and bonds required and other information for proposers may be had at the office of the Bureau of Canals, Albany, N. Y.; at the office of the Division Engineer, Department of Public Works, at Utica, Syracuse, Rochester and Buffalo; and at the Terminal Warehouse, Pier 6, East River, New York City.

Blueprint copies of plans will be furnished by the State Engineer and Surveyor upon the receipt at his office in the Telephone Building, Albany, N. Y., of payment at the rate of fifteen cents (15c.) per sheet. Refund will not be made for any blueprints which may be returned.

Monthly estimates will be paid of ninety per centum (90 per cent) of the work done at the contract price. Every proposal for said work must be accomplished by a money deposit in the form of a draft or certified check upon some good banking institution in the city of Albany or New York, issued by a national or state bank, in good credit within the State and payable at sight to the Commissioner of Canals and Waterways for five per centum (5 per cent) of the amount of the proposal.

The person whose proposal shall be accepted will be required to execute a contract and furnish bonds within ten days from the date of notice of award delivered to him or them in person or mailed to the address given in the proposal.

Upon execution of the contract and approval of bonds the certified check or draft will be returned to the proposer unless the same shall have been presented for collection prior to such time in which case the amount of the deposit will be refunded by the Commissioner of Canals and Waterways.

The deposits of bidders other than the one to whom the award of contract shall be made will be returned immediately after the award has been made.

The bond required for the faithful performance of the contract shall be in such sum as shall be fixed by the Commissioner of Canals and Waterways, which sum shall not be less than twenty per centum (20 per cent) of the estimated cost of the work, according to the contract price, and an additional bond known as the labor bond, in the sum of ten per centum (10 per cent) of the amount of the estimated cost of the work according to the contract price, will be required as security that the contractor will pay in full at least once in each month all laborers employed by him upon the work specified to be done in the contract.

In the event that more than one surety company is offered as surety on said bonds co-insurance only will be accepted.

Each proposal must be addressed to the Bureau of Canals, State Department of Public Works, Albany, N. Y., and must be endorsed on the envelope with the name of the construction for which the proposal is made.

Award, if made, will be made to the person or persons whose proposal shall be lowest in cost to the State for doing the work, and which shall comply with all provisions required to render it formal. Before any award shall be made the lowest bidder will be required to satisfy the Commissioner of Canals and Waterways of his ability to provide suitable equipment and materials for the proper performance of the work.

The right is reserved to reject all proposals and readvertise and award the contract in the regular manner if, in the judgment of the undersigned, the interests of the State will be enhanced thereby.

ROYAL K. FULLER,
Commissioner of Canals
and Waterways.

Bids: Jan. 3.

Railroad Siding, Relocating Electric Railroad and Bridge

Kansas City, Mo.

Sealed proposals will be received by the Purchasing Agent of Kansas City, Missouri, at the office of the Purchasing Agent, Second Floor, City Hall, until 2 oclock p.m., January 3, 1924, for furnishing the labor and materials for the grading for a railroad siding about three-fourths of a mile long, and a relocated electric railroad and highway about four-fifths of a mile long including a reinforced concrete highway bridge, span 16 feet, width 18 feet, located just north of North Kansas City. The proposals shall be in accordance with drawings and specifications on file in the office of the Board of Fire and Water Commissioners of Kansas City, Missouri, of Fuller and Maitland, Engineers for the Board of Fire and Water Commissioners, 600 Walnut Street, Kansas City, Missouri, and of Fuller and McClintock, 170 Broadway, New York City. Copies of the drawings and specifications may be obtained from Fuller and Maitland, 600 Walnut Street, Kansas City, Missouri, upon the deposit of $10.00 for each set, which deposit will be refunded provided the drawings and specifications are returned in good condition within 30 days after bids are received.

Each bidder shall deposit with the City Comptroller a certified check on a solvent bank or trust company in the amount of five thousand dollars ($5,000), payable to the City Comptroller of Kansas City, Missouri, and accompany his bid with the Comptroller's receipt therefor. The said certified check is required as a guarantee that the bidder will, within ten (10) days after receiving the award of the contract, file with the City a satisfactory bond to the amount of fifty per cent of the bid price, and will execute the contract.

The Board of Fire and Water Commissioners does not bind itself to accept the lowest or any bid offered, and reserves the right to reject any or all bids, and to waive any irregularity or informality in the bids.

MARTY H. RAMING,
Purchasing Agent.

FULLER AND MAITLAND,
Engineers.

By Authority of the Board of Fire and Water Commissioners.

Bids: Feb. 4, 1924.

University Buildings

Urbana, Ill.

Sealed proposals for General Work on four buildings to be erected for the University of Illinois in Urbana, Illinois, will be received at the office of James M. White, Supervising Architect, 256 Administration Building, Urbana, up to 2:00 p.m., Monday, February 4, 1924.

Bidders interested should write the Supervising Architect immediately for information as to type and size of buildings and dates when plans will be available.

OFFICIAL PROPOSALS

Bids: Jan. 3.

Sewer Construction

McKenzie, Tenn.

Sealed bids for the construction of a vitrified pipe sewer system and settling tanks for the City of McKenzie will be received by the Mayor and City Council at the office of H. C. Bryant, City Clerk until 2 p.m., January 3, 1924, at which time and place they will be opened and publicly read.

The approximate quantities are as follows:

38,506 Lineal feet 8" Sewers
4,620 Lineal feet 10" Sewers
900 Lineal feet 12" Sewers
1,650 Lineal feet 15" Sewers
134 Manholes
12 Flush Tanks
588 Lineal feet vertical risers
2 Reinforced concrete settling tanks

Plans and specifications may be examined at the office of H. C. Bryant, City Clerk, at McKenzie, or at the office of the Engineer, or a copy may be obtained from the Engineer upon receipt of a deposit of $15.00, of which amount $10.00 will be refunded when the plans and specifications are returned in good condition. If additional information is required, address the Engineer.

The right is reserved to reject any and all proposals and to waive informalities. The contractor will be paid cash on monthly estimates amounting to 85% of the work done.

All proposals and bids must be accompanied by a certified check drawn on a responsible bank or trust company, and made payable to H. C. Bryant, City Clerk, for a sum of not less than 5% of the amount of the proposal; or a bidders bond for the same amount by a surety company authorized to do business in the State of Tennessee, will be accepted. The successful bidders will be required to furnish a performance bond in the sum of 50% of the contract price.

December, 1923.

H. C. BRYANT,
City Clerk.

B. H. KLYCE, Engineer,
506 4th and 1st Natl. Bank Bldg.,
Nashville, Tenn.

Bids: Jan. 19.

Pipe Line, Tunnel, Dam, Etc.

Charlottesville, Va.

Sealed proposals will be received by the City Manager at his office, Charlottesville, Va., until 11 o'clock a.m., January 19th, 1924, for the construction of approximately 12 miles of 18 inch Cast Iron Pipe Line and 700 lineal feet of 4 x 6 Tunnel, a Diversion Dam, Grit Chamber and Regulating works. Pipe and Specials will be furnished by the City of Charlottesville, f.o.b. cars. Plans and Specifications can be seen on or after January 1, 1924, at the office of the City Manager, Charlottesville, Va., and at the offices of the Engineers, Fuller and McClintock, 170 Broadway, New York City, or Lee H. Williamson, National Bank Building, Charlottesville, Va. Proposal blanks will be forwarded upon application to the City Manager. Construction Bond to the amount of the contract will be required and each proposal must be accompanied by a certified check for $10,000.00.

Arrangements for inspection of the line can be made at the office of Lee H. Williamson, National Bank Building, Charlottesville, Va.

The right is reserved by the City Manager to reject any or all bids.

BOYD A. BENNETT,
City Manager.
City of Charlottesville, Va.

OFFICIAL PROPOSALS

Bids: Jan. 15.

Construction of Flood Control Works

OFFICE OF THE BOARD OF DIRECTORS THE PUEBLO CONSERVANCY DISTRICT

Pueblo, Colo.

Dec. 17, 1923.

Sealed proposals will be received by The Pueblo Conservancy District, Pueblo, Colorado, until 2 o'clock, p.m., on Tuesday, January fifteen, 1924, for the construction of a relocated river channel and the relocation of 35 miles of railroad yard tracks in Pueblo, also a barrier dam 6 miles west of Pueblo, involving approximately the following principal quantities divided into contracts as follows:

No. 1. Channel Excavation above Santa Fe avenue; material used in Railroad Yard and Levee Fills.
Upper railroad fill.........464,000 Cu.Yds.
Lower railroad fill .... 90,000 Cu.Yds.
Levees ....486,500 Cu.Yds.

No. 2. Concrete Levee Paving.
Steel sheet piling ....74,400 Sq.Ft.
Concrete slab revetment ....26,600 Cu.Yds.

No. 3. Railroad Track Construction below Dry Creek Bridge.
Track laying and surfacing ......26.47 Mi.
Alterations to tracks............. 3.53 Mi.
(Rails and ties to be furnished to Contractor.)

No. 4. Channel Excavation, below Santa Fe avenue, 64,000 Cu.Yds.

No. 6. Concrete Intake Structure, Reinforced concrete, 350 Cu.Yds., Reinforced concrete pipe, 48" Diam., 808 lin.ft.

No. 7. Retaining walls in Levee at Round House and at Union Depot, concrete, 1,986 Cu.Yds.

No. 8. Dyke below Santa Fe avenue, 6,000 Cu.Yds.

No. 9. Dykes at Dry Creek. 26,000 Cu. Yds.

No. 10. Dykes at North Side Water Works Reservoirs, 55,000 Cu.Yds.

No. 12. Railroad Track Removal, Removing and storing track materials, 32 miles.

No. 13. Railroad Embankment above Dry Creek. Embankment, 130,000 Cu.Yds.; Riprap, 1,600 Cu.Yds.

No. 14. Railroad Track Construction above Dry Creek. Track laying and surfacing, 3.86 miles. (Rail and ties to be furnished to Contractor.)

No. 17. Concrete Culvert, North Side Water Works. Reinforced concrete, 139 Cu.Yds.; Timber flume, 60 MBM.

No. 18. Concrete Culvert, South Side Water Works. Reinforced concrete, 64 Cu. Yds.; Timber flume, 16 MBM.

No. 21. Upper Railroad Bridge, Substructure; concrete, 2,000 Cu.Yds.

No. 22a. Upper Railroad Bridge, Superstructure, 4-100 foot double track, through riveted truss spans. Structural steel, fabrication and delivery, 1,750,000 lbs.

No. 22b. Upper Railroad Bridge, Superstructure. 4-100 foot double track through riveted truss spans Structural steel, erection, 1,750,000 lbs. Deck timber, 80 MBM.

No. 23. Concrete Railroad Bridge at Dry Creek, Reinforced concrete through girders. Reinforced concrete, 4,800 Cu.Yds.

No. 30. Lower Railroad Bridge, Substructure. Concrete, 2,920 Cu.Yds.

No. 31a. Lower Railroad Bridge, Superstructure. 2-200 foot double track through riveted truss spans, skewed. Structural steel, fabrication and delivery, 2,500,000 lbs.

No. 31b. Lower Railroad Bridge, Superstructure. Structural steel, erection, 2,-600,000 lbs.; deck timbers, 80 MBM.

No. 32. Santa Fe Avenue Highway Bridge, Substructure. Concrete, 325 Cu.Yds.; Steel tubes for cylinder piers, 4.

No. 33a. Santa Fe Avenue Highway Bridge, Superstructure, 1-280 foot through riveted highway span. Structural steel, fabrication and delivery, 615,000 lbs.

No. 33b. Santa Fe Avenue Highway Bridge, Superstructure. Structural steel, erection, 615,000 lbs.; Deck timber, 50 MBM.

No. 34. Rock Canyon Barrier, Embankment. Earth fill, 90,000 Cu.Yds.

No. 35. Rock Canyon Barrier, Concrete. Plain concrete, 5,000 Cu.Yds.; Reinforced concrete, 7,328 Cu.Yds., which works are a part of the system of flood control and stream elimination for The Pueblo Conservancy District, to be carried out under authority of The Conservancy Act of Colorado, and are in accordance with the Official Plan of the District.

The contracts will include, in addition to the principal quantities given, incidental work, such as excavation, backfill, track material, etc. Cement reinforcing steel and track material will be furnished to the Contractor. Other contracts necessary for the completion of the project have been deferred.

Proposals must be on the blank forms furnished by the Board, and must be accompanied by a certified check for not less than 6 per cent of the aggregate amount of the bid, figured on the basis of the estimated quantities and the unit prices bid, but which in no case shall be less than $1,000 or need be more than $50,000, such check to be drawn to the order of The Pueblo Conservancy District, as a guarantee that the bidder, if awarded a contract, will, within 15 days after the contract is delivered to him for that purpose, execute the same and furnish surety bond for the faithful performance of the contract in the sum of 65 per cent of the contract price; said contract and bond to be on the standard forms adopted by the Board. A bidder submitting alternative bids may furnish a single certified check covering the largest amount required by any alternative.

If any bidder, to whom an award has been made, shall fail to execute the contract or to furnish satisfactory bond within the time hereinbefore specified, or as extended by the Board, the award shall thereupon become void, in which case the proceeds of the certified check shall become the property of the District, and the contract may be awarded to the next lowest or best bidder; and such next lowest or best bidder shall thereupon assume the contract, as if he were the party to whom the award was first made.

Each bidder must, in his proposal, present satisfactory evidence that he has been engaged in constructing works of the general character covered by his proposal, and that he is fully prepared, and has the necessary capital, to begin the work promptly, and to conduct it as required by the contract and specifications.

The right is reserved to reject any or all bids, and to waive any technical defects, as the interests of the District may require.

Drawings, specifications, proposal blanks, and other information may be obtained on application to the Chief Engineer, The Pueblo Conservancy District, Pueblo, Colorado, at whose office drawings, borings and other data may be inspected This information is now on file for examination and will be ready for mailing on or before January first. Specifications, drawings, sample blank forms and proposal forms covering any one contract will be furnished for $1.00, or all contracts for $15.00.

Bids should be sealed and marked "Bid on Pueblo Conservancy Contract," and inclosed in an envelope addressed to Chas. W. Lee, Room 740, First National Bank Bldg., Pueblo, Colorado, or presented in person at the time of the letting. Bids will be opened by the Board, in the Council Chamber, at the City Hall, Pueblo, at 2 p.m., Tuesday, January 15, 1924.

Done this 17th day of December, 1923, at Pueblo, Colorado, pursuant to resolution of the Board of Directors of The Pueblo Conservancy District.

E. D. SPRUILL,
Secretary.

Bids: Jan. 16.

(READVERTISEMENT)

Delaware River Bridge

CONTRACTS NOS. 9A, 9B, 9D, 10A & 10B DEMOLITION

Philadelphia, Pa.

Sealed proposals for the demolition and removal of the buildings on the site of the Philadelphia approach between Front Street and Third Street, and between Fourth Street and Sixth Street, and the buildings on the site of the Camden Approach between Delaware Avenue and Fourth Street, will be received by the Delaware River Bridge Joint Commission at Room 806, Widener Building, Philadelphia, Pa., until 2:30 o'clock p.m., January 16, 1924, when they will be publicly opened and read. The contracts will be awarded, or all bids rejected, within fourteen days after bids are opened. The right is reserved to reject any or all bids.

Separate bids are asked for each of three sections of the Philadelphia Approach, and each of two sections of the Camden Approach. The work includes the demolition and removal of structures and certain other work incidental thereto. The work under Contracts 9A, 9B, 10A and 10B, is to be completed in three months, and that under 9D in six months.

Bids must be made upon the blank proposal forms, which together with specifications, bond and contract form, and contract drawings, may be obtained at the office of the Joint Commission, upon deposit of $10.00, which deposit will be refunded upon receipt of bid or upon the return in good condition of the copies so taken.

Each proposal must be accompanied by a certified check for Three Thousand Dollars, drawn upon a national or state bank or trust company having an office either in Philadelphia or Camden, and payable to the Delaware River Bridge Joint Commission, and surety's consent must be shown. The bidder or bidders to whom the contract for each section is awarded will be required to give bond in the sum of fifty per cent of the amount of such contract, but not less than $25,000.

Delaware River Bridge Joint Commission.
GIFFORD PINCHOT,
Chairman.
JOSEPH K. COSTELLO,
Secretary.

Bids Jan. 29.

Street Paving

Baton Rouge, La.

Sealed bids will be received by the Commission Council, Baton Rouge, La., until 11:00 A.M., Jan. 29th, 1924, for paving sixteen streets. Bids will be received upon Asphaltic Concrete, Brick, Sheet Asphalt, and Warrenite Bitulithic, all on concrete base.

Approximate Quantities:
102,269 sq.yds. surfacing and base.
20,311 lin.ft. straight curb and gutter.
3,327 lin.ft. header curb.
585 lin.ft. circular curb and gutter.
3,970 lin.ft. drain pipe, 10 inch.
2,945 lin.ft. drain pipe, 12 inch.
150 lin.ft. drain pipe, 15 inch.
140 lin.ft. drain pipe, 18 inch.
56 catch basins.
3 manholes.
2,180 lin.ft. stone header.
27,680 cu.yds. excavation.

Plans and specifications are on file in the office of the Consulting Engineer, City Hall, Baton Rouge, La. Copies may be had upon payment of fifteen dollars, which will not be returned.

A certified check, or bidder's bond, for 5% of amount bid, payable to the Commissioner of Finance, City of Baton Rouge, must accompany each bid. The right is reserved to reject any and all bids

J. W. BILLINGSLEY,
Consulting Engineer.

OFFICIAL PROPOSALS

Bids: Jan. 10.

Land Dredge

OFFICE OF THE COMMISSIONERS OF CHATHAM COUNTY AND EX-OFFICIO JUDGES

Savannah, Georgia.
December 13, 1923.

Sealed proposals will be received by the Commissioners of Chatham County and ex-officio Judges until the 10th day of January, 1924, at 12:30 o'clock p.m., and publicly opened by them at their office at that time for furnishing the County with One (1) Internal Combustion Land Dredge equipped with not more than three-quarter cubic yards capacity bucket, operated by at least fifty horse power Internal Combustion Engine. The machinery must be so designed as to dig new ditches and also to clean out those already dug.

Bidders will be required to submit with their bids specifications to the minutest detail of the machinery they propose to furnish, giving full weight of machine, length of boom, turning radius, compression per square inch on Caterpillar Tractors, and the total load on hoisting cable at different elevations of the boom, with guarantee of cost of operation, etc., and must also state at what place similar machinery to that bid on is in operation.

Proposals must be accompanied by a certified check, money deposit or bidder's liability bond, payable to the Commissioners of Chatham County, in an amount equal to 5 per cent of the amount of the total bid, to insure the succesful contractor delivering the machinery bid on and at the time he agreed to deliver the same.

TIME OF PAYMENT: The successful bidder will be paid on the 15th of the following month after delivery and acceptance of the machinery by the County Commissioners, by a warrant on the County Treasurer to be paid when in funds. Said warrent when presented to and stamped by the County Treasurer will bear interest at the rate of 7 per cent from the time of said presentation and stamping until paid.

The right is reserved to reject any or all bids and to waive all formalities.

By order of:
COMMISSIONERS OF CHATHAM COUNTY AND EX-OFFICIO JUDGES.
G. REUBEN BUTLER,
Clerk. (L. S.)

Bids: Feb. 5.

Sewers

Baton Rouge, La.

Sealed bids will be received by the Commission Council of Baton Rouge, La., at the City Hall, until 11:00 A.M., Feb. 5th, 1924, for constructing certain Sanitary Sewers and appurtenances in the City of Baton Rouge.

Approximate Quantities:
2,100 lin.ft. 10 inch V. C. Pipe.
2,500 lin.ft. 24 inch V. C. Pipe.
520 lin.ft. 36 inch Cast Iron Pipe through levee.
17 Manholes.

Plans and specifications on file in the office of the Consulting Engineer, City Hall, Baton Rouge. Copies may be had upon payment of $7.50, which will not be returned.

A certified check, or bidder's bond, for $2,000.00, payable to the Commissioner of Finance, Baton Rouge, must accompany each bid. The right is reserved to reject any or all bids.

J. W. BILLINGSLEY,
Consulting Engineer.

Bids: Jan. 14.

Filtration Plant

North East, Pa.

Sealed proposals will be received up to eight o'clock p.m., Monday, January 14, 1924, at the Council Rooms of the Borough of North East, Pa., for the construction of a rapid sand filtration plant, complete, consisting of two units of a capacity of 600,000 gallons daily. Plans and specifications may be seen at the office of the Boro Engineer or of the Boro Secretary. A deposit of $10.00 will be required for each set of plans given out, to be refunded when contract is awarded and plans returned. All bids must be accompanied by a certified check for 5 per cent of the amount of bid and the right to reject any or all bids is reserved.

J. N. LEET,
Secretary.

OFFICIAL PROPOSALS

Bids: Jan. 17.

Double-Deck Bridge and Approach

New Orleans, La.

Sealed proposals will be received by the Board of Commissioners of the Port of New Orleans, at their office, Suite 200, New Court Building, until 3:00 P.M., Thursday, January 17, 1924, and then publicly opened for contracts in connection with the construction of a double-deck bridge and approach span, containing about 213 tons of structural steel, operating machinery and trim, for the ferry landing at the foot of Canal Street, New Orleans, La., as follows:

Requisition E. D. 14393—Under one contract.

Furnishing structural steel for ferry bridge with or without erection of bridge, of machinery and of trim.

Requisition E. D. 14394—Under one contract.

Erection of ferry bridge, of machinery and of trim.

Requisition E. D. 14395—Under one contract.

Furnishing ferry bridge machinery.

A deposit of $1,000 in cash or certified check is required with the proposal to cover the first requisition and $400 in cash or certified check with each of the other proposals.

A bond to the amount of fifty per cent (50%) of the sum bid will be required with each notarial contract signed.

Specifications and proposal forms are on file in the office of the Supervisor of Purchases, at No. 1 Canal Street, New Orleans, Louisiana. Complete sets for each proposal will be furnished to prospective bidders on deposit of $10 for each set, which will be refunded to depositors who submit proposals or return sets in good condition.

The right is reserved to reject any or all bids and to waive informalities.

J. H. WALSH,
General Manager.

Bids: Jan. 30.

42 in.—48 in. and 60 in. Intercepting Sewers, Sewage Pumps, and Sewage Disposal Plant Improvements

Fostoria, Ohio.
December 24th, 1923.

Sealed proposals for the construction of 42" 48" and 60" Intercepting Sewers and Pumping Machinery, Superstructures, Grit Chamber, Sludge Beds, and other improvements to the Sewage Disposal Plant, will be received by the City of Fostoria, Ohio, until 12 o'clock p.m., Eastern Standard Time, on the 30th day of January, 1924, and will then be publicly opened and read.

Official Proposal Blanks, Instructions to Bidders, Specifications, Form of Contract and Bond may be seen at the office of the Director of Public Service, Fostoria, Ohio, or one (1) copy of plans and specifications may be obtained by bona fide bidders upon application to The J. N. Chester Engineers, Union Bank Building, Pittsburgh, Pa., or to the City of Fostoria, Ohio, and deposit of Twenty-five Dollars ($25.00), which amount will be refunded to bidders on receipt of a bona fide bid, or upon the return within thirty (30) days after receipt of bids, of both plans and specifications, in good order.

The right is reserved to reject any or all bids.

JAMES MANECKS,
Director of Public Service.
THE J. N. CHESTER ENGINEERS,
Union Bank Building,
Pittsburgh, Pa.

Bids: Jan. 11.

Viaduct and Retaining Wall

Seattle, Wash.

Sealed proposals will be received by The Seattle Board of Public Works up to 10 o'clock a.m., January 11th, 1924, for the construction of a concrete viaduct and retaining wall on West Spokane Street. Approximately 2400 cubic yards excavation, 4600 cubic yards concrete and 650,000 pounds reinforcing steel will be used with all necessary drainage and lighting.

Plans and specifications may be obtained of the City Engineer upon the payment of $10, which will be refunded if the plans are returned in good condition.

J. D. BLACKWELL, City Engineer.

OFFICIAL PROPOSALS

Bids: Jan. 24.

Storm Drainage

Baton Rouge, La.

Sealed bids will be received by the Commission Council of Baton Rouge, La., at the City Hall, until 11:00 A.M., Jan. 24, 1924, for constructing certain storm drains in the City of Baton Rouge. The work will be let in three contracts, the Goose Hollow, Saint Philip, and Roseland Terrace Canals.

Combined Approximate Quantities:
4,250 cu.yds. Class "A" Concrete.
384,000 lbs. Reinforcing Steel.
650 lin.ft. Pipe.
16 Manholes.

Plans and specifications are on file in the office of the Consulting Engineer, City Hall, Baton Rouge, La. Copies may be had upon payment of ten dollars, which will not be returned.

A certified check, or bidder's bond, for five thousand dollars, payable to the Commissioner of Finance, City of Baton Rouge, must accompany each bid. The right is reserved to reject any and all bids.

J. W. BILLINGSLEY,
Consulting Engineer.

Bids: Jan. 10.

Water Main

Norfolk, Va.

Sealed proposals for relaying a 16-inch water main will be received at the office of the Director of Public Works, Norfolk, Virginia, until 12 o'clock noon, January 10, 1924, at which time and place they will be publicly opened.

The work includes taking up 22,000 feet of a present 16-inch main, hauling to the new location, and relaying same, together with necessary valves, hydrants and fittings, with cross-connections to small existing mains.

Plans, specifications, form of proposal, contract and bond may be obtained at the above office upon deposit of $10.00, which will be refunded when plans and forms are returned.

A certified check on a Norfolk or other acceptable bank in the sum of Five Hundred ($500.00) must accompany each bid. The right to reject any or all bids is reserved.

WALTER H. TAYLOR, 3RD,
Director of Public Works.

U. S. GOVERNMENT

U. S. ENGINEER OFFICE, Milwaukee, Wis. Sealed proposals will be received here until 3 p.m., Jan. 16, 1924, and then opened, for constructing steel dump scows and barge. Further information on application.

U. S. ENGINEER OFFICE, 250 Old Land Office Building, Washington, D. C. Sealed proposals will be received here until 12 M. January 15, 1924, and then opened, for the construction of the Filtration Plant and Pumping Station substructures for the District of Columbia water supply project. Further information on application.

U. S. ENGINEER OFFICE, P. O. Box 72, Louisville, Ky. Sealed proposals will be received here until 2 p.m., central time, Jan. 3, 1924, and then opened, for furnishing, delivering and erecting gates for Lock No. 45, Ohio River. Further information on application.

U. S. ENGINEER OFFICE, P. O. Box 72, Louisville, Ky. Sealed proposals will be received here until 2 p.m., central time, December 29, 1923, and then opened, for furnishing and delivering Metal Work for Dams Nos. 44 and 45, Ohio River. Further information on application.

U. S. ENGINEER OFFICE, Cincinnati, Ohio. Sealed proposals for furnishing, delivering and erecting gates for Lock No. 34, Ohio River, will be received here until 11 a.m. January 19, 1924, and then opened. Information on application.

TREASURY DEPARTMENT, Office of the Supervising Architect, Washington, D. C., Dec. 20, 1923. Sealed proposals will be opened in this office at 3 p.m., Jan. 21, 1924, for the construction, including mechanical equipment, of a one story brick and tile non-fireproof Post Office building, approximately 62 x 64 feet in size at State College, Pa. Drawings and specifications may be obtained from the Custodian of the site at State College, Pa., or at this office in the discretion of the Supervising Architect. Jas. A. Wetmore, Acting Supervising Architect.

POSITIONS VACANT

AN experienced structural steel detailer wanted to do detailing and estimating. Location west of Mississippi River. P-254, Engineering News-Record, Old Colony Bldg., Chicago, Ill.

DRAFTSMEN and checkers, experienced in making shop drawings for structural steel work. Good opportunity for competent men. Apply Whitehead & Kales Co., Detroit, Mich.

EXPERIENCED architectural and structural designer and draftsman. Only technical graduates, thoroughly familiar with building codes need apply. State age, availability and salary. P-272, Eng. News-Record, Leader-News Bldg., Cleveland, Ohio.

ESTABLISHED construction company doing general building construction, requires the services of an experienced estimator. State experience and salary expected in first letter. Communications confidential. Address P-176, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

LEVELERS and rodmen for work on subway construction, New York City; entrance salary $1,601 per annum, with opportunities for advancement; open to graduates in civil engineering or those with at least one year's satisfactory practical experience; citizens only; apply giving full information as to education and experience to Chief Clerk, Transit Commission, 49 Lafayette Street, New York City.

PUMP draftsman: Large mid-west manufacturer has opportunity for man familiar with centrifugal, steam and power pumps. Must be good detailer and thoroughly familiar with material lists. Good opportunity for young, energetic pump man. Location Michigan. P-261, Engineering News-Record, Leader-News Bldg, Cleveland, Ohio.

SEVERAL experienced bridge designers for highway work wanted; must be good draftsmen. Give complete statement of education and experience, age and nationality. Submit sample of drafting. State salary. P-229, Engineering News-Record, Old Colony Bldg., Chicago, Ill.

STRUCTURAL engineers wanted for designing structural steel factory and mill buildings; also for designing reinforced concrete buildings; state experience in full detail and salary expected. P-245, Engineering News-Record, Leader-News Bldg., Cleveland, Ohio.

STRUCTURAL engineer, experienced in truss, general steel, design and drafting; give full particulars as to training previous positions age and salary expected. Asbury Bridge & Iron Works, Asbury Park, N. J.

STRUCTURAL engineer wanted, experienced in estimating and detailing, one with sales experience preferred. State experience, also salary expected in first letter. Southern Ohio territory. P-275, Eng. News-Record, Leader-News Bldg., Cleveland, Ohio.

POSITIONS VACANT

STRUCTURAL steel and railroad bridge draftsman wanted. State age, nationality, education, experience in full, salary expected aand date you can report for work. Address P. G. Lang, Jr., Engineer of Bridges, Baltimore and Ohio Railroad Company, Baltimore, Md.

SUPERINTENDENT to take charge of a sand and gravel dredging plant. Must understand the operation of floating derricks having clam-shell buckets and hoisting sand and gravel out of beach. Must be familiar with the construction and operation of a screening plant and the loading of scows. Location, forty miles from New York on Long Island. State age, experience and salary expected. P-186, Eng. News-Record, 10th Ave. at 36th St., New York.

WANTED (at once) structural draftsman. Only first-class men need apply. Apply Bethlehem Construction Company, Bethlehem Trust Bldg., Bethlehem, Pa.

WANTED: The Blaw-Knox Company has an opening for a young civil engineer interested in being trained for sales work. This is a good opportunity. Construction experience necessary, particularly in highway and concrete construction. Sales experience desirable but not essential. Write your story completely, with references in first letter, to Blaw-Knox Company, attention Sales Manager, P. O. Box 915, Pittsburgh, Pa.

WANTED, writer in civil engineering subjects; must be a college graduate with experience in railroad surveying and construction; position requires residence in Eastern city of 160,000. State education and experience, also initial salary expected in first letter. New York or Philadelphia interview. P-248, Engineering News-Record, 10th Ave. at 36th St., New York.

WE need a Surveyor who is experienced in the relocation of city and country property lines from descriptions by metes and bounds and who not only can keep, but is in the habit of keeping, full and complete notes of all he does. He need not be an engineer, though training as an engineer would not disqualify. We are not advertising for students. We want someone who can deliver the goods. Please do not reply to this ad unless you can fill the bill and are dependable, accurate, sound in wind and limb, and intend to stick. If you do answer, state age, education, experience, least salary considered, and date available. Box 796, Asheville, N. C.

WE require the services of an engineer-surveyor who is familiar with the following branches of work: relocation of property corners from descriptions by metes and bounds; stadia, road and sewer location and construction; topography, drafting, etc. Judgment in the first named branch is an important item. Please do not answer this ad unless you can fill the bill and are accurate, dependable, healthy and intend to stick. We do not want a rolling stone, as this will be a permanent job for the right man. If you do answer, state age, education, experience, least salary considered and date available. Brown & Gibbs, Asheville, N. C.

Notice to Advertisers!

Owing to the holiday—New Year's Day—the "*Searchlight*" pages of the January 3rd issue of *Engineering News Record* will close for press earlier than usual. Copy should reach us as follows:

Display Ads—Copy required by 10 A.M., Saturday, December 29th.

Want Ads—Copy required by Noon, Saturday, December 29th.

Proposal Ads—Copy required by 5 P.M., Monday, December 31st.

EMPLOYMENT SERVICE

SALARIED men seeking tentative offers of new connections, are invited to communicate confidentially with the undersigned, who will negotiate overtures without jeopardy to present connections. A professional, ethical service, restricted to high grade positions; established 1910. Our "Refund Contract" guarantees refund of retaining fee to the client named therein, if service is not satisfactorily rendered and refund be requested within three months from date remitted. Send name and address only for particulars. R. W. Bixby, Inc., 701 Lockwood Building, Buffalo, New York.

EXECUTIVES, engineers and other qualified men whose salary requirements are over $2,500 per year, find our confidential direct service to specific employers extremely satisfactory. An inquiry entails no obligation. The National Business Bourse, Inc., H. H. Harrison, President, Association Building, Chicago.

EMPLOYMENT AGENCIES

GENERAL ENGINEERING AGENCY, Monongahela Bank Building, Pittsburgh, Pa. Supply employers everywhere, freely, prepared proposals available plant managers, superintendents, chief engineers, designers, draftsmen, transitmen, office clerks. Power engineers, electricians, master mechanics for every purpose, individuals or groups. General registration, no registration fees. We send men to Canada, Mexico, Central and South America.

NATIONAL CLERICAL BUREAU — Wisconsin's only technical agency offers special opportunity to technical men to locate in Milwaukee and vicinity where diversified industries assure both opportunity for advancement and steady employment. No advance fee. Loan & Trust Building, Milwaukee, Wis.

WANTED—Teachers engineering subjects. Draftsmen, mechanical, structural, architectural and civil engineering work. Recent graduates for various engineering opportunities. Cleveland Engineering Agency, Rose Bldg., Cleveland, Ohio.

POSITIONS WANTED

Civil Engineers

CIVIL engineer, age 31, ten years' experience, highway location and construction, railroad location, construction, tunnel driving, industrial construction surveys, reports, estimates. Desires permanent position with chance of advancement through meritorious service. At present employed as resident engineer but available on short notice; location immaterial. PW-244, 7ngineering News-Record, Old Colony Bldg., Chicago, Ill.

CIVIL engineer, 20 years' experience, Mexico and West Indies. Railroads, surveys and construction; wharves and harbor improvements, highways, streets and sewers. Excellent record as sales engineer. Speaks and writes Spanish fluently. Available on short notice. PW-279, Eng. News-Record, 10th Ave. at 36th St., New York.

CIVIL and mining engineer, perfect knowledge of Spanish and Spanish American countries, desires representation of manufacturing, industrial or engineering firm in Chile, Peru, Argentine and Bolivia. PW-269, Eng. News-Record, 10th Ave. at 36th St., New York.

POSITIONS WANTED

ENGINEER, C. E., structural steel and concrete design, ten years on first class hotels, office buildings, theatres and industrial plants. PW-257, Eng. News-Record. 10th Ave. at 36th St., New York.

JUNIOR civil engineer, married, varied field and office experience. PW-240, Engineering News-Record, 10th Ave. at 36th St., New York.

RECENT graduate civil engineering (24) desires connection in any engineering capacity offering experience and advancement; four months on outside building construction work and seven months' structural and topographical drafting experience; prefer location in New York City or vicinity. PW-266, Eng. News-Record, 10th Ave. at 36th St., New York.

Surveyors

TRANSITMAN—Inspector, varied field and office experience, desires change. PW-239, Eng. News-Record, 10th Ave. at 36th St., New York.

TRANSITMAN desires position. West Coast preferred. University training and four years' experience in office and field. PW-273, Eng. News-Record, 883 Mission St., San Francisco, Cal.

Bridge and Structural

STRUCTURAL engineer, with eighteen years' designing and construction experience of structural steel and reinforced concrete structures, is open for engagement; South preferred. Engineer, 108 West Harris St., Savannah, Ga.

STRUCTURAL steel estimator and contracting engineer. Twelve years experience, designing, estimating and selling structural steel, reinforcing steel and allied products. Can take complete charge of any structural job and handle it throughout all branches of fabricating shop. Financially responsible, open for engagement after February 1st with medium sized structural shop or contractor specializing in steel construction. PW-280, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

Estimators

ESTIMATOR, building construction executive, twenty years' experience high class work New York City, purchasing, sub contracting, systematize construction accounting and costs. PW-255, Engineering News-Record, 10th Ave. at 36th St., New York.

Drafting and Designing

NEAT DRAFTSMAN; transitor levelman; long experience in land surveying and titles; 2 years' inspector concrete paving N. C. state highway; competent foreman, grade or paving; speak a little Spanish. 49 years old. Box 43, Jefferson, N. C.

TOPOGRAPHICAL draftsman, experienced. first class; good letterer, well versed in surveying. Available now. PW-247, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

Mechanical and Electrical

ELECTRICAL Engineer, 13 years' experience, design, construction and operation of power plants and substations both high and low voltage, field and factory testing, industrial power distribution, specifications, steam, electric and hydroelectric. Desire change in position PW-54, Engineering News-Record, 10th Ave. at 36th St., New York.

Superintendents

ASPHALT plant superintendent, twelve years' experience; can furnish complete organization; salary $75 weekly. Available Jan. 1. PW-252, Engineering News-Record, Real Estate Trust Bldg., Philadelphia, Pa

CONSTRUCTION superintendent, age 34, graduate civil engineer, experience docks, industrial plants, foundations, excavation operations, in charge of two million yard project, seeks permanent connections where loyalty and strict attention to business will be appreciated. PW-274, Eng. News-Record, Old Colony Bldg., Chicago, Ill.

POSITIONS WANTED

LIVE Superintendent or General Superintendent. Practical construction man. Try me on docks, power plants, drydocks, canals, other work. Fifteen years responsible charge. Would consider association with engineer. Have experience if you have money. PW-213, Engineering News-Record, Leader-News Bldg., Cleveland, Ohio.

ROCK and earth excavation superintendent or walking boss wishes job on heavy excavation; prefers heavy rock work; has long experience in well drill and jackhammer work. Last heavy job 150,000 cubic yards big shot on same work nine tons seven hundred pounds; best of references. Have job now but wish to change. State salary. PW-208, Eng. News-Record, 10th Ave. at 36th St., New York.

STRUCTURAL steel fabricating shop superintendent or foreman, age 36, wishes position; competent, reliable, good organizer and producer, clean record. PW-258, Engineering News-Record, 10th Ave. at 36th St., New York.

SUPERINTENDENT, broad experience all kinds heavy construction, bridges, caissons, foundations, dams, waterworks, etc.; have good following of men; salary $500; available at once. PW-264, Eng. News-Record, 10th Ave. at 36th St., New York.

SUPERINTENDENT construction, technical education, long experience United States and in Latin America, hydro-electric construction, factories, railways, docks and heavy machinery installations, thoroughly capable organizer from inception to completion of job, speak Spanish and Portuguese fluently, some French; location anywhere. Address: P. D. Cox, Apt. 38, 87 Hamilton Place, New York.

SUPERINTENDENT, eighteen years' experience general heavy construction, foundations, caissons, bridges, locks, dams, waterworks and power houses; have executive ability and had full charge of important contracts; available two weeks. PW-263, Eng. News-Record, 10th Ave. at 36th St., New York.

SUPERINTENDENT or general foreman, heavy industrial and public works construction. Engineer. Salary $75 week. Available immediately. PW-260, Engineering News-Record, Real Estate Trust Bldg., Phila., Pa.

SUPERINTENDENT on highway construction, familiar with all types of pavements. PW-235, Engineering News-Record, Old Colony Bldg., Chicago, Ill.

Miscellaneous

CHIEF engineer of industrial firm is near completion of design construction and equipment program of very large manufacturing plant. He has had many years' experience on greatest undertakings of this country. Will be available in near future. PW-243, Engineering News-Record, Leader-News Bldg., Cleveland, Ohio.

CONSTRUCTION manager, M. Am. Soc. C. E., 42 years of age, solicits correspondence from those desiring a construction engineer who has had broad experience in railroad, highway, bridge and heavy foundation construction. At present employed as construction engineer in charge of $1,000,000 gravity type dam. Available Feb. 1, 1924. Minimum salary considered $7,500. Speak Spanish. PW-250, Engineering News-Record, Old Colony Bldg., Chicago, Ill.

ELECTRICAL engineer, experienced in factory maintenance and construction, desires position as electrical engineer or chief electrician. Available after Jan. 1st. PW-281, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

ENGINEER, executive, 23 years' experience in engineering work. Water systems including dams, reservoirs, filter and pumping stations. Hydraulic, ice and gas plants, municipal work; past five years assistant manager and chief engineer of a holding corporation operating the water, gas and ice plants of Omaha, Neb. Mem Amer. Soc. of Civil Engineers and Amer. Water Works Assoc. F. P. Larmon, 4912 California St., Omaha, Neb.

ENGINEER, with private schooling and twelve years' general engineering as railroad, highway, plant and coal mining, construction, maintenance and surveys, open for engagement Jan. 1; age 32, married. PW-196, Eng. News-Record, 10th Ave. at 36th St., New York.

POSITIONS WANTED

FOREMAN, experienced, sewers, water, gas, roads, concrete, general excavation. Matthews, Room 628, 15 Park Row, New York City. Phone Barclay 8143.

GENERAL foreman or foreman for rigger, reinforced steel, structural steel, concrete, or labor gang. 25 years' experience in construction of all kinds. Available immediately. PW-271, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

GENERAL foreman, experienced heavy timber, concrete, pile driving, dock building, scow building; single; go anywhere; references. PW-270, Eng. News-Record, Real Estate Trust Bldg., Phila., Pa.

GRADUATE in marine engineering, age 24, single, desires position as a maintenance engineer ashore, home or abroad; four years' practical experience in internal combustion and steam engineering; willing worker; will accept low wage where prospects are good. PW-277, Eng. News-Record, McGraw-Hill Co., 6-8 Bouverie St., London, E. C., England.

MAN, experienced as timekeeper, timeclerk, paymaster on construction work and coal stripping, desires position. Will consider anything with prospects, and immediately available, A1 references. PW-276, Eng. News-Record, Leader-News Building, Cleveland, Ohio.

YOUNG man, six years' experience on construction work, timekeeping, payroll clerk, purchasing agent, engineering, wishes permanent position with construction company. A1 reference. Address Box 34, Hannibal, N. Y.

WORK WANTED

Designing, Detailing Checking
For structural steel and reinforced concrete. Industrial, mechanical, structural engineering. Shop drawings. Central States Engineering Company, 28 East Jackson Boulevard, Chicago, Ill.

PLANS, exhibits, maps, charts, structural details, tracing, lettering, coloring, etc. The Drafting Co., 449 West 123rd St., New York City. Morningside 0973.

SALESMEN AVAILABLE

SALESMAN, mechanical engineer, experienced, high class. SA-267, Eng. News-Record, 10th Ave. at 36th St., New York.

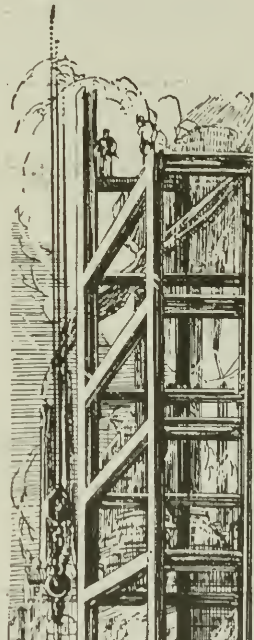
Additional undisplayed advertisements on page 54

320

Construction Protection

The Quartermaster Auction at Boston, Jan. 17, offers Engineering Contractors a large amount of Waterproof Duck

The ever-present probability of unfavorable weather makes it inadvisable for the larger construction firms to allow their stocks of tarpaulin and other waterproof fabrics to run low. Here is an opportunity to replenish depleted stocks and lay up a large amount of waterproof fabric at a bargain price.

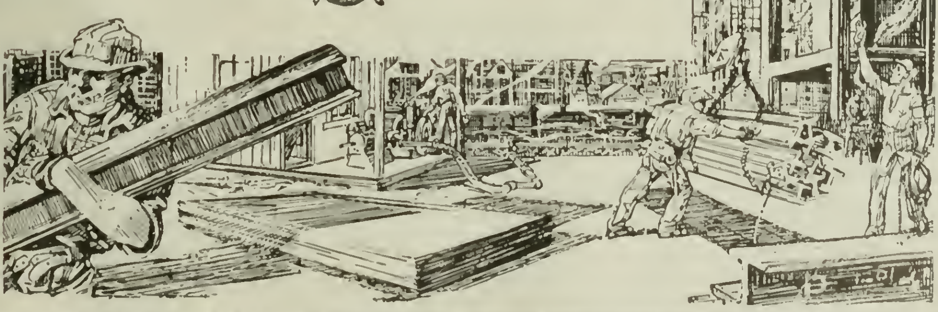


The Chemical Warfare Service has on hand at Edgewood Arsenal, Md., approximately 558,190 yds. of olive drab duck that was paraffined and waterproofed for gas mask fabric. It is to be offered for sale in the Quartermaster Auction to be held at the Army Supply Base, Boston, Mass., January 17. The material will be sold in lots of 5,000 yds. or more by sample, being available for inspection at point of storage daily, except Saturday and Sunday, between 10 A. M. and 2 P. M.

The Government feels that large structural engineering firms can profitably absorb quantities of this waterproof fabric and invites them to inspect the material. For all terms of sale and information, write for the catalog which is obtainable at the office of the Q. M. Supply Officer, 1st. Ave. and 59th. St., Brooklyn, N. Y., or the Commanding Officer, Army Supply Base, Boston, Mass.

The Government reserves the right to reject any or all bids.

At this same auction the Quartermaster Corps is offering 1,240,801 yds. of commercial duck of miscellaneous widths, weights and shades. Also a number of used motors and machine tools of well-known makes. This material is listed and fully described in the above-mentioned catalog.



WAR DEPARTMENT

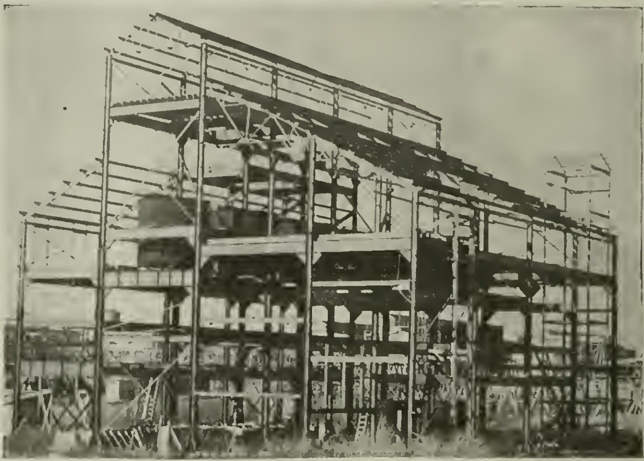
STRUCTURAL STEEL BUILDINGS

At the Old Hickory Powder Plant, Old Hickory, Tennessee

4—Structural steel buildings, 85 ft. 6 in. wide, 184 feet long, and 75 ft. 6 in. high. Covered with corrugated iron. Heavy construction, as shown by picture. Designed for heavy loading on floors.

A building identical to these was recently dismantled and shipped to Detroit, Michigan, where it will be re-erected in almost the exact form of the original. *Good proof of the sales values at Old Hickory.*

Write for further information



STRUCTURAL STEEL BUILDING

OLD HICKORY POWDER PLANT

Old Hickory, Tennessee

(Continued from Page 52)

SALESMEN AVAILABLE

MACHINERY salesman. Mechanical engineer. Experienced design, sale compressed air, electric, gasoline, oil, steam equipment for contractor, mine, power plant, shop including crushing, excavating, hoisting, pumping, etc. SA-268, Eng. News-Record, 10th Ave. at 36th St., New York.

AGENTS AND SALESMEN

Agents Wanted

for high quality steel windows and allied products. A desirable account for desirable agents. We give and expect close co-operation. Allison Steel Products Co., Chester, Pa.

TUTORING

CIVIL engineer teaches arithmetic, algebra, geometry, trigonometry, drafting, architectural, mechanical, structural, topographical surveying. Mondell, 50 E. 42nd St., New York.

EXCAVATIONS

Steam shovel work wanted on contract or rental basis. Crews furnished. No job too large or too small.

JOHN P. GILBERT
50 Church Street, New York City.

EXCAVATION

Steam Shovels for rent with crews or work taken by contract.

Dinkeys and care or teams furnished.

H. C. AMBLER
3717 Old York Road, Philadelphia, Pa.

Notice to Manufacturers

Contractor's Equipment Company would be interested in adding one or two lines of Nationally Advertised Products. To Manufacturers requiring large distribution, we can offer excellent facilities. Branch Sales Organization and Warehouses maintained in 5 representative Cities at present time.

BO-200, Engineering News-Record
10th Ave. at 36th St., New York City

Philadelphia Salesroom

Space with Machinery Representatives for display, office and storage. Ground floor, double glass front, well lighted, excellent location for manufacturer or representative of kindred line, to open branch office.

BO-232, Engineering News-Record
Real Estate Trust Bldg., Phila., Pa.

FOR SALE—BOUND VOLUMES

Engineering News—57-64 inclusive.
Engineering Record—55-57 inclusive.
Engineering Record—60-64 inclusive.
Engineering Contracting—31-34 inclusive.
Transactions A.S.C E.—67-82 inclusive.
Transactions A.S.C E.—Index 1911.
Transactions Cornell Society of C. E.— 2 Volumes 1898-1908.

C. J. PATERSON
936 E. 67th St. Cleveland Ohio.

Buff & Buff 2B Transit, nearly new.
8-in. Semi Circular Veroler Protractor.
Set Alteneder Drawing Insts. Knife Spring Pens, center adj. on bow insts.
Bound volumes Engineering News, 1908 to 1912.
Unbound volumes Engineering News, 1913 to 1919.

NILES POULTRY FARM
Cherry St., Hicksville, L. I.

Second-Hand Transits and Levels

Guaranteed in Good Order and Adjustment.

Write for New Bargain List

WILLIAMS, BROWN & EARLE, INC.
918 Chestnut St., Philadelphia, Pa.
Department D

NEW AND USED SURVEYING INSTRUMENTS AT FACTORY PRICES

Satisfaction guaranteed or money refunded. Write for complete list and catalogue of our high grade instruments and supplies for civil engineers, surveyors, mining, builders, contractors, etc.; 40 years' experience in repairing instruments of all makes at reasonable prices. Prompt service.

WISSLER INSTRUMENT CO.
607 N. Broadway, St. Louis, Mo.

FOR SALE

Used Transits and Levels

BUFF, 46 Dey St., New York.

USED EQUIPMENT

AND NEW, OFFERED FOR RE-SALE

Space for these advertisements is sold by the advertising inch—30 inches to a page. The price per inch is based on total space used—multiply ad space by number of insertions.

RATE PER INCH:
1 to 3 inches..............$5.00 an inch
4 to 7 inches.............. 4.80 an inch
8 to 14 inches.............. 4.70 an inch

An inch is measured vertically on one column—three columns to a page. Any space may be used measured by the even inch in height by 1, 2, or 3 columns in width.

RATES FOR LARGER SPACES, OR SPACE ON A YEARLY BASIS, FURNISHED ON REQUEST.

ALPHABETICAL INDEX TO ADVERTISEMENTS

GENERAL CONTRACTORS EQUIPMENT

PILING

PIPE

RAILS

"WE BUY, REBUILD, SELL or RENT"

ANNOUNCEMENT!

In addition to our large stock of equipment listed on the lower part of this page, we have purchased the following equipment which was just released from a large sewer job being completed in Detroit. This equipment will not be loaded out to our Plants for several weeks, and we are now offering same for sale f.o.b. Detroit. Description as listed below:

BOILER

1—Ames Locomotive type, 100 hp., Butt strapped, complete with stack.
Also several small vertical boilers.

DUMP CARS

64—Western, 4-yd., 36-in. gauge.
27—K. & J., 4-yd., 36-in gauge.
4—Drop bottom Concrete Cars, 36-in. ga.
12—Koppel 1½-yd., "V" shaped, cradle dump cars, 30-in. ga. All steel, spring draw bars and axles.

CRANE

1—15-ton Brown Hoist Locomotive Crane, 8-wheel MCB, standard 48-ft. boom. also 1—65-ft. goose neck boom.

DREDGE

1—Hydraulic Dredge, Hull 32x8x110-ft., equipped with 12-in. Erie Pump, 250 hp. Ball Engine, tandem compound, and 300 hp. Scotch Marine Boiler, 3 Morrison Furnaces. This Dredge is complete with all miscellaneous equipment and is now located at Erie, Pennsylvania.

LOCOMOTIVES

1—Brooks, 16x24, standard gauge, 6-wheel switcher with tender Weight on drives 45 tons.
2—Porters, 18-ton, 36-in. gauge, cyl. 10x16. Shop No. 5238 and No. 4612.
3—Vulcan, 18-ton, 36-in. gauge, cyl. 10x16, Shop No. 1612, No. 1577 No. 1575.
2—Porter, 14-ton, 36-in. gauge, cyl. 9x14, Shop Nos. 2873 and 3469.
2—Burton 3½-ton, 36-in. gauge, purchased new in 1921.

DRAGLINE

1—Class No. 20 Bucyrus Dragline Excavator, 2½-yd. Page Bucket. Steam, Shop No. 856, on skids and rollers. 85-ft. boom.

PUMPS

Miscellaneous lot of piston pumps, consisting of Cameron & Prescott & Blake.
1—Pulsometer No. 3.
1—Pulsometer No. 7, 4-in. suction and 4-in. discharge.
1—Centrifugal, 8-in., direct connected to Westinghouse 9x8 engine.

STEAM SHOVEL AND CRANE

1—Erie type "B", traction wheels, high lift, ¾-yd., also has ½-yd. sewer bucket and stick, also 30-ft. crane boom.
1—Bucyrus 70-C, Shop No. 1260, equipped with 2½-yd. dipper, new boiler.

All equipment listed below is in stock and may be inspected at one of our four Rebuilding Plants

CLAMSHELL BUCKETS

3—2-yd., 2 Owens, 1 O&S
2—1½-yd. Williams, heavy duty.
23—1-yd., Blaw Knox, Standard, Lakewood, Owens.
34—¾-yd., Standard, Keisler, Hayward, Owens and Blaw Knox.
14—½-yd. All makes.

CONCRETE MIXERS

2—Ransome, No. 56-S, cap. 2-yd., on skids, without power.
60—Concrete Mixers, sizes 28S, cap. 1-yd., 21S, cap. ¾-yd.; 14S, cap. ½-yd. and 10S, cap. 1¼-yd. With steam or electric power with side loaders or batch hoppers Following makes: Marsh-Capron, Koehring, Milwaukee, Ransome, Smith, Smith-Chicago, Rex, Lakewood, Foote, Cube or Oshkosh
42—7S cap. 1 bag, with low charging platforms, with gasoline engines.

CARS

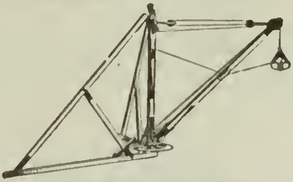
52—Koppel Flat Cars, 24-in. gauge, Spring Journal and draw bars, Frame 35x84x6 in. channels.
15—Lakewood Flat Cars, spring journals and spring draw bars, ball bearing

CATERPILLAR CRANE

1—Northwest Combination Crane and Dragline caterpillar, 40-ft. boom, 70 hp Gasoline Engine, ¾-yd. Page Bucket
1—Brownhoist, combination Crane & Dragline, 40-ft. boom, ¾-yd clam shell bucket has ⅝-yd skimmer scoop attachment also equipped to handle 1-yd. Dragline bucket.

COMPRESSORS

1—Ingersoll-Rand, Steam cap. 960 cu. ft. per minute, 100 lb. pressure
1—Sullivan, Class W.G.3 belt driven, cyl. 10x12
1—Westinghouse, size 11x11x12, on skids.
1—Westinghouse, size 8x8x9, on skids.



ELECTRIC HOISTS AND DERRICKS FROM HOG ISLAND

Specifications of Electric Hoists

35—American late model hoists. These hoists have 2 drums with attached swinging gear, with 37-hp. Otis A.C., 440-v., 60-cy., 3-ph. electric motor—complete with controllers and resistance grids—can be changed to suit customer's current requirements if desired.

Can furnish counterwighted holding drums with these hoists when used for operating bucket.
Also several 55 and 75-hp., single and double drum hoists with A.C. motors

Specifications of Derricks

Large number of practically new American stiff-leg derricks.
Boom, 14x14x80-ft., trussed.
Mast, 16x16x40-ft.
Legs, 14x14x62-ft.
Bull wheel, 16-ft.
For Single Line Work or Arranged for Bucket Operation.
Will sell fittings only if desired.
Also have large stock of lighter stiff-leg derricks, several steel stiff-legs, 20, 30 and 50 ton.

GUY DERRICKS

9—Wood Guy Derricks; bucket operating or hook line, masts 60 to 90 ft., booms 50 to 80-ft., with "American" fittings.

STEAM HOISTS

10—Three-Drum Hoists, with or without boilers. Sizes, 9x12, 9x10, 8¼x10, and 7x10, with separate swingers for derrick work. All makes.
26—Two-Drum Hoists, with or without boilers. Sizes, 10x12, 9x10, 8¼x10, 7x10, 6¼x10, 6x8, and 5x8. Can be equipped with holding drum for bucket work. Several special Cableway Excavator or Drag Scraper Hoists. All makes.
2—8¼x10 American, D.C., D.D., with swingers.
1—7x10 National Single drum with boiler.

LOCOMOTIVES

2—3 ton Plymouth, 24-in. gauge gasoline.
1—7-ton Davenport, 24-in. gauge, steam.
1—6 ton Whitcomb, 24-in. gauge, gasoline.
1—6-ton Plymouth, 24-in. gauge, gasoline.

ROAD ROLLERS

1—10-ton Austin, 3-wheel, gasoline, single cylinder.
5—10-ton, 3-wheel, steam—2 Buffalo-Pitts, 1 Kelly-Springfield, 1 Peerless, 1 Monarch.
1—5-ton Iroquois Tandem, steam.
1—3-ton Erie Tandem, steam, new.

STEAM SHOVELS

4—Keystone Excavators, 3—No. 3, 1—No. 4
2—Type O Thew on traction wheels with ⅝-yd. dipper
1—Type A-1 Thew, traction wheels, ⅞-yd. dipper.

CRANES

2—Byers Auto Cranes, on traction wheels, with 30-ft. boom, with ½ or ¾-yd. clam shell bucket, 1 steam, 1 gasoline.
1—15-ton, 8-wheel, O.&S., 40-ft. boom.

The above is only a partial list of our equipment. Write for latest stock list

Equipment Corporation of America

Manufacturers and Rebuilders of Contractors' Equipment

PHILADELPHIA, PA.
855 Land Title Bldg.
Phone, Spruce 5408

CHICAGO, ILL.
1455 Lumber Exchange Bldg.
Phone, Randolph 6586

PITTSBURGH, PA.
655 Empire Bldg.
Phone, Smithfield 1502

FOR SALE OR RENT

STEAM SHOVELS

1—Type B Erie Traction. Shop No. 321. ¾-yd. dipper.
7—70C Bucyrus, Shop Nos. 1277, 1445, 1482, 1499, 1582, 1608 and 1998; 2½-yd. dippers.
3—70-ton Bucyrus. Shop Nos. 920, 977, and 1233. 2½-yd. dippers.
1—Model 60 Marion. Shop No. 2367. 2½-yd. dipper.
1—Model 80 Marion. Shop No. 876, 4-yd. dipper.

STEAM SHOVEL PARTS

1—1½-yd. Coal Loading Dipper for Marion 36 Steam Shovel.
2—Booms for 70-ton Bucyrus, length 29 ft.
1—Boom for 70C Bucyrus shovel, composite, length 40 ft.
1—Marion Dipper, 2½ cu. yd. capacity.
1—Bucyrus Dipper, 3 cu. yd. capacity.
Jack Arms and Boom Engines for 70-ton Bucyrus Shovels.

DRAGLINE EXCAVATORS

1—Class 7 Bucyrus. Shop No. 798, mounted on skids and rollers, 42-ft. boom, 1-yd. bucket.
1—Class 14 Bucyrus. Shop No. 745, mounted on skids and rollers or tandem wheels, 60-ft. boom, 2-yd. Page bucket.
1—Class 14 Bucyrus, Shop No. 2140, mounted on caterpillars, 60-ft. boom, 2-yd. Page bucket.

LOCOMOTIVES

1—18 x 24 American, 6-wheeled switcher, Brooks No. 2318. Wt. 55 tons on drivers.
1—18x24 American 6-wheeled Switcher, Brooks No. 1778. Wt. 50 tons on drivers.
1—16x24 Baldwin 6-wheeled Switcher, with tender. Shop No. 44887. New in 1917. Wt. 43 tons on drivers. 180 lbs. pressure.
1—16x24 Vulcan 4-wheeled Switcher with tender. Shop No. 1764. Wt. 40 tons. 180 lbs. steam pressure.

LOCOMOTIVES (Continued)

1—16x24 Baldwin 4-wheeled Switcher with tender. Shop No. 37643. Wt. 39 tons. 180 lbs. steam pressure.
1—16x24 Davenport 4-wheeled Switcher, with tender. Shop No. 900. Wt. 38 tons. 170 lbs. steam pressure.
1—17x24 Baldwin 4-wheeled Saddle Tank Locomotive. No. 15683. Wt. 47 tons.
1—16 x 22 C. M. & St. P. Ry., Class J-2, 4-wheeled switcher. Weight 32 tons.
1—Std. gauge 11x16 Davenport Dinkey. Shop No. 1163, new in 1912. Air brakes, automatic couplers. Wt. 20 tons
2—Std. gauge 11x16 American 4-wheeled Saddle Tank Locomotives. Shop Nos. 46519 and 47421, built 1912. Wt. 21 tons. Steam brakes, automatic couplers.
1—Std. gauge, 11x16 Davenport Dinkey. Shop No. 1027, new in 1910. Steam brakes. Wt. 20 tons.
1—36-in. gauge, 10x16 Vulcan Dinkey; Shop No. 868. Wt. 18 tons.
2—24-in. gauge, 7x12 Davenport Dinkies. Shop Nos. 1411 and 1524. Wt. 9 tons.
1—24-in. gauge, 7x12 Vulcan dinkey, Shop No. 2345. Wt. 9 tons.
1—24-in. gauge 6x10 Davenport side tank Dinkey. Shop No. 1307. Wt. 7 tons.
1—24-in. gauge 5x10 Shay geared, Lima No. 2678. Wt. 12 tons.
1—24-in. gauge, 6-ton Plymouth. Type 2, No. 1077.

CRANES

1—30-ton Ohio Locomotive Crane. No. 3416, new in 1919. 55-ft. boom, 20-ft. extension, 1½-yd. clam shell bucket.
1—Pintle Type Crane, built by Variety Iron & Steel Works. New in 1919; 48-ft. boom, 15-ton cap. at 18-ft. radius; 7-ft. 10½-in. gauge, 12-ft. wheelbase, self-propelling. Base of boom 17 ft. above track. Bucket-operating drums. Wt. 50 tons. Price, 25% of new.
1—10-ton Industrial Crane (Shop No. 1989). 4 wheeled, 40 ft. boom.
1—Crane Boom, 33 ft. long, drum and necessary equipment for converting type B Erie shovel into crane.

DUMP CARS

38—20-yd. Western, all steel Air Dump Cars, 80,000 lb. capacity.
20—12-yd. Western Air Dump Cars, 19-ft. beds, steel sills, box girder doors.
4—16-yd. Western Air Dump Cars, steel sills, box girder doors.
8—12-yd. Western Hand Dump Cars, 19-ft. beds, steel sills, box girder doors, full M.C.B.
15—8-yd. Western, 36-in. gauge, double truck side Dump Cars; steel draw sills, wood beds.
4—4-yd. Continental, 36-in. Gauge Side Dump Cars, wood beds, steel draw sills.
9—12-yd. Western Air Dump Cars, 26-ft. beds.
4—4-yd. Western, 36-in. gauge, Wood Sill Dump Cars, truss rod doors.
24—4-yd. Continental, 36-in. gauge, wood draw sills, 4 pedestals, truss rod doors.
8—3½-yd. Peteler 36-in. gauge side dump cars, wood sills and wood beds.

SPREADER CARS

1—Std. gauge Jordan All Steel Spreader Car, 100,000 lb. capacity. Shop No. 317.
1—Std. gauge Western Spreader Car.
1—36-in. gauge Western Spreader Car.
1—36-in. gauge Oliver Spreader Car.

MISCELLANEOUS

1—7x10 D.C., D.D. Lidgerwood Hoist No. 25967. No boiler.
1—7x10 D.C., D.D. Lambert Hoist, with or without boiler.
3—1½-yd. Western Bottom Dump Wagons.
3—Locomotive Air Pumps, 9½-in. and 11-in. simple, 8½-in. and 9½-in. cross compound.
2—80-hp. horiz. Boilers, with fittings.
1—1½-yd. Page Dragline Bucket.
6—Mead-Morrison 1½-yd. Clam Shell Buckets.
3—1¼-yd. O. & S. coal loading clam shell buckets.

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(Successors to Clapp, Norstrom & Riley Equipment Co.)

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R. R. Pin Connected Through Truss Span

228 ft. 0 in. C. to C. of end pins
E 40 213 tons

Forty Other Bridges

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PULSOMETER STEAM PUMP

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Four cylinder 7½x10 Valve-in-head Enterprise gasoline engines very rugged design with two extra heavy flywheels, designed for duty on excavating machinery. Will develop 55 hp at 400 r.p.m. All working parts enclosed. Fan and other auxiliaries direct driven. These engines are all new, have never been used. Are surplus stock, account change in design of our machines. Will sacrifice. Complete description on request.

BUCYRUS COMPANY
Specialty Dept.
South Milwaukee, Wis.

FOR SALE

Pawling & Harnischfeger full Caterpillar Crane, Model 206, new 1923, equipped with 40-ft. boom, 50-hp. gas engine, ¾-yd. clam shell bucket, used 60 days.
Northwest Crane, with 40-ft. boom, 1-yd. clam shell bucket, also equipped with ¾-yd. shovel dipper. Machine new this spring.
Brown Hoist Locomotive Crane, 8 wheel, 50-ft. boom, 1½-yd. clam shell bucket.
Marion Model 28 Steam Shovel, traction wheels, ¾-yd. dipper, also equipped with 33-ft. crane boom, and ¾-yd. clam shell bucket.
American Switcher Locomotive, type 0-6-0, 18x24-in. cylinders, 180 lb. boiler pressure, first class working condition.

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1—Keystone, equipped with both skimmer and ditcher scoops. Machine just coming out of shop, and will guarantee condition. Price with terms.

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188 pieces 17 ft. long.
4 corner pieces 17 ft. long.

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PARSONS' TRENCHING MACHINE

For Immediate Delivery

JOHN B. McLANE & COMPANY
Newport, Kentucky

1—0 42 Austin, steam driven, digs 18 ft. deep, up to 12 inches wide.
1—00 12 Austin, steam driven, digs 12 ft. deep, up to 12 inches wide.
1—00 12 Austin, gasoline driven, digs 12 ft. deep, up to 12 inches wide.
1—Austin Backfiller, all caterpillar traction.
3—Parsons Backfiller, caterpillar traction.

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TRENCH MACHINES

Parsons 48, Steam, cuts to 48 in. wide x 18 ft. deep. Location New York City. Bargain.
Austin Backfiller Caterpillar, 30-ft. boom. Cheap.
Buckeye No. 4, Gasoline. Good shape.
2—Austins 00-12, Gasoline. Almost junk prices.

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1924 will be a year of contentment and joy—

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"DECO" Protects the Purchaser

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1—40-ton Industrial, 80-ft. boom.
• 1—25-35-ton, Type J. McMyler, with new A.S.M.E. boiler. 50-ft boom. Bucket operating.
1—30-ton Ohio, 50-ft boom.
• 3—25-ton Brownhoist, broad gauge, 1 electric and 2 steam
1—25-ton Industrial, 70-ft. boom.
1—20 ton Brownhoist, 8-wheel, bucket operating
• 1—20-ton Browning, 8-wheel, 50-ft. boom. Bucket operating.
• 1—15-20-ton Ohio, 50-ft boom
• 1—Osgood 7½-ton, 4-wheel, standard gauge, 40-ft. boom Bucket operating.
• 5—Osgood 7½-ton, 4-wheel, standard gauge, 40-ft. boom Single line.
1—Erie, 36-ft boom, ¾-yd. c.s.
1—205 P & H. gasoline, c.s. and d.l. bucket

DRAGLINES

2—Class 24 Bucyrus, 100 ft booms.
1—Class 175 Bucyrus 125-ft boom.
1—3-T Monighan Walker 60-ft boom
1—Class 9½ Bucyrus, 60 ft boom

STEAM SHOVELS

Caterpillar Type

1—Marion 31 High lift or standard
1—Marion 28 High lift
1—Osgood 29, High lift
1—Osgood 18, High lift or standard
1—Erie B.

STEAM SHOVELS—Cont.

Traction Type

2—Erie ¾ High lift, 1 year old.
1—Thew ¾ High lift, 1 year old.
6—Erie Osgood, Marion, Thew ¾ yd.

Railroad Type

Marion 40, 41, 60, 70, 92.
Osgood 43, 69, 73.
Bucyrus 45C, 70C, 95C, 175.

TRACTORS

2— 5-ton Holt Caterpillar
1—10-ton Holt Caterpillar

LOCOMOTIVES

1—63-ton Baldwin Mogul
• 1—50-ton, 6-wheel switcher, I.C.C. condition.
• 1—30-ton, American, 4-wheel S. T. air brakes.
1—28-ton Porter, Std. gauge
1—25-ton Baldwin Almost new Standard gauge, gasoline Cost $25,000 Will sell at a bargain.
• 1—21-ton, Vulcan, Standard gauge, New A.S.M.E. boiler
• 1—21 ton, Vulcan, 30-in gauge, S. T
2—18-ton Vulcan, 30-in gauge
• 1—12-ton Baldwin, 36-in gauge, S.T.

DUMP CARS

•20—Western 12-yd. air dump cars.
9—K & J. 16-yd. Automatic.
•50—Western and K. & J. 4-yd., 36-in. gauge.
10—4-yd., 30-in. gauge.
20—Western and Koppel, 6-yd. Standard gauge.
20—Western 12-yd. All steel. Hand dump.

OVERHEAD CRANES

Ton	Span Ft. In.	Make	Motors	Control
5	33–5	Niles	3-220 VDC	Cage
15	54–3	Niles	3-550VDC	Cage
20	46	Shaw	4-220 VDC	Cage
20	75	Shaw	4-220 VDC	Housed
25	78	Niles	1-550 VDC	To suit
30	59–6	Morgan	4-220 VDC	Cage
40	48	Alliance	4-220 VDC	Cage

1—Jordan Spreader
1—Western Spreader
1—Western 36-in. Gauge

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823 H. P. Stirling Water Tube Steam Boilers

From the Old Hickory Powder Plant, Old Hickory, Tennessee. Used less than ninety days, and in excellent condition. Inspection invited.

OFFERED AT MONEY SAVING PRICES

SPECIFICATIONS

Class M-30, each unit having 8226 sq. ft. heating surface, in accordance with following specifications and A.S.M.E. Code

The heating surface of each boiler consists of three steam and water drums and a mud drum, as follows:

3—Steam Drums 42-in. diameter, 17-ft. 1⅝-in. long, ⅝-in. plate

1—Mud Drum, 48 in. diameter, 16-ft 7⅝-in. long, 1-in. plate.

Drums connected by 630 tubes, 3¼-in. diameter, connections made by expanding wrought tubes into reamed tube seats.

Space occupied by each boiler 18 ft wide, 23-ft. 3-in. deep, 20-ft. 0-in. high.

DRUM CONSTRUCTION

All flanges for blow-off, feed, safety valve and water column connections made of wrought steel and riveted to the drums. The cylindrical portions of each drum made of a tube plate and a shell plate. Longitudinal seams double riveted, butt joint, circular seams, single riveted, lap joint.

TUBES

Tubes, 3¼ in., hot rolled, seamless steel, No. 10 gauge, for working pressure of 180 pounds to and including 225 pounds. Spaced alternately wide and narrow to facilitate replacement.

VALVES AND FITTINGS

Each boiler supplied with the following valves and fitting

1—1½ in. Safety Valves, nickel seat, set to blow at 200 pounds.
1—15 in. Ashcroft Steam Gauge with 12-in., 100 lb dial
1—Water column fitted with bronze mountings for glass water gauge with special shut-off device operated from fire room floor to allow renewal of glass under pressure. Three try cocks with lifting handles for operating from fire room floor, fitted with steam metal valves. Independent blow-off pipes from bottom of column and glass gauge, carried down the front, terminating in the ash pit, fitted with valves at height of hand
1—3-in. Hancock Bronze Stop Valve and one 3-in. Hancock Bronze Check Valve for feed.
2—2½-in. Blow-Off Valves and two Stop Cock
2—2½ in. Bronze Stop Valve on steam dusting hose connection.

STOKER ENGINE

1—8x8-in. Buffalo Vertical Engine, single acting, inclosed type, Class A, rated at 32 hp., 350 r.p.m. equipped with one 2½-in. Buffalo governor. Engine and accessories by Buffalo Forge Company.

Write for Special Bulletins

on New and Used Equipment at Old Hickory Powder Plant.

No. 7	Tanks
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No. 11	Blowers Equipment
No. 12	Industrial Railway
No. 20	Scales

Write for illustrated folder and prices.

FIXTURES

A full set of cleaning and ash doors and frames for side and rear walls, giving access to all parts for exterior cleaning. A large circular door and frame for access to mud drum manhead.

One cast iron damper box, damper and operating rig all supported from boiler structural supports, arranged for connection to horizontal breeching in rear, and operated from front of boiler.

Necessary buckstays and tie rods for securing all parts in position, and supports for baffle walls

WORKING PRESSURE

The boilers were constructed for a working pressure of 200 pounds per square inch. All drums were tested and made tight under hydrostatic pressure of 300 pounds. When erected complete the boilers were tested and made tight under hydrostatic pressure of 250 pounds.

ACCESSORIES

Accessories furnished in addition to those mentioned:

1—8-in. Foster Non-return Valve.
1—6 Element Vulcan Soot Blower complete with all piping and valves.
1—Bailey Flow Meter, Type D 25, Class 56, rated flow 28,000 pounds per hour, maximum flow 70,000 lbs. per hour.

STOKERS

8 Retort Westinghouse Double Dump Underfeed Stoker, with line shaft, sprockets, transmission guards, extension coal hopper, etc.

FAN AND TURBINE

1—Buffalo Turbo-Conoidal Fan, Type T D 9½, double inlet. Capacity 100,000 cu. ft per minute at 6 in water pressure and 970 r.p.m. Driven by 225-hp horizontal multi-stage, non condensing Moore turbine and reduction gear. Gear ratio, 3800 r.p.m.—970 r.p.m. Throttle valve 3 in. Steam consumption at 180 hp.—31.6 pounds; at 225 hp.—33.2 pounds

OLD HICKORY POWDER PLANT, Old Hickory, Tennessee

CRANES

2—20-ton **Brown Hoist**, double drums, 45-ft. booms.
1—20-ton **Ohio**, double drums, 50-ft. boom.
1—20-ton **Link Belt**, double drums, 50-ft. boom.
1—25-ton **Browning**, double drums, 60-ft boom.
1—25-ton **Industrial**, double drums, 50-70-ft. boom.
1—25-ton **McMyler**, double drums, 45-65-ft. boom.
1—30-ton **Ohio**, double drums, 50-ft. boom.
1—40-ton **Industrial**, double drums, 50-70-90-ft. boom
1—Type B Erie Caterpillar, 40-ft. boom.

STEAM SHOVEL

1—Type B **Erie**, full revolving, new 1923, all steel caterpillar, A.S.M.E. boiler, ¾-yd. dipper; high lift boom 21 ft.; dipper handle 15 ft.; boom hoist, used 3 months, guaranteed perfect condition.

GREY STEEL PRODUCTS CO.
111 Broadway, New York, N. Y.

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Cranes—Shovels

1—No. 45 Bucyrus, 1¾-yd. **R.R. Steam Shovel**, in A-1 used condition. Price, $4500. Located Minnesota.
1—No. 1-T Monighan **Gasoline Dragline**, 1-yd. Page bucket. 50-ft. boom. New walker just installed.
1—7-ton O & S **Crane**, 35-ft. boom, ¾-yd. clam shell; used only 6 months. Price with bucket $4,200.
1—21-E Foote **Caterpillar Paver**, boom and bucket. Used only 9 months, $4,500.
1—Keystone No. 6, just overhauled, $3,200.
1—**Stiff Leg Derrick**, Amer., 7x10 double drum hoisting engine, 60-ft. boom, 36-ft. mast. Located Southern Illinois.

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Locomotive Cranes

2—Browning, 20-ton, 8-wheel, 65-ft. boom—Portland, Maine.
1—Browning, 15-ton, 8-wheel, 38-ft. boom—Townley, N. J.
1—O. & S. 15-ton, 8-wheel, 50-ft. boom—New York.
1—Interstate, 15-ton, 8-wheel, 50-ft. boom—Townley, N. J.
1—Brownhoist, 20-ton, 8-wheel, 40-ft. boom—Townley, N. J.

Hoisting Machinery Co.
50 Church St., New York, N. Y.

LOCOMOTIVE CRANES, ETC.

No. 3 Byers, 32-ft. boom, ¾-yd. bucket, steam.
BYERS AUTOCRANE, 30-ft. boom, 1-yd. bucket.
GYRATORY and ROLL CRUSHERS.

STEAM SHOVELS

Model 28 MARION, ⅝-yd dipper, railway type.
3—Model 60 Marion, 2½-yd. dipper, rway type.
225-B Bucyrus Electric Shovel, 5-6-8-yd. buckets.
No. 0 Thew and No. 31 Marion.

BOILERS, AIR COMPRESSORS, ETC.

50—5000-ft. Air Compressors, steam and electric.
100-hp., 125-150-lb. Boiler, encased type.

HOISTS, ETC.

25 and 50-hp. Elec. Hoists, D D Dragline, 440-v., 60-cy., 3 ph. Motors.
100-hp. Thomas, 2 speed, 220 v., 3 ph., 60 cy
No. 3 GYRATORY PORTABLE CRUSHER.
6-8 10 and 12-in. Pump, Water and Gravel.

ROSS POWER EQUIP. CO.
Indianapolis, Ind.

FOR SALE

Farrell Jaw Crusher

1—36x18, first class condition, Manganese fitted.

INTERSTATE CRUSHED STONE CO.
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BUY NOW and SAVE!

These items represent an investment amounting to thousands of dollars. We have concluded to turn this stock into ready cash in the shortest possible time. Everything is offered for

IMMEDIATE SALE!

To do this we realize that we must make our prices so attractive that alert buyers will be quick to snap up these wonderful values.

What Can You Use?

1—95-ton Bucyrus Railroad Type Steam Shovel, with 5-yd. Dipper.

3—70-ton Bucyrus Railroad Type Steam Shovels, with 2½ yd. Dippers.

Above Shovels are rebuilt—
Available for prompt shipment

60—12-yd. All Steel Hand Dump Cars—Standard Gauge.

1—10-in.x16-in. Buchanan Jaw Stone Crusher. Style "B." Mounted on Trucks.

1—Kent Crushing and Pulverizing Mill.

1—9-in.x10-in. No. 924 Goulds Triplex Vertical Power Pump. single acting. Iron plungers. Capacity 350 gals. per minute, pressure up to 100 lbs., 6-in. suction, 5-in. discharge. Tight and loose pulleys 20-in.x8-in.

1—8-in.x8-in. Deane Triplex Vertical Power Pump. Capacity 235 gals. per minute, 6-in. suction, 5-in. discharge, tight and loose pulleys, 30-in.x7-in.

1—10-in.x6-in.x18-in. Cameron Steam Pump. Capacity 175 gals. per minute, 4-in. suction, 3-in. discharge.

1—14-in.x10¼-in.x10-in. Worthington Duplex Steam Pump. Capacity 700 gals. per minute, 8-in. suction, 7-in. discharge.

1—Rotary Drum Sand Dryer. Drum 36-in. dia., 15 ft. long. Equipped with coal or wood burning furnace.

2—7½-in.x10-in. Dake Double Cylinder Steam Hoists, with single geared drum. Equipped with reversing throttle valve.

1—24-in. Horizontal Centrifugal Pump, 24-in. suction, 24-in. discharge, suitable for head up to 50 ft. Belt pulley 32-in.x20-in. Manufactured by Kingsford Machine Company.

1—10-in. Horizontal Centrifugal Pump, 12-in. suction, 10-in. vertical top discharge, suitable for head up to 50 ft. Belt pulley 18-in.x15-in. Manufactured by Fulton Machine Company.

1—10-in.x16-in. Erie City Automatic Center Crank Steam Engine—50 hp.

500 Ton I-Beams, Channels, Angles, Re-inforcing Rods, Etc.

300 Ton New Steel Plates, 7/16-in., ½-in., 9/16-in. thick, 18-in. to 48-in. wide, 14 to 24 ft. lengths.

6—30-in. dia. 70-ft high Steel Self-Supporting Smoke Stacks. Lower half made of ¼-in., upper half 3/16-in. plate. Bell bottom 48-in. dia., with heavy cast iron base plates.

4—7000-gal. New Steel Storage Tanks. Square. Size 6-ft. 9-in.x 10-ft.x16-ft. 3-in. Thickness of plate ⅜-in. Weight about 17,000 lbs.

HARRIS BROTHERS CO.
35th and Iron Streets
CHICAGO

A Service You Will Appreciate

My business is more than merely buying and selling used cranes. It is knowing exactly what service cranes are capable of and how different types should be used. When you are in the market for a locomotive crane, I can help you select the one best suited for your needs—and probably save you money on your purchase.

Philip T.
KING
"The Crane Man"

Locomotive Cranes

1—Rebuilt **Industrial**, 20-25 ton cap., double drums, 50-ft. boom, outriggers, 8-wheel MCB. Like new. Guaranteed. Located Bay City, Mich

1—23-ton **McMyler**, 8-wheel MCB., double drums, 45-ft. boom, with 7½ kw. Engberg Generator. Located Buffalo, N. Y.

1—20-ton cap. **Brown Hoist** single drum 40-ft. boom, 8-wheel M.C.B. Located Philadelphia, Pa

1—20-ton cap. **Industrial**, 8-wheel MCB. double drums, 50-ft., boom, 1½-yd. clamshell bucket. Located La Salle, Ill.

1—25-ton cap., Model "E" **Ohio**, 8-wheel MCB., double drums, 50-ft. boom, **Brand New**. Located Bucyrus, Ohio.

1—30-ton cap. Model "F" **Ohio**, 8-wheel MCB, double drums, 50-ft. boom. Overhauled; like new. Located Hartford, Conn.

1—7½-ton cap. **Osgood**, double drums, 4-wheel, standard gage, 40-ft. boom. Located Kingston, N. Y.

FOR RENT

I will rent any of my Cranes on a straight rental basis or with a view to purchase. Terms exceptionally favorable to you.

Philip T. KING 30 Church St. New York

SELECTED ITEMS

From Our Large Stock of New and Overhauled Equipment

1—9x10 American Hoist 3-drum double cylinder with boiler, 100 lb. steam pressure, New York certificate.

1—8¼x10 Lidgerwood Hoist, 3-drum double cylinder with A S M E. boiler, New York or Penn. certificate.

1—8¼x10 Lidgerwood Hoist, D D.D.C with boiler (Mass. Standard)

1—7x10 Lidgerwood Hoist, D D.D C. with boiler and geared swinger attached, 100 lb. pressure, New York State.

1—7x10 Stroudsburg Cableway Hoist D D.D.C. reversible link motion, with Mass. boiler.

1—7x10 Mead-Morrison D D.D.C. Skeleton Hoist.

1—7x10 Mead-Morrison S.D.D.C. Skeleton Hoist.

1—6½x10 Lambert D D.D.C. Hoist, with boiler, New York State certificate, 100 lb. pressure, geared swinger attached.

2—5½x8 American Hoists, D.D.D.C., with boilers and geared swingers.

Also Forms, Graders, Concrete Mixers, Road Pumps, Shovels, Buckets, etc.
Write for complete list.

THE HUBBARD-FLOYD CO., Inc.

MAIN OFFICE: 452 Lexington Ave., New York, N. Y. Vanderbilt 1465
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PUMPS

1—"New" 10-in. Hill Centrifugal direct connected to 4 cylinder gasoline motor, 4x6-in. cylinder. "New."

Motor Driven Centrifugals

4—3 in., 2½ hp., 220 v. D.C.
1—5 in., 10 hp., 220 v. D.C.
1—4 in., 10 hp., 220 v. A.C.
1—4 in., 15 hp., 220 v. D.C.
2—6 in., 35 hp., 220 v. D.C.
2—8 in., 35 hp., 220 v. D.C.

A. J. O'Neill Company

1524 Chestnut St., Philadelphia, Pa.

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CORLISS ENGINES

2—Monarch Cross Compound, size 16x32x42 in., built for 160-lb. steam pressure, and 85 r.p.m. Manufactured by H. N. Strait Mfg. Co. Are in good condition. May be seen in operation.

Kansas Portland Cement Co.

1608 Federal Reserve Bank Bldg., Kansas City, Mo.

FOR SALE

100,000 lbs. Capacity Flat Car

38 ft long, steel underframe.
First class condition. Immediate shipment

ZELNICKER IN ST. LOUIS

We Buy and Sell Rails, Cars, Steel Piling, Etc.

LOCOMOTIVES, NEW

30-in. and 36-in. gauge, 23 tons. Tractive Power 9170 lbs. Coal, oil or wood burners.

Very Attractive Prices

R. POLIAKOFF
700 Sixth Ave. New York, N. Y.

FOR SALE OR RENT

STEAM SHOVELS

1—Model 29 Osgood, revolving, Shop No. 1118, mounted on caterpillars, 30-ft boom, 20-ft. dipper handle, ¾-yd dipper

3—70C Bucyrus, Railway type, Shop Nos. 1457, 1199 and 1582, standard gauge, 2½-yd dippers.

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1—Model 28 Marion, Shop No. 2804, revolving, traction wheels, standard boom, ¾ yd. dipper.

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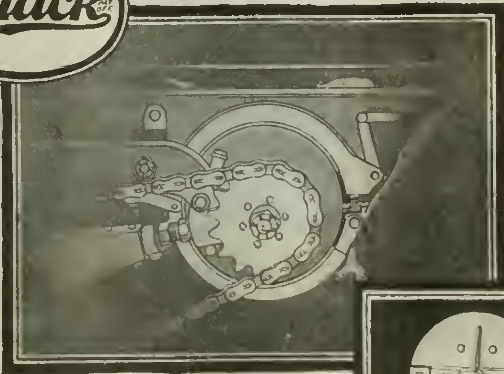

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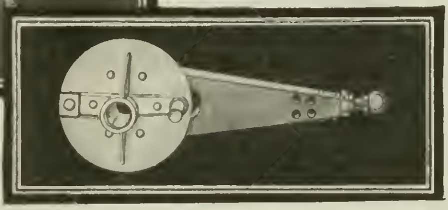

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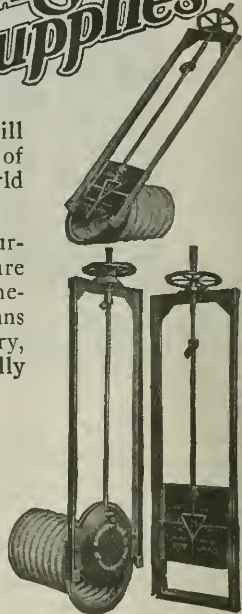

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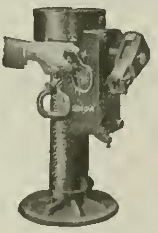

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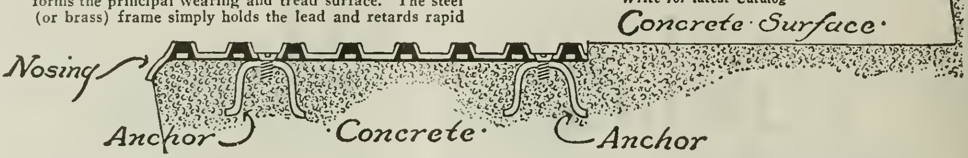

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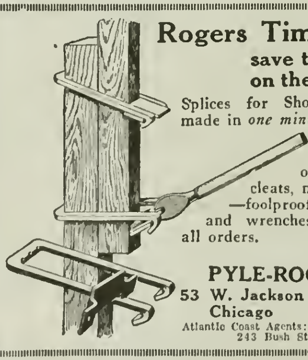

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Standard for all Metal Sash

Over 15,000,000 Pounds used

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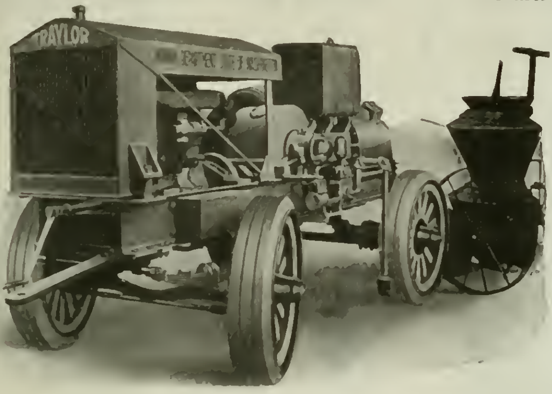
Get a compressor that will go to the point wanted—from job to job—or here and there on the job—and stand the wear and tear of constant movement.



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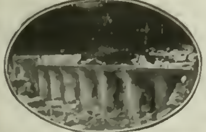

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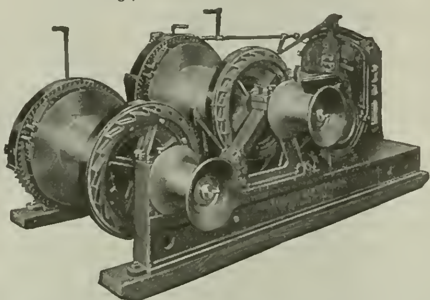

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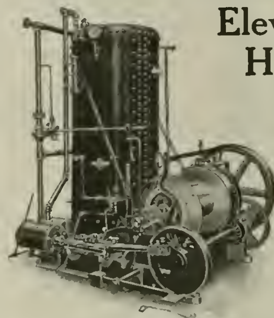
Brick Mason's Elevator Hoist



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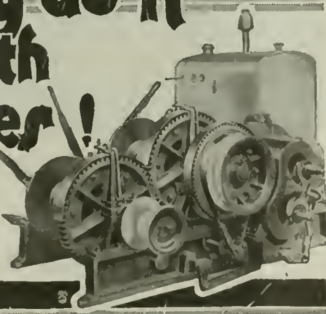

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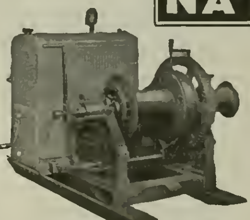

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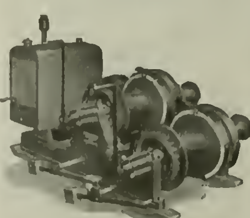

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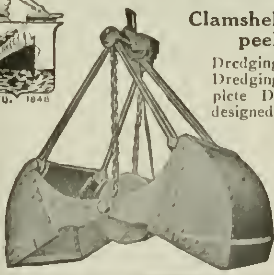

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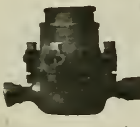

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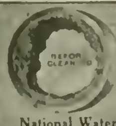

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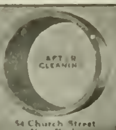

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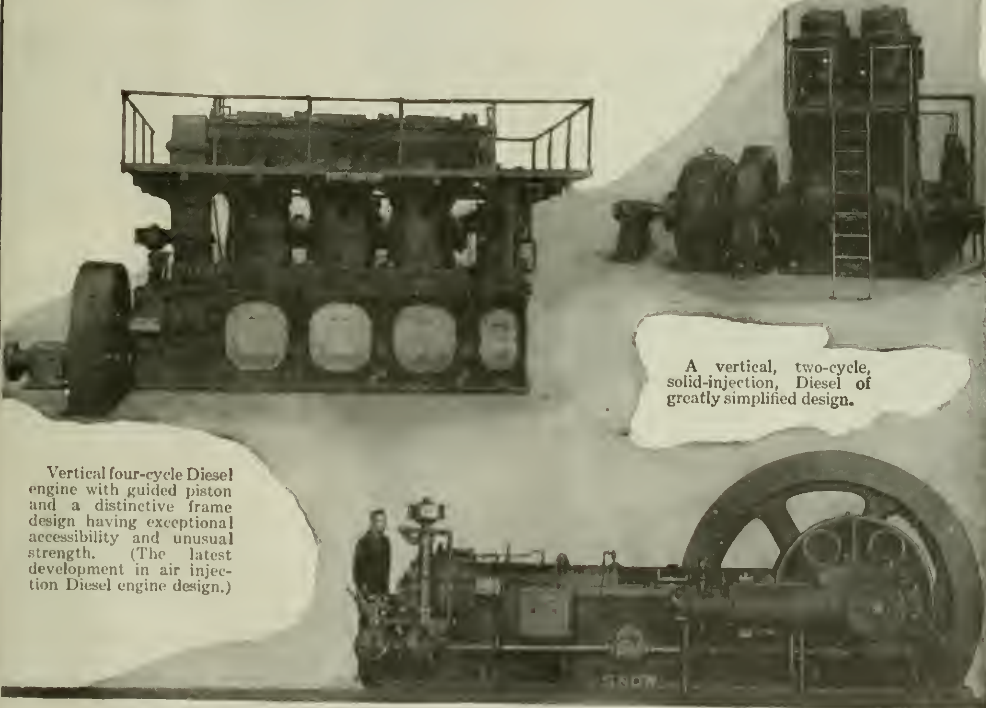

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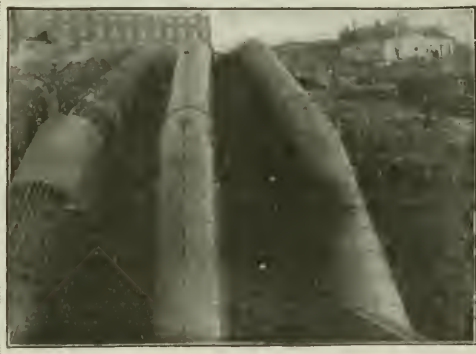

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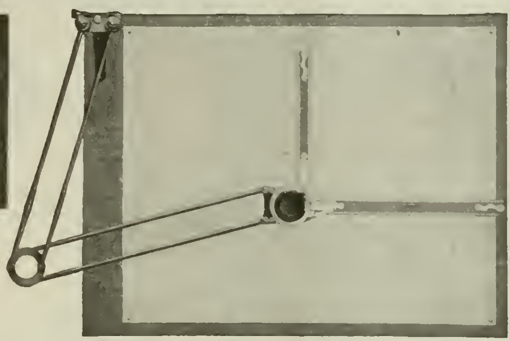

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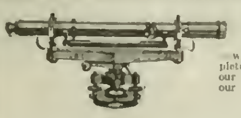

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Lidgerwood Mfg. Co.
Marion Steam Shovel Co.
Osgood Company

Dredges, Dipper
Austin Mchy. Corp.
Erie Steam Shovel Co.
Osgood Company

Dredges, Hydraulic
Atlantic Gulf & Pacific Co.
Marion Steam Shovel Co.
Morris Machine Co.

Drills, Core
Ingersoll-Rand Co.
Keystone Driller Co.
McKiernan-Terry Drill Co.
Sullivan Mchy. Co.

Drills, Rock
Chicago Pneumatic Tool Co.
Jeffrey Mfg. Co.
Ingersoll-Rand Co.
McKiernan-Terry Drill Co.
Sullivan Mchy. Co.

Drums, Holding
Blaw-Knox Co.
Haiss Mfg. Co., Inc., Geo
Hayward Co.

Dryers
Blaw-Knox Co.

Dryers, Sand and Gravel
Vulcan Iron Works of Pa.

Elevators, Bucket
Austin-Western Rd. Mch.Co.
Brown Hoisting Mchy. Co.
Haiss Mfg. Co., Inc., Geo.
Hendrick Mfg. Co.
Jeffrey Mfg. Co.
Monighan Mach. Co.
Ohio Locomotive Crane Co.

Elevators; Contractors' Material
Austin-Western Rd. Mch.Co
Byers Mach. Co.
Clyde Iron Works Sales Co
Haiss Mfg. Co., Inc., Geo.
Insley Mfg. Co.
Ransome Concrete Mchy. Co
Thomas Elevator Co.

Elevators, Factory
Ridgway & Son Co., Craige

Bingamon Street Bridge, Reading, Pa., crossing the Schuylkill.
Designed by C. F. Sanders, County Engineer, Berks County, Pa.

Bridge at Olympia, Wash. Elastite Expansion Joint used.

Protecting great bridges against temperature

TEMPERATURE fluctuation, and the consequent expanding and contracting of these great concrete masses, are rendered harmless to the durability of big bridges and viaducts by the installation of Elastite Expansion Joint at regular intervals.

The fact that Elastite Expansion Joint, "the sandwich joint," is handled as a slab, in any dimension and thickness, makes installation comparatively simple and easy. It is the practical joint used exclusively by practical engineers and contractors. It is easily cut to shape with an old saw, or can be supplied cut to exact fit to meet your requirements.

When you need "joint," remember that there are big stocks of Elastite Expansion Joint in seventeen cities. Your order will be immediately shipped to your job from the nearest point. Send for sample and all the facts.

THE PHILIP CAREY COMPANY
18 Wayne Ave., Lockland, Cincinnati, Ohio

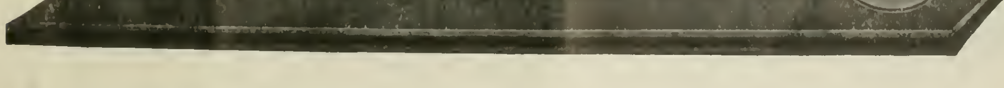
Carey Elastite
TRADE MARK REG U.S. Pat. Office
EXPANSION
JOINT
PROVED AND
ACCEPTED

Carey Elastite Expansion Joint is used in these bridges and viaducts

Akron Ohio — North Hill Viaduct
Augusta, Ga. — Archibald W. Butts Memorial Bridge
Bethlehem, Pa. — Hill-to-Hill Bridge
Cincinnati, Ohio — Park Avenue Bridge
Fort Wayne, Ind. — Harrison Street Bridge
Galveston, Texas — Galveston Causeway
Hawkinsville, Ga. — Oemulgee River Bridge
Kansas City, Mo. — Benton Boulevard Viaduct
Little Rock, Ark. — Broadway Bridge
Oahu, Hawaii — Hecia Viaduct
Pulaski, New York — Salmon River Bridge
Reading, Pa. — Bingamon Street Bridge
St. Louis, Mo. — Chauteau Avenue Viaduct
St. Louis, Mo. — Jefferson Avenue Bridge
Laredo, Texas — Laredo International Bridge
Washington, D. C. — Key Bridge
Watertown, New York — Grove Street Bridge

Carey Elastite Expansion Joint is an asphaltic body, formed of a high-grade asphaltic compound carefully refined and tempered, sandwiched between two walls of asphalt-saturated felt forming an elastic, compressible joint. It is made in lengths, widths and thicknesses as required, can be cut to crown or to any special shape and comes to the job ready to use.

12-23



Engineers, Roofing
Federal Cement Tile Co.
Marks Corp., The H. E.

Engineers
(See also Directory of Engineers)
Atlantic Gulf & Pacific Co.
MacArthur Conc. Pile & Fdation. Co.
Parsons, Klapp, Brinckerhoff & Douglas
Raymond Concrete Pile Co.
Spencer, White & Prentis
Stone & Webster, Inc
Terry & Tench Co., Inc.

Engineers' and Draftsmen's Instruments and Supplies
Beckmann Co., L.
Dietzgen Co., Eugene
Hamilton Mfg. Co.
Gurley, W. & L. E.
Keuffel & Esser Co.
Lufkin Rule Co.
Monroe Calcul. Mch. Co.
Weber Co., The F.
Wiebusch & Hilger, Ltd.
Wood-Regan Instr. Co.

Engines, Gas, Gasoline & Oil
Allis-Chalmers Mfg. Co.
Automatic Machine Co.
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Worthington Pump & Mchy. Corp.

Engines, High Duty Water-Works
Morris Machine Works

Engines, Hoisting
(See Hoists)

Engines, Steam
Chicago Pneumatic Tool Co.

Engines, Traction
Best Tractor Co., C. L.

Excavator, Cableway
Clyde Iron Works Sales Co.
Lidgerwood Mfg. Co.
Mead-Morrison Mfg. Co.
Mundy Hoist. Eng. Co., J. S.
Sauerman Bros.

Excavators, Ditch & Trench
Austin Mchy. Corp.
Bay City Dredge Works
Erie Steam Shovel Co.
Keystone Driller Co.
Marion Steam Shovel Co.
Moore Trench Mch. Co.
Osgood Company
Parsons Co.
Pawling & Harnischfeger Co.
Thew Shovel Co.

Excavators, Dragline
Austin Machinery Corp.
Bay City Dredge Works
Byers Mach. Co.
Erie Steam Shovel Co.
Hayward Co.
Marion Steam Shovel Co.
McMyler-Interstate Co.
Mead-Morrison Mfg. Co.
Osgood Company
Pawling & Harnischfeger Co.
Sauerman Bros.

Expanded Metal
Berger Mfg. Co.
Consolidated Expanded Metal Cos.
Northwestern Expanded Metal Co.

Expansion Bolts
National Lead Co.

Filters, Water, Municipal and Industrial
Amer. Water Softener Co.
California Filter Co.
International Filter Co.
Roberts Filter Mfg. Co.

Fireproofing Material & Construction
Berger Mfg. Co.
Marks Corp., H. E.
Northwestern Expanded Metal Co.

Floor, Asphalt Mastic
Standard Oil Co. of N. Y.

Floor Hardener, Concrete
(See Conc. Floor Hardener)

Floor, Wood Block
Barrett Company
Jennison-Wright Co.
Republic Creosoting Co.

Flooring, Fireproof
Irving Iron Works
Marks Corp., H. E.
Universal Safety Tread Co.

Flumes, Iron & Steel
Armco Culvert & Flume Mfrs. Assn.
Blaw-Knox Co.
Hardesty Mfg. Co., R.

Forgings
Bethlehem Steel Co.
Carnegie Steel Co.

Form Clamps
Concrete Steel Co.
Insley Mfg. Co.
Pyle-Rogers Co.
Universal Form Clamp Co.

Form Tighteners
Concrete Steel Co.
Marion Malleable Iron Wks.

Forms, Culvert, Road, Sewer, Tunnel, etc.
Blaw-Knox Co.
Heltzel Steel Form & Ir. Co.
Lakewood Engr. Co.

Forms for Curb and Gutter
Blaw-Knox Co.

Forms for Walls, Building Construction, etc.
Berger Mfg. Co.
Blaw-Knox Co.
Concrete Steel Co.
Heltzel Steel Form & Ir. Co.

Foundations
McArthur Concrete Pile & Foundation Co.
Raymond Concrete Pile Co.
Spencer, White & Prentis.
Simplex Concrete Pile Asso.
Underpinning & Found. Co.

Frogs and Switches, Railway
Bethlehem Steel Co.
Foster Co., L. B.
Ramapo Ajax Corp.

Garbage Disposal Apparatus
Jeffrey Mfg. Co.

Gas Producers
Blaw-Knox Co.

Gate, Hoist
Dayton Globe Iron Works

Gates, Sluice
Chapman Valve Mfg. Co.
Coffin Valve Co.
Coldwell-Wilcox Co.
Crane Company, The
Dayton Globe Iron Works
Hardesty Mfg. Co., R.

Gauges, Loss of Head
Simplex Valve & Meter Co.

Gauges, Rates of Flow
Simplex Valve & Meter Co.

Gears
Earle Gear & Mach. Co.

Generators, Electric
Allis-Chalmers Mfg. Co.

Glass, Fireproof
(See Wire Glass)

Governors, Waterwheel
Woodward Governor Co.
Worthington Pump & Machy. Corp.

Graders, Road
Adams & Co., J. D.
Austin-Western Rd.Mchy.Co.
Erie Steam Shovel Co.
Hadfield-Penfield Steel Co.
Western Wheeled Scraper Co.

Granite
Granite Paving Block Mfrs.'

Graphite
Detroit Graphite Co.

Gratings, Subway
Irving Iron Works
Mitchell-Tappen Co.
Universal Safety Tread Co.

Gravel Washing Plants
Sauerman Bros.

Gypsum
Keystone Gypsum Fireproofing Co.
Marks Corp., H. E.

Hammers, Electric
National Elec. Mfg. Co.

Hammers, Pneumatic
Chicago Pneumatic Tool Co.

Hammers, Steam Pile
(See Pile Hammers, Steam)

Heaters, Tar & Asphalt
Honhorst Co., The Jos.
Littleford Bros.

Hoists, Concrete Tower
Clyde Iron Works Sales Co.
Insley Manufacturing Co.
Lakewood Engr. Co.
Mead-Morrison Mfg Co.
National Hoisting Eng. Co.

Hoists, Contractors' Electric
Allis-Chalmers Mfg Co.
Bay City Dredge Works
Byers Mach. Co.
Clyde Iron Works Sales Co.
Dobbie Foundry & Mach.Co.
Flory Mfg. Co., S
Lidgerwood Mfg. Co.
Mead-Morrison Mfg. Co.
Mundy Hoist. Eng. Co., J.S.
National Hoisting Eng. Co.
Northern Engineering Wks.
Porter Co., H. K.
Ransome Con. Mchy. Co
Stroudsburg Engine Works
Thomas Elevator Co.
Vulcan Iron Works of Pa.

Hoists, Contractors' Gasoline
Clyde Iron Works Sales Co.
Lidgerwood Mfg. Co.
Mead-Morrison Mfg. Co.
Mundy Hoist. Eng. Co., J.S.
National Hoisting Eng. Co.
Stroudsburg Engine Works
Thomas Elevator Co.

Hoists, Contractors' Steam
Allis-Chalmers Mfg. Co.
Byers Mach. Co.
Clyde Iron Works Sales Co.
Ingersoll-Rand Co.
Lidgerwood Mfg. Co.
Mead-Morrison Mfg. Co.
Mundy Hoist Eng. Co., J. S.
National Hoisting Eng. Co.
Stroudsburg Engine Works
Thomas Elevator Co.
Vulcan Iron Works of Pa.

Hoists, Hydraulic Head Gates
Dilts Machine Wks., Inc.

Hoists, Motor, Truck
Mead-Morrison Mfg. Co.
Wood Hyd. Hoist & Body Co.

Hoists, Pneumatic
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.
Stroudsburg Engine Works
Sullivan Machinery Co.

Hoists, Skip
Mead-Morrison Mfg. Co.

Hoppers, Concrete
Insley Manufacturing Co.
Ransome Concrete Mchy. Co.

Hoppers, Steel
Harris Brothers Co.
Heltzel Steel Form & Ir. Co.
Honhorst Co., The Jos.

Horses, Steel
Economy Scaffold Co.

Hose, Air
Chicago Pneumatic Tool Co.

Hydrants
Chapman Valve Mfg. Co.
Ludlow Valve Mfg. Co.
Smith Mfg. Co., A. P.
Wood & Co., R. D.

Incinerators
Powers Specialty Co.

Inserts, Concrete
Concrete Steel Co.

Inspecting Laboratories
(See Directory of Engineers)

Instruments, Drawing
Keuffel & Esser Co.

Instruments, Surveying
Ainsworth & Sons, Wm.
Berger & Sons, C. L.
Brandis & Sons
Buff & Buff Mfg. Co.
Gurley, W. & L. E.
Keuffel & Esser Co.
Lietz Co., A
Weber Co., The F.

Iron Work, Structural and Ornamental
Hendrick Mfg. Co.
Irving Iron Works Co.
Ryerson & Son, Jos. T.
Snead Architect. Iron Wks.
Universal Safety Tread Co.

Jacks, Lifting
McKiernan-Terry Drill Co.
Norton, Inc., A. O.
Roos Company, H. W.

Joints, Expansion Paving
Barrett Company
Carey Co., The Philip

Joints, Filler Paving
Barrett Company
Standard Oil Co. of N. Y.

Joints, Flexible Pipe
Central Foundry Co.
Crane Company, The
U. S. Cast Ir. Pipe & Fdy. Co.

Kilns, Rotary
Vulcan Iron Works of Pa.

Lath, Expanded Metal
Armco Culvert & Flume Mfrs. Assn
Berger Mfg. Co.
Mitchell-Tappen Co
Northwest'n Exp. Metal Co.

Leadite
Leadite Co., Inc., The

Lead Pencils
Koh-I-Noor Pencil Co.

Lights, Contractors'
Carbic Manufacturing Co.

Loaders, Wagon
(See Wagon Loaders)

Locomotives, Compressed Air
Baldwin Locomotive Co.

Locomotives, Electric
Baldwin Locomotive Co.
Jeffrey Mfg. Co.

Locomotives, Gasoline
Baldwin Locomotive Co.
Fate Root Heath Co.
Hadfield-Penfield Steel Co.
Milwaukee Loco. Mfg Co.
Vulcan Iron Works of Pa.
Whitcomb Co., Geo. D.

Locomotives, Steam
Baldwin Locomotive Co.
Davenport Locomotive Wks.
Vulcan Iron Works of Pa.

Locomotives, Storage Battery
Ironton Engine Co.
Jeffrey Mfg. Co.
Whitcomb Co., Geo. D.

Lumber
Eppinger & Russell Co.
Lawson & MacMurray
Long-Bell Lumber Co.

Manhole Covers
Central Foundry Co.

Manometers
Simplex Valve & Meter Co.

Meter Boxes
Pittsburgh Meter Co.

Meter Provers
Hersey Mfg. Co.
Pittsburgh Meter Co.

Meters, Boiler Feed Water
Builders Iron Foundry

Meters, Current
Gurley, W. & L. E.

Meters, Gas and Steam
Builders Iron Foundry
Wallace & Tiernan Co., Inc.

Meters, Venturi
Builders Iron Foundry

Meters, Water, Oil, etc.
Builders Iron Foundry
Gamon Meter Co.
Hersey Mfg. Co
Neptune Meter Co.
Pittsburgh Meter Co.
Simplex Valve & Meter Co.
Worthington Pump & Machy. Corp.

Mixers, Asphalt
(See Mixers, Hot)

Mixers, Concrete
Austin Machinery Corp.
Cement-Gun Co.
Lakewood Engineering Co.
Ransome Concrete Mchy Co.

Mixers, Grout
Austin Machinery Corp.
Ransome Concrete Mchy Co.
Union Iron Works

Mixers, Hot
Austin Machinery Corp.

Mixers, Mortar
Austin Machinery Corp.
Ransome Concrete Mchy Co.

Mixers, Paving
Austin Machinery Corp
Ransome Concrete Mchy. Co.

Mixers, Pneumatic
Ransome Concrete Mchy. Co.

Mortar
Carney Co., The

Motors, Electric
Allis-Chalmers Mfg. Co.
Westinghouse Tr. Brake Co.

Motor-Truck Bodies
Wood Hyd. Hoist & Body Co.

Motor Truck Tires
Ajax Rubber Co.

Motor Trucks
(See Trucks, Motor)

Oxy-Acetylene Apparatus
Blaw-Knox Co.
Oxweld Acetylene Co.

Packing, Water Pipe
Jenkins Bros.

Paints, Graphite
Detroit Graphite Co.
Truscon Laboratories

Paints, Light Reflecting
Detroit Graphite Co.
Truscon Laboratories

Paints, Metal Protective
Barrett Company
Carey Co., The Philip
Detroit Graphite Co.
National Lead Co.
Protexol Corp.
Toch Brothers
Truscon Laboratories

Paving, Asphalt
Carey Co., Philip
Standard Oil Co. of N. Y.

Paving Blocks, Creosoted Wood
(See Creosoted Block Timber, Poles, Cross-Arms, Lumber)

Paving Blocks, Granite
Granite Paving Block Mfrs.

Paving Breakers
Ingersoll-Rand Co.

Paving, Cold Patching
Standard Oil Co. of N. Y.

Paving Guards, Steel
Godwin Co., Inc., W. S.

Penstocks
Blaw-Knox Co.

Pile Drivers
McKiernan-Terry Drill Co.
McMyler Interstate Co.
Union Iron Works

Pile Hammers, Steam
McKiernan-Terry Drill Co.
National Hoisting Eng. Co.
Union Iron Works
Vulcan Iron Works of Chic.

Piles, Concrete
MacArthur Concrete Pile & Foundation Co.
Raymond Concrete Pile Co.
Simplex Concrete Pile Co.
Spencer, White & Prentis

Piles, Creosoted Wood
Jennison-Wright Co.
Long-Bell Lumber Co.

Piling, Interlocking Steel
Bethlehem Steel Co.
Carnegie Steel Co.

Pipe, Bends
East Jersey Pipe Co.
National Valve & Mfg. Co.

Pipe, Cast Iron
Amer. Cast Iron Pipe Co.
Central Foundry Co.
Fox & Co., John
Glamorgan Pipe & Fdry. Co.
McWane Cast Iron Pipe Co.
U. S. Cast Ir. Pipe & Fdry. Co.
Warren Fdry. & Pipe Co.
Wood & Co., R. D.

Pipe, Concrete
Lock Joint Pipe Co
Newark Concrete Pipe Co.

Pipe, Corrugated
Austin-Western Rd. Mch. Co.
Canton Culvert & Silo Co.
Hardesty Mfg. Co., The R

Pipe Covering, Asbestos
Carey Co., The Philip

Pipe Covering, Wood
Michigan Pipe Co.
Standard Wood Pipe Co.
Wyckoff & Son Co., A.

Pipe Fittings
Builders Iron Foundry
Central Foundry Co.
U.S. Cast Ir. Pipe & Fdy. Co.
Westinghouse Tr. Brake Co

Pipe Joint Compounds
Leadite Co., Inc., The

Pipe, Lock Bar
East Jersey Pipe Co.

Pipe, Lock Joint
Lock Joint Pipe Co.

Pipe, Reinforced Concrete
Newark Concrete Pipe Co

Pipe, Riveted Steel
American Spiral Pipe Wks.
Blaw-Knox Co.
East Jersey Pipe Co.
Hardesty Mfg. Co., The R.
Petroleum Iron Wks. Co.
Tippett & Wood

Pipe, Sewer
Dickey Clay Mfg. Co.

Pipe Shores
Marion Malleable Iron Wks.

Pipe, Spiral
Abendroth & Root Mfg. Co.
American Spiral Pipe Wks.
Blaw-Knox Co.
Robertson Bros. Mfg. Co.

Pipe, Tap Welded
American Spiral Pipe Wks.

Pipe, Vitrified Clay
Clay Products Assn.

Pipe, Wood
Continental Pipe Mfg. Co.
Michigan Pipe Co.
Standard Wood Pipe Co.
Wyckoff & Son Co., A.

Poles, Creosoted Wood
Amer. Creosoting Co. (Ky.)
Colonial Creosoting Co.
Georgia Creosoting Co.

Poles, Steel Structural
Blaw-Knox Co.

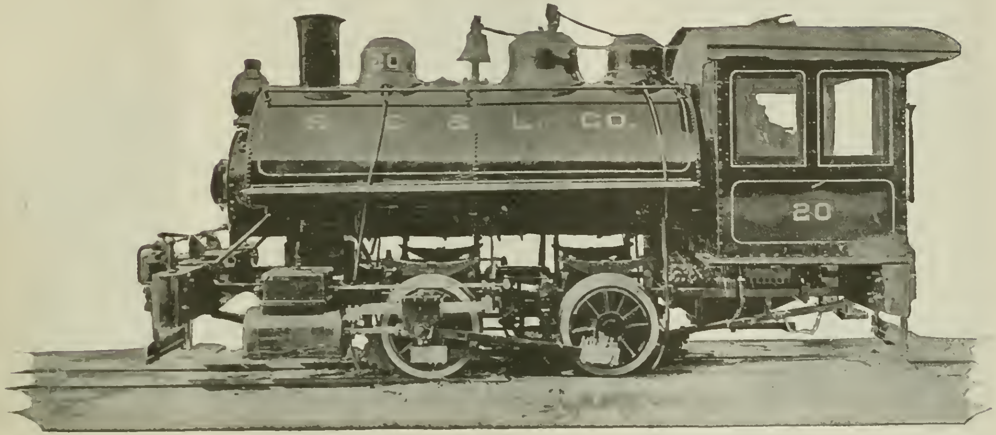
Pressed Steel Products
Berger Mfg. Co.
Blaw-Knox Co.

Prints, Black Line
K. L. M. Print Co. of N. Y.

Pullers, Car
Mead-Morrison Mfg. Co.

Pulverizers
Jeffrey Mfg. Co.

Pumps, Air Lift
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.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Sullivan Machinery Co.
Traylor Engr. & Mfg. Co.

Pumps, Boiler Feed, Steam
Earle Gear & Machine Co.
Ingersoll-Rand Co.

Pumps, Centrifugal and Multi-Stage High Lift
Aurora Pump & Mfg. Co.
Earle Gear & Machine Co.
Erie Pump & Engine Co.
Ingersoll-Rand Co.
Keystone Driller Co.
Lecourtenay Co.
Manistee Iron Works
Morris Machine Works

Pumps, Contractors'
Ingersoll-Rand Co.
Pulsometer Steam Pump Co.

Pumps, Deep Well
Aurora Pump & Mfg. Co.
Cook, A. D.
Keystone Driller Co.

Pumps, Diaphragm
Boston & Lockport Bl. Co.
Manistee Iron Works

Pumps, Dredging and Sand
Erie Pump & Engine Co.
Marion Steam Shovel Co.
Morris Machine Works
Worthington Pump & Machy. Corp.

Pumps, Power
Cook, A. D.
Lecourtenay Co.

Pumps, Underwriters' Centrifugal
Allis-Chalmers Mfg. Co.
Earle Gear & Machine Co.

Pyrometers
Taylor Instrument Cos.

Rail and Rail Joints, Fastening & Specialties
Carnegie Steel Co.
Foster Co., L. B.
Rail Joint Co.

Railroad Ditchers
Erie Steam Shovel Co.
Marion Steam Shovel Co.

Recorders, Water Stage
Gurley, W. & L. E.

Regulators, Compressed Air
Oxweld Acetylene Co.

Reinforcing Bar Couplings
Concrete Steel Co.
Marion Malleable Iron Wks.

Reinforcing Concrete
(See Conc. Reinforcement)

Reinforcing Metal for Concrete Work
Amer. Steel & Wire Co.
Berger Mfg. Co.
Concrete Steel Co.
Corrugated Bar Co.
Northwestern Expanded Metal Co.
Truscon Steel Co.

Riveting Machines
Allen, John F.
Chicago Pneumatic Tool Co.

Road Finishers, Concrete
Austin Machy. Corp.
Lakewood Engr. Co.

Road Oilers, Pressure
Austin-Western Rd. Mch.Co.

Road Oils & Preservatives
Barrett Company
Standard Oil Co. of N. Y.
Universal Road Machy. Co.

Road Rollers, Gas. & Steam
Austin-Western Rd. Mch.Co.
Buffalo-Springfield Roll. Co.

Rolls, Crushing
Allis-Chalmers Mfg. Co.
Jeffrey Mfg. Co.

Roofing, Gypsum
Marks Corp., The H. E.

Roofing, Metal
Amer. Sheet & Tin Plate Co.
Berger Mfg. Co.

Roofing, Prepared
Barrett Company
Carey Co., The Philip

Roofing, Tile
Federal Cement Tile Co.
Keystone Gypsum Fireproofing Co.
Truscon Laboratories

Rope, Wire, Transmission Hoisting or Haulage
American Steel & Wire Co.
Leschen & Sons Rope Co
Roeblings Sons Co., J. A

Sash Operating Apparatus
Allison Steel Products Co.

Sash Steel, Window
(See Window Sash)

Scales, Automatic
Toledo Scale Co.

Schools & Colleges
(See Directory of Engineers)

Scrapers, Scarifiers, Plows
Adams & Co., J. D.
Austin-Western Rd. Mch.Co.
Western Wheeled Scraper Co.

Screens, Revolving
Austin Western Rd. Mch. Co.

Screens, Sand, Gravel and Coal
Austin-Western Rd. Mch.Co.
Haiss Mfg. Co., Inc., Geo.
Hendrick Mfg. Co.

Second-Hand Equipment
(See Searchlight Section)

Sewage Disinfection
Wallace & Tiernan Co., Inc.

Sewer Cleaning Mchy.
Turbine Sewer Mach. Co.

Sewer Rods
Turbine Sewer Mach. Co.

Shafting
Ryerson & Son, Joseph T.

Sharpening Mach. Drill Bit
Ingersoll-Rand Co.

Sheaves
Haiss Mfg. Co., Inc., Geo.

Sheets, Iron and Steel
Amer. Sheet & Tin Plate Co.
Armco Culvert & Flume Mfrs. Assn.
Bethlehem Steel Co.
Ryerson & Son, Joseph T.

Sheets, Roofing and Siding
Amer. Sheet & Tin Plate Co.
Armco Culvert & Flume Mfrs. Assn.
Ryerson & Son, Joseph T.

Shelving, Steel
Berger Mfg. Co.

Shingles, Zinc
Illinois Zinc Co.

Shores, Adjustable
Roos Co., H. W.

Shovels, Electric
Erie Steam Shovel Co.
Keystone Driller Co.
Marion Steam Shovel Co.
Pawling & Harnischfeger Co.
Thew Shovel Co.

Shovels, Gasoline
Marion Steam Shovel Co.
Pawling & Harnischfeger Co.
Thew Shovel Co.

Shovels, Steam
Erie Steam Shovel Co.
Keystone Driller Co.
Marion Steam Shovel Co.
Osgood Company
Thew Shovel Co.

Skips, Stone
Insley Manufacturing Co

Slabs, Cement Roofing
Federal Cement Tile Co

Slag
Carnegie Steel Co.

Slate Structural
Structural Slate Co.

Sprinklers and Sweepers Street
Austin Machinery Corp.
Austin-Western Rd Mch.Co.

Standpipes
Blaw Knox Co.
Chicago Bridge & Iron Wks
Pittsb'gh-Des Moines St. Co.
Tippett & Wood

Steam Specialties
Jenkins Bros.

Steel
Ryerson & Son, Joseph T

Steel, Curb & Gutter Forms
Heltzel Steel Form & Ir Co.

Steel Plate Construction
Bethlehem Steel Co.
Blaw-Knox Co
Chicago Bridge Iron Wks.
East Jersey Pipe Co.
Heltzel Steel Form & Tr. Co.

Honhorst Co., The Jos.
Littleford Bros.
Petroleum Iron Wks. Co.
Pittsb'gh-Des Moines St. Co.
Riter-Conley Co.
Union Iron Works
Williams Co., G. H.

Steel, Rock Drill
Ingersoll-Rand Co.

Steel, Structural
Belmont Iron Works
Berlin Construction Co.
Bethlehem Steel Co.
Blaw-Knox Co.
Boston Bridge Works
Carnegie Steel Co.
Construction Specialties Co.
Eastern Bridge & Struc. Co.
Fort Pitt Bridge Works
Kenwood Bridge Co.
McClintic Marshall Co.
Milwaukee Bridge Co.
Minneapolis Steel & Mch. Co.
Miss. Valley Struc. Steel Co.
Morava Construction Co.
Mount Vernon Bridge Co.
Penn Bridge Co. (Pa.)
Phoenix Bridge Co.
Pittsb'gh-Des Moines St. Co.
Riverside Bridge Co.
Shoemaker Bridge Co.
Snare Corp., Frederick
Snead Architect. Iron Wks.
Virginia Bridge & Iron Co.
Wisconsin Bridge & Iron Co.

Steel, Tool
Bethlehem Steel Co.
Carnegie Steel Co.
Ryerson & Son Co., Jos. T.

Stokers
Babcock & Wilcox Co.
Westinghouse E. & M. Co.

Stone-making Plants
Atrax Corpn. of America

Strainers, Well
Cook, A. D.

Subgraders
Lakewood Engr. Co.

Superheaters
Babcock & Wilcox Co.
Power Specialty Co.

Tables and Boards, Drawing
Dietzgen Co., Eugene
Economy Drg. Table & Mfg. Co.
Hamilton Mfg. Co.
Weber Co., F.

Tampers, Power
Pawling & Harnischfeger Co.

Tanks, Air Compressor
Chicago Pneumatic Tool Co.
East Jersey Pipe Co.
Westinghouse Tr. Brake Co.

Tanks, Elevated Steel
Chicago Bridge & Iron Wks.
Graver Corp.
Littleford Bros.
Petroleum Iron Wks. Co.
Pittsb'gh-Des Moines St. Co.

Tanks, Elevated, Wood
Continental Pipe Mfg. Co.

Tanks, Oil Storage
Blaw-Knox Co.
Riter-Conley Co.

Tanks, Septic
Dickey Clay Mfg. Co.

Tanks, Welded and Riveted
Hardesty Mfg. Co., The R.

Tapes, Steel and Metallic
Dietzgen Co., Eugene
Hamilton Mfg. Co.
Keuffel & Esser Co.
Lufkin Rule Co.
Wiebusch & Hilger, Ltd.

Tar
Barrett Company

Telephones, Automatic
Automatic Electric Co.

Testing Laboratories
(See Engineers' Directory)

Thermometers
Taylor Instruments Cos

Ties, Creosoted Wood
Amer Creosoting Co. (Ky.)
Colonial Creosoting Co.
Georgia Creosoting Co
Jennison-Wright Co.

Ties, Steel
Carnegie Steel Co.

Tile, Concrete Bldg.
Federal Cement Tile Co
Truscon Laboratories

Tile, Roof Cement
Federal Cement Tile Co.
Truscon Laboratories

Tin Plate
Amer. Sheet & Tin Plate Co.
Bethlehem Steel Co.

Tires, Truck
Ajax Rubber Co.

Tools, Pneumatic
Chicago Pneumatic Tool Co.
Ingersoll-Rand Co.

Torches, Welding & Cutting
Oxweld Acetylene Co.

Towers, Concrete
(See Hoists, Conc. Tower)

Towers, Radio
Blaw-Knox Co.

Towers, Transmission
Blaw-Knox Co.

Track, Industrial & Portable
Bethlehem Steel Co.
Foster Co., L. B.
Lakewood Engr. Co.

Tractors
Best Tractor Co., C. L.
Eagle Wagon Works
Ford Power Equip. Exp.
Minne. Steel & Mchy. Co.

Trailers
Eagle Wagon Works
Watson Truck Corp.

Transits and Levels
Ainsworth & Sons, Wm.
Beckmann Co., L.
Berger & Sons Co., C. L.
Brandis & Sons
Buff & Buff Mfg. Co.
Gurley, W. & L. E.
Lietz Co., A.

Treads, Safety
Concrete Steel Co.
Irving Iron Works
Universal Safety Tread Co.

Trolleys, I-Beam
Brown Hoisting Machy. Co.

Trucks, Motor
Eagle Wagon Works
Ford Power Equip. Exp.
International Motor Co.
Watson Truck Corp.

Tunnel Liner Plates
Blaw-Knox Co.

Turbines, Hydraulic Impulse and Reaction
Allis-Chalmers Mfg. Co.
Pelton Water Wheel Co.
Smith Co., S. Morgan
Worthington Pump & Machy. Corp.

Turbines, Steam
Allis-Chalmers Mfg. Co.

Turnbuckles
Laughlin Co., The Thos.

Turntables
Blaw-Knox Co.
Foster Co., L. B.

Underpinning
Spencer White & Prentis
Underpinning & Found. Co.

Unloaders
Erie Steam Shovel Co.

Unloaders, Car
Haiss Mfg. Co., Geo.
Heltzel Steel Form &Ir. Co.
Jeffrey Mfg. Co.

Valves, Air, Water, Steam and Gas
Chapman Valve Mfg. Co.
Coldwell-Wilcox Co.
Coffin Valve Co.
Crane Company, The
Golden-Anderson Valve Specialty Co.
Ludlow Valve Mfg. Co.
National Valve & Mfg. Co.
Simplex Valve & Meter Co.
Smith Mfg. Co. A. P.

Valves, Altitude
Golden-Anderson Valve Specialty Co.
Ludlow Valve Mfg. Co.

Valves, Angle, Check, Gate and Globe
Chapman Valve Mfg. Co.
Coffin Valve Co.
Golden-Anderson Valve Specialty Co.
Jenkins Bros.
Ludlow Valve Mfg. Co.
National Valve & Mfg Co
Simplex Valve & Meter Co.
Westinghouse Tr Brake Co

Valves, Automatic
Golden-Anderson Valve Specialty Co.
Ludlow Valve Mfg. Co.
Westinghouse Tr. Brake Co

Valves, Control Electric
Chapman Valve Mfg. Co.
Dean, Ltd., Payne

Valves, Control Hydraulic
Chapman Valve Mfg. Co.

Valves, Float
Golden-Anderson Valve Specialty Co.

Valves, Regulating
Golden-Anderson Valve Specialty Co.
Ludlow Valve Mfg. Co.
Simplex Valve & Meter Co.

Valves, Return
Golden-Anderson Valve Specialty Co.

Valves, Safety
Golden-Anderson Valve Specialty Co.

Valves, Sewage
Chapman Valve Mfg. Co.

Valves, Sluice
Chapman Valve Mfg. Co.
Coffin Valve Co.

Wagons, Asphalt
Eagle Wagon Works
Watson Truck Corp.

Wagons, Dump, Auto
Austin-Western Rd. Mch.Co.
Eagle Wagon Works

Wagons, Dump
Austin-Western Rd. Mch.Co.
Watson Truck Corp.

Wagon Loaders
Austin Machinery Corp.
Austin Western Rd. Mch. Co.
Barber-Greene Co.
Erie Steam Shovel Co.
Haiss Mfg. Co., Inc., Geo.
Jeffrey Mfg. Co.
Specialty Engr. Co.

Water-Main Cleaning
Nat'l Water Main Clean. Co.

Waterproofing Compounds and Materials
Anti-Hydro Waterproof. Co.
Barrett Company
Carey Co., The Philip
Sonneborn Sons, L.
Toch Brothers
Truscon Laboratories
Weber Engineering Co.

Water Purification
Electro Bleaching Gas Co.
Wallace & Tiernan Co., Inc.

Water Softeners
Amer. Water Softener Co.
California Filter Co.
Graver Corporation
International Filter Co.
Roberts Filter Mfg. Co.

Water Wheels, Impulse and Reaction
Pelton Water Wheel Co.
Smith Co., S. Morgan

Welding and Cutting Apparatus
Blaw-Knox Co.
Oxweld Acetylene Co.

Winches, Motor Truck
Mead-Morrison Mfg. Co.

Winches, Ship, Hand, Steam and Electric
Brown Hoisting Mchy Co
Dobbie Frdy. & Mach. Co.
Lidgerwood Mfg. Co.
Mead-Morrison Mfg. Co.
Mundy Hoisting Eng. Co.J.S

Window Sash Putty
Truscon Laboratories

Window Sash Steel
Allison Steel Products Co

Wire Glass
Mississippi Wire Glass Co.

Wire Rope
(See Rope, Wire)

Wire and Cable, Electrical
American Steel & Wire Co

Wood Casings
Michigan Pipe Co., The

Wood Preservatives
Barrett Company
Detroit Graphite Co
Protexol Corp.
Truscon Laboratories

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